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Improving Education  
Achievement  
and Attainment  
in Luxembourg

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Ekkehard Ernst**

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**IMPROVING EDUCATION ACHIEVEMENT AND ATTAINMENT IN LUXEMBOURG**

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**By**

**David Carey and Ekkehard Ernst**

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### **Improving education achievement and attainment in Luxembourg**

Improving education achievement in Luxembourg is a priority for strengthening productivity growth and enhancing residents' employment prospects in the private sector, where employers mainly hire cross-border workers. Student achievement in Luxembourg is below the OECD average according to the 2003 OECD PISA study, with the performance gap between immigrant and native students being above average. A factor that makes learning more difficult in Luxembourg than in other countries is the use of three languages of instruction (*Lëtzebuergesch*, German and French). New empirical evidence presented in this paper based on the PISA tests suggests that the reforms over the past decade or so to attenuate these difficulties have had considerable success: the adverse impact of immigrant status on PISA test scores is around the OECD average. The fact that the performance gap between immigrant and native students is nevertheless greater than average reflects other factors, notably the relatively large difference in socio-economic background between immigrant and native students. The paper also discusses further reforms that are underway or planned to improve achievement of immigrant students. Another feature of Luxembourg's education system is that it is highly stratified, with children being sorted into a large number of parallel tracks at an early stage and there being a high rate of grade repetition. International evidence suggests that stratification increases the impact of socio-economic background on student achievement. Reforms to reduce stratification are discussed in the remainder of the paper, together with reforms to enhance achievement more generally by improving teaching skills and basing school programmes on key competences.

This paper relates to the 2006 Economic Survey of Luxembourg ([www.oecd.org/eco/surveys/luxembourg](http://www.oecd.org/eco/surveys/luxembourg)).

JEL Classification: I2, I21, I28, J24

Keywords: Education, PISA, achievement, survey data analysis, secondary education, attainment, school system, stratification, tracking, streaming, teachers' skills, trilingual education, pre-school education, immigration and socio-economic background, general education, vocational education, key competences

### **Améliorer la performance du système éducatif au Luxembourg**

Améliorer la réussite scolaire au Luxembourg constitue une priorité pour renforcer la croissance de la productivité et augmenter les perspectives de l'emploi des résidents dans le secteur privé, dans lequel les employeurs ont principalement recours à de la main-d'œuvre transfrontalière. La réussite scolaire des élèves au Luxembourg est en dessous de la moyenne de l'OCDE selon l'étude PISA de 2003, avec une différence de réussite entre élèves immigrés et natifs au-dessus de la moyenne. Un des facteurs qui rend l'apprentissage plus difficile au Luxembourg que dans d'autres pays est l'utilisation de trois langues d'instruction (luxembourgeois, allemand et français). Basés sur les tests PISA, les nouveaux travaux empiriques présentés dans ce papier suggère que les réformes durant cette dernière décennie visant à atténuer ces difficultés ont connu un succès notable : l'impact négatif du statut d'immigré sur les performances PISA est autour de la moyenne de l'OCDE. Certes, il existe une différence de résultats entre les élèves immigrés et nationaux – différence supérieure à la moyenne – mais cela est dû à d'autres facteurs, notamment les origines socio-économiques différentes des élèves immigrés et nationaux. Le papier discute également d'autres réformes actuellement en route ou planifiées visant à augmenter la réussite scolaire des élèves immigrés. Une autre caractéristique du système éducatif luxembourgeois est sa stratification accrue, qui sélectionne tôt les enfants dans un nombre important de parcours parallèles. Par ailleurs, le redoublement de classe est important. Les comparaisons internationales suggèrent que la stratification augmente l'impact du cadre socio-économique sur la réussite scolaire de l'élève. Le papier discute ainsi des réformes sur une réduction de stratification, mais aussi des réformes visant une augmentation générale de la réussite scolaire en augmentant les compétences d'enseignement des professeurs ainsi qu'une réorientation des programmes scolaires autour des compétences clés.

Ce document se rapporte à l'Étude économique du Luxembourg 2006 ([www.oecd.org/eco/etudes/luxembourg](http://www.oecd.org/eco/etudes/luxembourg)).

Classification JEL : I2, I21, I28, J24

Mots clés: éducation, PISA, réussite scolaire, analyse des données d'enquête, éducation secondaire, système scolaire, stratification, compétences des enseignants, éducation trilingue, éducation préscolaire, immigration et cadre socio-économique, éducation générale, formation professionnelle, compétences clés.

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## Improving education achievement and attainment in Luxembourg

by David Carey and Ekkehard Ernst<sup>1</sup>

### Introduction

1. Education achievement in Luxembourg is below the OECD average and there are large differences in achievement between natives and immigrants. These weaknesses in achievement contribute to a relatively high secondary school drop-out rate and to the relatively low proportion of the population that attains tertiary qualifications. Such achievement and attainment results weigh on productivity and, in interaction with high minimum wages rates and reservation wages, on the employment rate. The authorities recognise the urgency of enhancing education outcomes and accordingly have implemented many reforms in recent years to improve performance and plan further reforms.

2. A particular challenge in Luxembourg arises from the country's geographical location at the border between French and German-speaking countries or regions. Both French and German are widely used in Luxembourg as is *Lëtzebuergesch*; all three languages are official languages. The education system endeavours to make students fluent in all three languages (as well as in English in most cases) to facilitate social cohesion. To this end, the education system is trilingual – all three languages are used as languages of instruction. However, this approach to education creates some learning difficulties for students from immigrant and lower socio-economic backgrounds. The authorities have undertaken reforms in recent years to reduce such barriers to achievement and plan to go further in this regard.

3. This chapter, which builds on the analysis on education and migration in the *2003 OECD Economic Survey of Luxembourg*, begins with an overview of education achievement and attainment in Luxembourg. In the second section, the trilingual education system is described and evidence is presented indicating that it makes learning more difficult for some children from immigrant and/or lower socio-economic backgrounds. Recent reforms to reduce linguistic barriers to achievement are discussed along with planned and suggested reforms in this respect. The third section discusses a variety of education

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1. This paper is based largely on material from the *OECD Economic Survey of Luxembourg* published in July 2006 under the authority of the Economic and Development Review Committee (EDRC). The authors would like to thank Simon Field, Andrew Dean, Val Koromzay, Mike Feiner and Patrick Lenain for valuable comments on earlier drafts. The paper has also benefited from discussions with numerous Luxembourg experts, notably from the Ministry of National Education. Special thanks go to Rebecca Oyomopito and Laure Meuro for technical assistance and to Chrystyna Harpluk and Deirdre Claassen for technical preparation.

practices in Luxembourg that are being reformed or could be reformed to enhance achievement. A summary of the main policy recommendations can be found at the end of the chapter.

## **Education outcomes are below the OECD average**

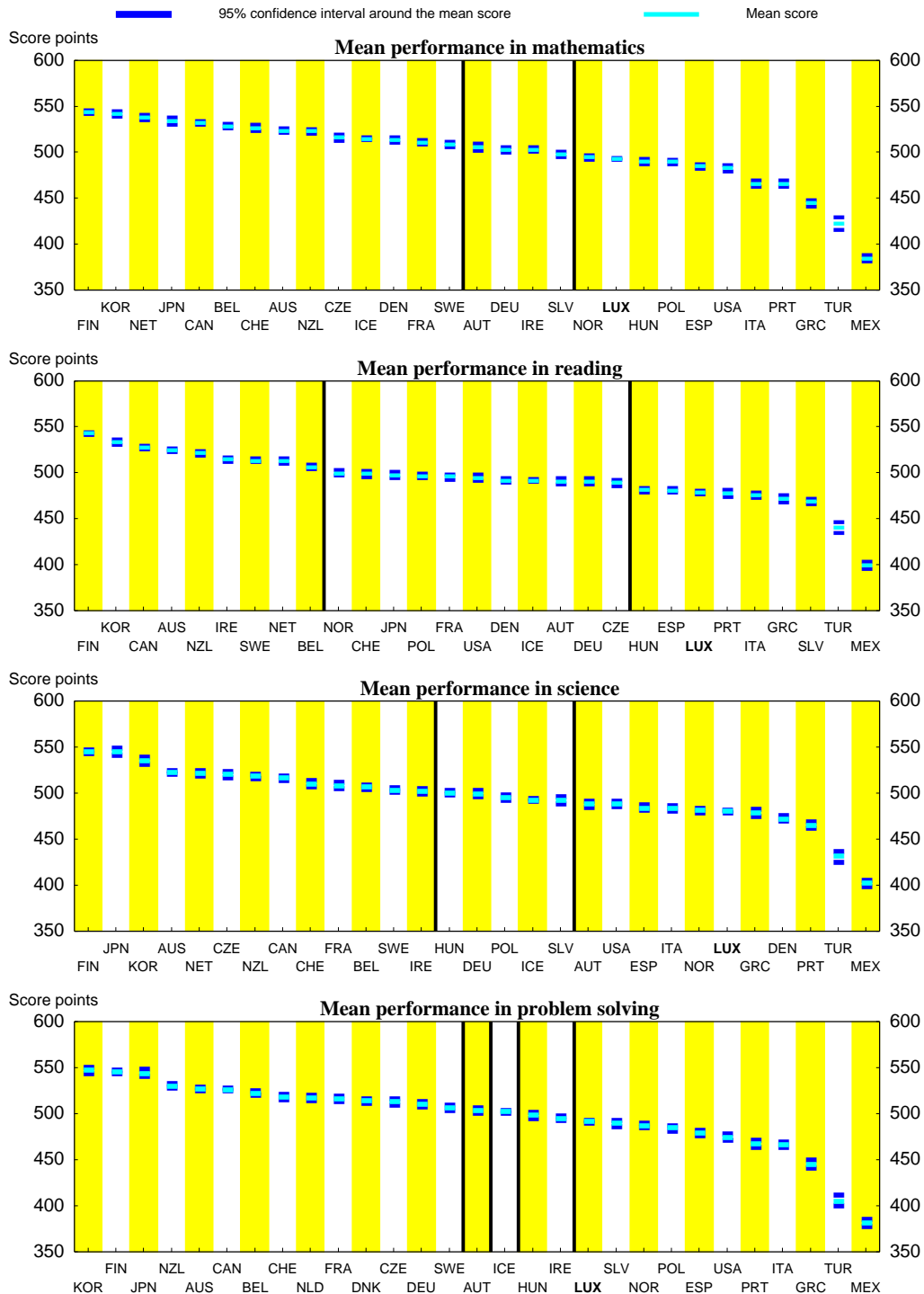
### ***Achievement is below the OECD average***

4. Luxembourg students scored below the OECD average in each of the subjects -- mathematics, reading, science, and problem solving -- included in the 2003 PISA study (Figure 1). The variances in results between schools and within schools in mathematics, the subject for which results were analysed in-depth in the 2003 PISA study,<sup>2</sup> were around the OECD average (OECD, 2004a, Figure 1). The shortfall in performance relative to the OECD average reflects low scores for immigrant students: native Luxembourg students (about 67% of the total) scored around the OECD average for native students in maths, reading, and problem solving and slightly below the OECD average in science (*ibid*, Table 2f; OECD, 2004b, Table 5.6). The gap between scores for immigrant students, whether born abroad (first generation) or second-generation residents, was around the OECD average in mathematics and problem solving, but greater than average in reading (Figure 2; OECD, 2004a, Table 2f; OECD, 2004b, Table 5.6). In science, the gap was greater than the OECD average for first-generation students but average for second-generation students (OECD, 2004a, Table 2f). Similar results obtain when students are classified according to whether they speak a language at home most of the time that is different from the language of assessment, from other official languages or from other national dialects (*ibid*, Figure 3 and Table 2g; OECD 2004b, Table 5.7). This performance gap is a serious problem as the share of immigrant students in Luxembourg is relatively high (see Figure 2). Children from less privileged socio-economic backgrounds in Luxembourg have lower scores in mathematics (the subject analysed in depth in the 2003 PISA study), although the impact is not significantly different from the OECD average (OECD 2004a, Figure 9).

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2. The 2000 PISA study focused on reading while the 2006 PISA study will focus on science.

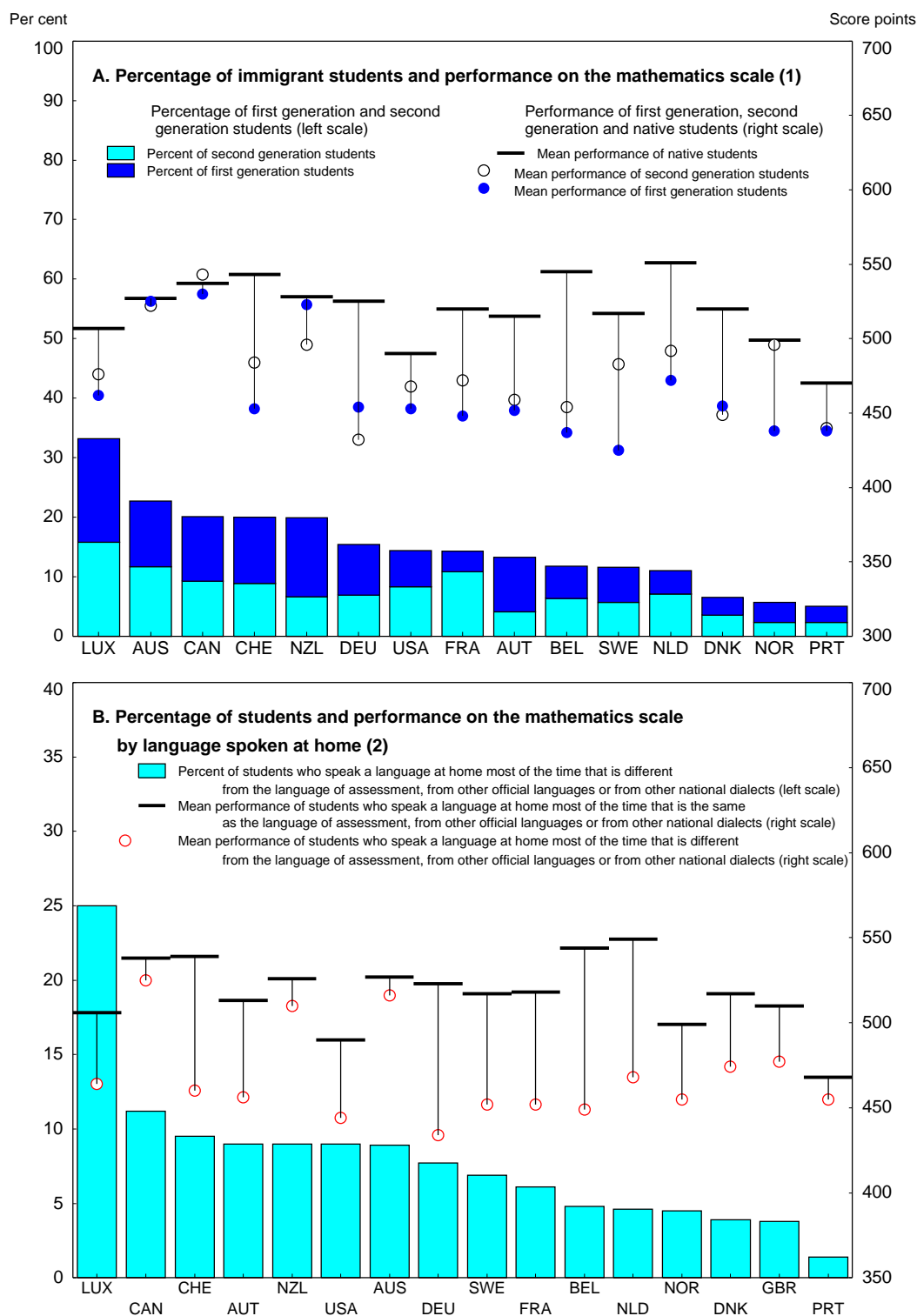
Figure 1 Student performance in the 2003 OECD PISA study<sup>1</sup>



1. Mean scores are not significantly different from the OECD average in countries in the middle sector of each panel. Countries to the left have mean scores that are significantly above the OECD average while the countries to the right, such as Luxembourg, have scores that are significantly below the OECD average. Although the mean score in problem solving in Iceland is lower than in Austria, this score nevertheless is significantly above the OECD average while that in Austria is not, owing to the narrower confidence interval around the mean for Iceland than for Austria - the 95% confidence interval around Iceland's mean lies above OECD average while that for Austria includes the OECD average.

Source: OECD PISA 2003 database. For further explanation, see OECD (2004a) and OECD (2004b).

**Figure 2. Relative performance of immigrants and national secondary school students**



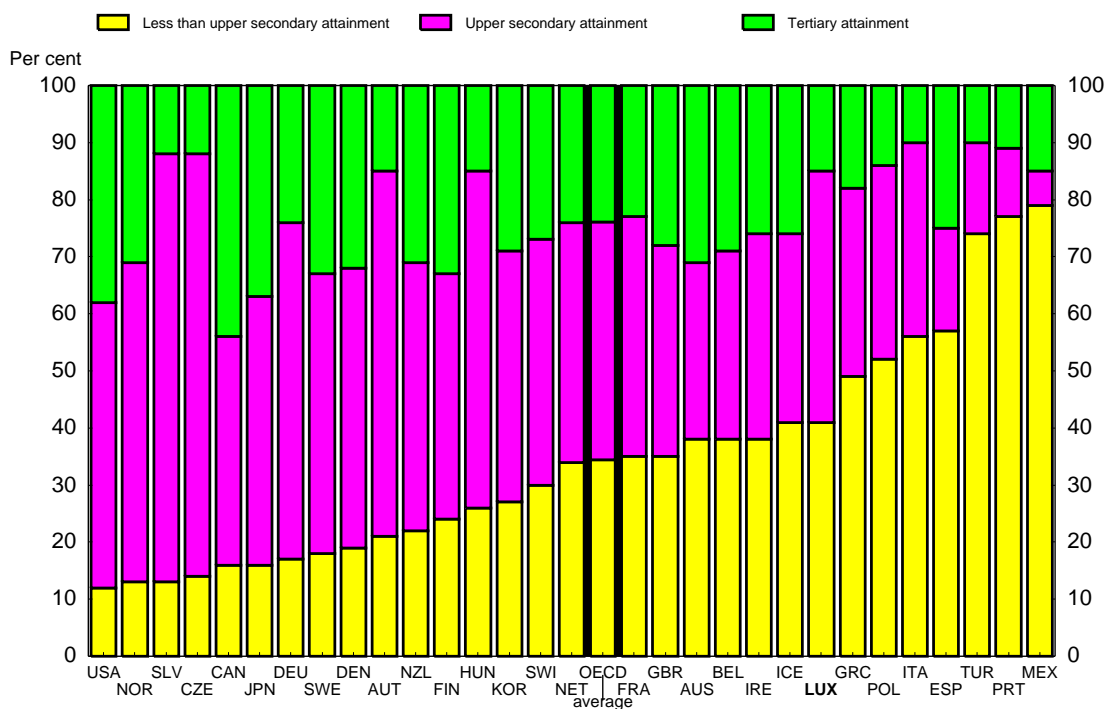
1. Only for countries where at least 3% of students are not native.
  2. Only for countries where at least 3% of students speak a foreign language at home.
- Source: OECD PISA 2003.



*Attainment is low*

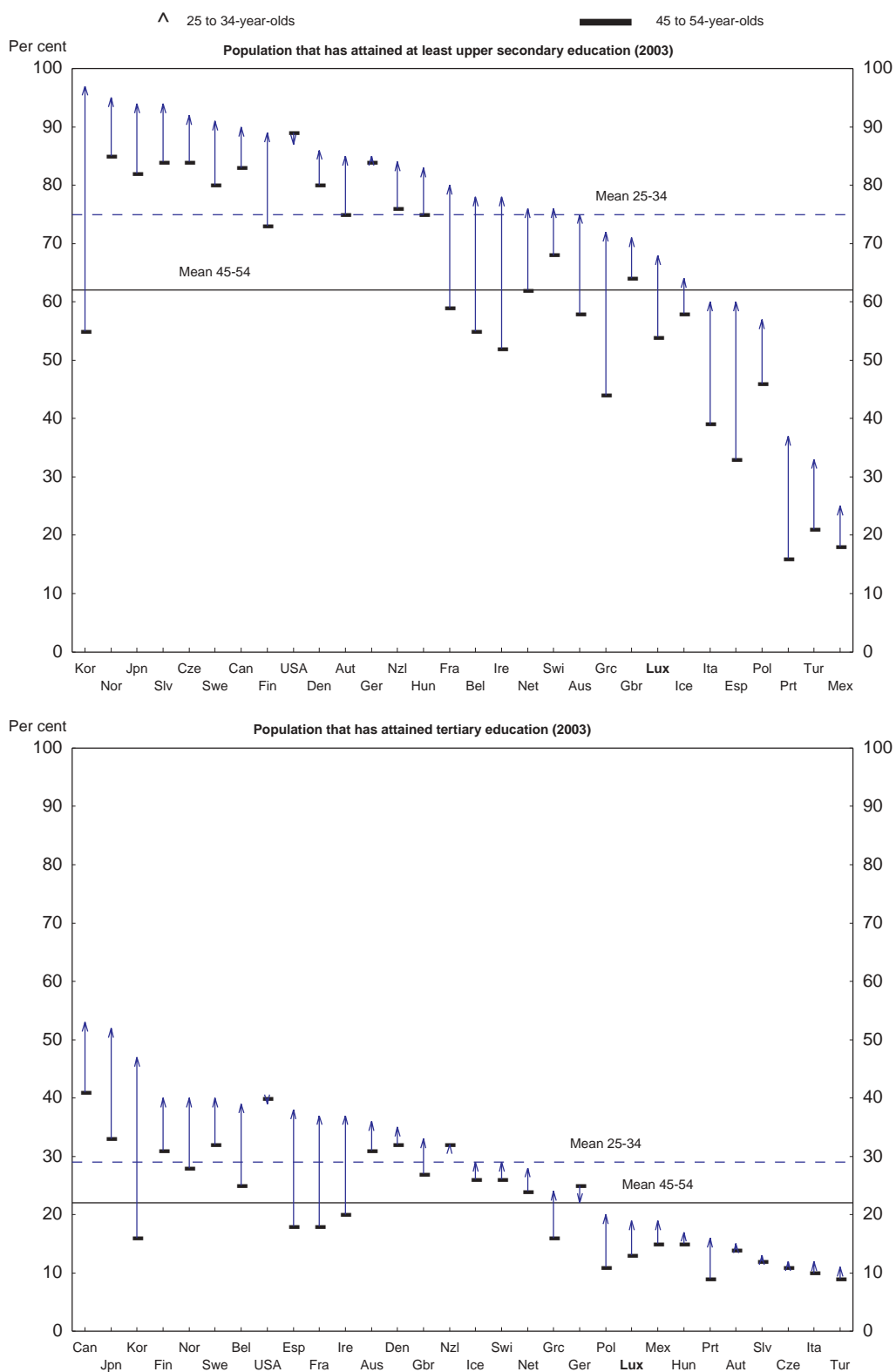
5. Education attainment is low in Luxembourg by international comparison. Forty-one per cent of the population aged 25-64 has not completed upper secondary school, compared with an OECD country mean of 24% (Figure 3). Only 15% of the population in this age group has completed tertiary education, which also compares unfavourably with the OECD country average. The proportion of the population with upper secondary attainment is similar to the OECD average. While fewer members of the younger cohorts fail to complete upper secondary education and more go on to attain a tertiary qualification than was the case for older cohorts, performance in these respects also compares unfavourably with most other OECD countries (Figure 4).

**Figure 3 Education attainment of the population aged 25-64, 2003**



Source: OECD, Education at a glance, 2005.

**Figure 4 Education attainment by age group, 2003**



Source: OECD, Education at a glance, 2005.

***Achievement and attainment are related***

6. Achievement and attainment at least to the upper secondary level are highly correlated across OECD countries. The relatively high proportion of the population aged 25-34 that has not completed upper secondary education is close to what might be expected on the basis of the cross-country relationship between average PISA results in mathematics, reading, science and problem solving and such attainment.<sup>3</sup> Raising achievement could make an important contribution to reducing the proportion of the population that does not complete upper secondary school.

**Building on successful measures to help students cope with trilingual education*****Trilingual education is important for social unity but creates learning difficulties for students from immigrant and/or lower socio-economic backgrounds***

7. Luxembourg is in an unusual linguistic situation in that the three official languages -- *Lëtzebuergesch*, German and French -- are spoken in the same geographical area. In these circumstances, educating residents to be able to speak all three official languages fluently is important for social unity. This emphasis is reflected in the school curriculum, which devotes about 50% of time to language courses (including considerable time for teaching English), and in the weight given to performance in German and French in deciding whether students advance to the next grade;<sup>4</sup> the high amount of time spent on language education reduces the amount of time available for other subjects, weighing on the PISA results. The Luxembourg education system is said to be trilingual because the three official languages are used as languages of instruction: *Lëtzebuergesch* is used in pre-school and orally in primary school, German in primary school and both French and German in secondary school, the degree to which each is used

3. This statement is based on the following least squares regression (t-statistics are shown in brackets):

$$AT = 75.552 - 0.229 * pcp1 + e$$

$$(34.555) (-6.653)$$

$$R \text{ bar sq.} = 0.607; DW = 2.428; F = 44.260$$

Where:

AT = proportion of the population aged 25-34 with at least upper secondary attainment in 2003; and

Pcp1 = is the first principal component of 2003 PISA scores in mathematics, reading, science and problem solving. This principal component explains 94% of the variation in the four achievement series. As they load negatively onto this principal component, a negative coefficient means that achievement is positively correlated with attainment.

While it would be preferable to relate PISA scores to attainment of the same cohort, this cannot be done as the necessary data are not available. The fact that the relationship is nevertheless significant suggests that cross-country achievement of 15 year-olds probably has been relatively stable over time – countries with high (low) achievement for 15 year-olds in 2003 probably also had high (low) achievement when 25-34 year-olds in 2003 were the same age (*i.e.*, between 1984 and 1993).

4. In primary school, advancement depends on results in French, German and mathematics (Berg and Weis, 2005, p. 82). In secondary school, advancement also depends on results in other branches, although where a student relies on compensation (see below) from a branch in which he/she has done well for an unsatisfactory performance in another branch, French, German and mathematics are weighted so that advancement is more difficult with an unsatisfactory performance in one of these branches; branches are listed in the annex to Berg and Weis (2005). In general, they correspond to disciplines, such as German, French or mathematics, but sometimes cover related disciplines, such as the social sciences branch in lower vocational secondary school, which comprises geography and history.

depending on the track, the grade and the branch.<sup>5</sup> This approach differs from that in plurilingual<sup>6</sup> countries, such as Switzerland and Belgium, where a single language of instruction is used within a linguistic community and other languages are taught as foreign languages. The authorities consider that using both German and French as languages of instruction in schools results in greater fluency in the second language than if it were simply taught as a foreign language, as occurs in other countries.

*Learning in German is challenging for students from Romance-language households*

8. While the emphasis on imparting skills in *Lëtzebuergesch*, which is a Germanic language, to immigrant children in pre-school prepares them for acquiring literacy skills in German in primary school, such children -- 70% of whom speak a Romance language at home<sup>7</sup> -- are nevertheless at a disadvantage as they are unlikely to speak *Lëtzebuergesch* as well as those for whom it is their mother tongue. As the primary school curriculum has been determined principally with native students in mind, German is taught at a faster pace than French. Acquisition of literacy skills in German slows down the acquisition of language skills by children from Romance-language homes and creates a barrier to the cognitive and communicative development of these children (Berg and Thoss, 1996). The learning problems in primary school caused by these children's weaknesses in German result in access being blocked for most of them to the prestigious academic track in secondary education (*Enseignement Secondaire*, ES; see Annex 4.A1 for a description of the school system) where French is the main language of instruction (Fehlen, 1997, p. 40) – children from Romance-language speaking households represent around 28% of primary students but only around 10% students in the academic track of secondary school (*Ministère de l'éducation nationale et de la formation professionnelle*, 2005, p. 20). Unfortunately for children in the vocational secondary education stream from Romance-language speaking households, the main language of instruction is German.<sup>8</sup>

9. For the minority of children from Romance-language households that make it into the academic track of secondary education, German remains a stumbling block: the failure rate in German is second only to that in mathematics whereas the failure rate in French is much lower (Berg and Weis, 2005, p. 90).

*French language requirements contribute to the failure of some native students*

10. For native Luxembourg children, the main linguistic challenge of the education system comes later as French grows in importance. Native children from lower socio-economic backgrounds tend to experience greater learning difficulties in French than in German (*ibid*, p. 92), contributing to the exclusion of most of them from the academic track in secondary education. With most vocational education being in German, French poses less of an obstacle to advancement for native students in this track. For many native children (irrespective of socio-economic background) in the academic track of secondary education,

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5. A summary of languages of instruction by track and grade can be found in Berg and Weis (2005), pp 69-73.

6. Plurilingual countries juxtapose different linguistic communities while multilingual individuals or communities master several languages (Fehlen, 2006).

7. The largest groups of immigrant students are the following: Portuguese (52.7%), Italians (7.7%), French (7.6%), Belgians (4.5%), and Cape Verdians (1.8%) (Berg and Weis, 2005, p. 99). Thus, approximately  $\frac{3}{4}$  of immigrants are from Romance-language speaking households, with Portuguese being by far the most important such language, followed by French.

8. German is the language of instruction in 80% of vocational education courses at secondary school and French is the language of instruction for the remaining 20% of courses, although the authorities report that the number of courses offered in French is rising.

French remains a linguistic stumbling block: in contrast to the situation for children from Romance-language speaking households, the failure rate in French is second only to that in mathematics while the failure rate in German is much lower (*ibid*, p. 90).

***Measures have been taken to help children from immigrant and/or lower socio-economic backgrounds cope with trilingual system***

11. The authorities have long been aware that trilingual education creates a more challenging learning environment for many students. Consideration has even been given to offering children the option between the current arrangements and an alternative in which the roles of German and French would be reversed to reduce barriers to achievement for immigrant children.<sup>9</sup> However, following a debate in 2000 on language education and integration of immigrant children, Parliament rejected this option out of concern that it would undermine social unity by creating two distinct linguistic communities (German and French speaking).<sup>10</sup> Instead, the authorities have sought to compensate for the added challenge of learning in a trilingual environment for children from lower socio-economic and/or immigrant backgrounds by giving them more help and introducing more flexibility into the system.

*Pre-school has been extended to 3-year olds and courses are offered to help immigrant children master their mother tongue*

12. Pre-school plays a vital role in promoting social unity. The aim is to ensure not only that children learn to socialise, as in other countries, but also that those from non-*Lëtzebuergesch*-speaking homes learn to speak the language. As noted above, such language competency helps to prepare children from homes where neither *Lëtzebuergesch* nor German is spoken<sup>11</sup> for acquiring basic literacy skills in primary school in German. According to the authorities, immigrant children are able to speak *Lëtzebuergesch* when they begin primary school. Work is underway to elaborate the basic vocabulary that children should learn during these years.

13. Participation in pre-school is compulsory from age 4, and has been extended on a voluntary basis to children aged 3 since 1998 with a view to giving immigrant children more time to learn *Lëtzebuergesch*.

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9. Concerning this option, Martin (1995, p. 32) wrote (in French) that for the moment “it seems materially and structurally impossible to establish in Luxembourg a complete curriculum parallel to the current curriculum in which the respective roles of French and German as they conceived in the current system would be reversed (this would therefore entail French, in other words a Romance language being the first language of instruction and German being taught at a slower pace as the second language; such a system could facilitate bilingualism for immigrant children).”

10. Tonnar-Meyer (2003, p. 86) report that the following conclusions emerged from the parliamentary debate – the education system must:

- “preserve the unity of the Luxembourg school as well as its qualifications, given that native and immigrant children going to the same school is more than ever an indispensable element of preserving social cohesion in Luxembourg in the medium- to long term;
- maintain the principle of trilingual education (*Lëtzebuergesch*, German and French) in Luxembourg schools; and
- promote specific measures, from the pre-school level, aimed at learning to use *Lëtzebuergesch* as the language of communication, thereby enabling this language also to play its role as an integrating factor in Luxembourg society.”

11. Sixty-four per cent of students come from households in which *Lëtzebuergesch* is spoken, with 86% of these students coming from households in which only *Lëtzebuergesch* is used, while a further 1% of students come from households in which only German is used (Berg and Weis, 2005, p. 22).

Approximately 85% of municipalities now offer pre-school education to 3-year olds and all must do so by 2009. About 75% of 3-year olds are enrolled.

14. Assistance is also provided in several pre-schools to children of Portuguese origin to help them to master their mother tongue as doing so enhances the development of cognitive and communication skills, facilitating the learning of other languages. The Portuguese-speaking persons who give these courses also explain to the students in Portuguese the course material to be taught in class (in *Lëtzebuergesch*). The authorities report that experience with these courses has been positive. Given that Portuguese-speaking students comprise around one half of immigrant students<sup>12</sup> and that the level of education attainment of their parents is lower than for most other immigrant groups, the emphasis on providing such courses in Portuguese is well founded.

*Extra help is available for immigrant children to follow the primary-school curriculum and learn German*

15. Classes have been offered since 1991 that enable students having difficulty learning in German to study material from the official primary-school programme in Portuguese or Italian. These classes, which take place during regular school hours, comprise introductory science from the 1<sup>st</sup> to the 4<sup>th</sup> year of primary school and, in the 5<sup>th</sup> and 6<sup>th</sup> years, natural science, history and geography. While few children of Italian nationality take them, they have proved increasingly popular with Portuguese students (Berg and Weis, 2005, p. 75). To help children from Romance-language households further in the second and third years of primary school, a series of mathematics manuals has been translated into French and the activity files for the introduction to science course have been produced in bilingual (French-German) form (*ibid*, p. 102). Moreover, supplementary courses in German are offered at the primary-school level to improve the German-language competence of immigrant children.

16. Integrating immigrant children who did not begin their education in the Luxembourg system is particularly challenging, especially if they have not acquired their literacy skills in a French or German speaking country. There are special classes for such students (the same holds for newly arrived students at secondary school) in which German and/or French are taught intensively with a view to enabling them to join the regular education programme as soon as possible. These classes have high teacher-pupil ratios to facilitate more rapid progress.

17. Greater efforts have also been made in recent years to inform immigrant parents about the education of their children (the same holds for secondary education) and to encourage such parents to take an interest in it (*ibid*, p. 101). To this end, meetings are organised to inform parents and encourage an exchange of views and information bulletins are produced in a variety of languages. Intercultural mediators facilitate communication between teachers and parents.

*Intensive language courses and more flexibility on language requirements help some children to succeed at secondary school*

18. A recent reform in vocational education has created the possibility for students to be instructed in French or German without having to achieve a high level of competence in the other language. The supply of courses in French has been enlarged, initially at the lower secondary level but more recently in the middle and upper levels of the more advanced tracks (*Régime technique* and *Régime de technicien*). The

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12. The breakdown by nationality of pre-school immigrant students in 2003/2004 was: Portuguese 49.6%; Ex-Yugoslav 11.8%; French 10.0%; Italian 6.6%; Belgian 5.8%; German 3.3%; and other 12.9% (Source. *Ministère de l'éducation nationale et de la formation professionnelle*, 2005, p. 25).

authorities report a positive experience with this reform. Textbooks also have been produced in bilingual (German-French) versions in some subjects in the more advanced track and in French in some cases in the less advanced vocational track.

19. In the academic secondary education track, classes in which German is taught as a foreign language have been set up in four schools. These classes are intended for students that at the end of primary school are strong in mathematics and French but relatively weak in German. They receive intensive instruction in German during their first three years in secondary school with a view to joining the regular programme subsequently. In a similar vein, an academic secondary school (*Hubert Clement lycée* in *Esch/Alzette*) set up a pilot project to provide extra help for students having difficulty with German. The project is considered to have been very successful and to have given the children concerned a greater sense of belonging (*ibid*, p. 101).

***These measures have helped to limit the adverse effect of immigrant and/or lower socio-economic backgrounds on PISA results to around the OECD average***

20. As discussed above, immigrant status is associated with lower PISA results in Luxembourg. At the same time, socio-economic status is positively associated with PISA results and most immigrants are from lower socio-economic-status households (OECD, 2004a, Figure 11 and Tables 4.5 and 4.2f). Hence, the relatively low PISA results for immigrant students could reflect their socio-economic status rather than their immigrant status. To disentangle these effects, it is necessary to do a multivariate regression analysis.

21. Such an analysis of the 2003 PISA results<sup>13</sup> (Table 1; see Annex 4.A2 for details) shows that socio-economic background has a significant positive effect on outcomes in Luxembourg while immigrant status (measured by being born abroad or having at least one foreign-born parent) has a negative impact on achievement (independently of socio-economic status).<sup>14</sup> In other words, privileged socio-economic backgrounds are associated with better scores and immigrant status is (independently) associated with lower scores. This relationship also holds in most other OECD countries (see Table 1). The effects of both socio-economic background and immigrant status on achievement in Luxembourg are not significantly different from the average for the OECD countries included in the analysis (Figures 4.5 and 4.6).<sup>15</sup> These results are a remarkable achievement in view of the added difficulty of learning in a trilingual education system. They attest to the success of the measures taken to compensate for this difficulty through extra inputs and flexibility in the system.

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13. The dependent variable is instrumented scores in mathematics, reading, science and problem solving.

14. The same applies when immigrant status is represented by speaking a language at home other than one of the official languages or national dialects.

15. These results are consistent with those in the forthcoming OECD report on immigrants in PISA by Petra Stanat.

**Table 1. Factors influencing 2003 PISA scores in selected OECD countries<sup>1</sup>**

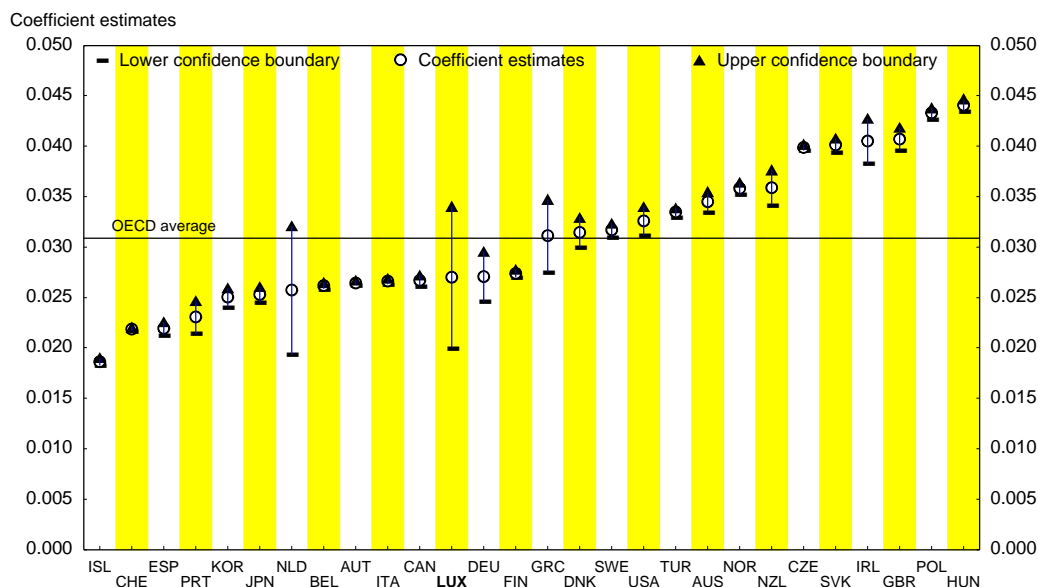
	Grade	Gender	Occupational status of parents	Immigration status	Ability grouping	Extra-curriculum school activities	R <sup>2</sup>	Number of observations
Australia	0.74	-0.13	3.45	-0.13	ns	0.17	0.16	11661
Austria	0.64	0.23	2.65	-0.41	-0.91	0.63	0.36	4308
Belgium	1.29	0.06	2.62	-0.45	0.21	0.71	0.44	8121
Canada	1.06	ns	2.67	-0.13	ns	0.04	0.16	24995
Czech Republic	0.81	ns	3.99	ns	-0.22	0.17	0.18	5987
Denmark	1.10	ns	3.14	-0.60	ns	ns	0.14	3728
Finland	0.97	-0.28	2.74	-0.66	ns	ns	0.12	5655
Germany	0.95	0.14	2.71	-0.45	-0.52	0.47	0.42	3741
Greece	0.69	ns	3.11	ns	Ns	0.31	0.19	4126
Hungary	0.83	-0.07	4.41	ns	0.09	0.36	0.28	4247
Iceland	ns	-0.57	1.87	-0.65	0.05	-0.18	0.06	2840
Ireland	0.43	-0.04	4.05	ns	ns	0.23	0.17	3283
Italy	1.06	ns	2.66	0.11	-0.30	0.38	0.22	10928
Japan	ns	ns	2.53	-0.53	-0.36	0.28	0.07	4143
Korea	0.62	ns	2.50	ns	0.12	0.57	0.12	5197
<b>Luxembourg</b>	<b>1.05</b>	<b>ns</b>	<b>2.70</b>	<b>-0.34</b>	<b>-0.28</b>	<b>0.25</b>	<b>0.33</b>	<b>3682</b>
Netherlands	1.07	0.12	2.57	-0.46	-0.21	1.13	0.40	3532
New Zealand	1.17	-0.06	3.59	-0.22	-0.08	ns	0.16	3644
Norway	0.76	-0.22	3.58	-0.57	-0.12	ns	0.12	3779
Poland	1.98	ns	4.33	ns	ns	-0.06	0.22	4207
Portugal	1.35	0.17	2.31	-0.42	ns	-0.10	0.52	4428
Slovak Republic	0.41	ns	4.01	-0.79	-0.15	0.24	0.18	6959
Spain	1.67	ns	2.19	-0.21	Ns	0.09	0.32	9678
Sweden	1.30	-0.15	3.17	-0.69	0.06	0.09	0.17	4376
Switzerland	0.81	ns	2.18	-0.74	-0.44	0.75	0.33	7684
Turkey	0.53	ns	3.35	ns	0.43	0.65	0.27	4213
United Kingdom	0.32	-0.21	4.07	-0.15	ns	0.07	0.14	8349
United States	0.67	ns	3.26	-0.26	ns	ns	0.16	4192

1. This table shows the coefficients estimated for each country individually by regressing the explanatory variables shown against 2003 PISA scores, which are summarised by the first principal component of the four PISA test scores (Mathematics, Science, Reading and Problem solving). The same specification is used for each country. "ns" means not statistically significant at the 5% level. France and Mexico are not included owing to missing observations of school-level data.

Source: PISA 2003, Secretariat's calculations.



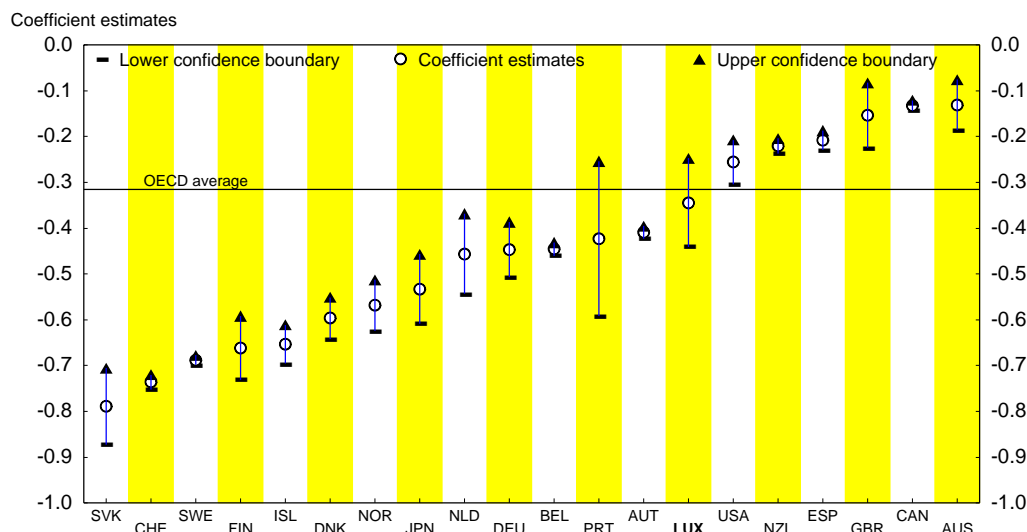
**Figure 5. The effect of socio-economic background on 2003 PISA scores in selected OECD countries<sup>1</sup>**



1. This graph shows coefficient estimates with 95% confidence intervals for the variable 'Highest occupational status of parents' from the multiple regression analysis summarised in Table 1 and described in more detail in Annex 4.A2. The OECD average is calculated for all OECD countries with available data (see Table 1).

Source: OECD, PISA 2003, Secretariat's calculations.

**Figure 6. The effect of immigrant status on 2003 PISA scores in selected OECD countries<sup>1</sup>**



1. This graph shows coefficient estimates with 95% confidence intervals for the variable 'Immigrant status' from the multiple regression analysis summarised in Table 1 and described in more detail in Annex 4.A2. Only coefficients significant at the 5% level have been reported. The OECD average is calculated for all OECD countries with available data (see Table 1), including zero values for countries for which the coefficient estimate was not significantly different from zero at the 5% confidence level.

Source: OECD, PISA 2003, Secretariat's calculations.

### ***Building on measures to help children from immigrant and/or lower socio-economic backgrounds***

22. While limiting the impact of immigrant and/or lower socio-economic status on PISA results to around the OECD average is a laudable achievement, the size of the immigrant student population (see Figure 2) and the fact that they mostly come from less favourable socio-economic backgrounds (OECD, 2004a, Figure 4) makes the payoff from reducing these effects particularly large. To this end, the measures outlined above to help immigrant children should be taken further in the following respects:

- *Make pre-school education for 3-year olds compulsory when such pre-school education is available in all municipalities.* The share of immigrant children (40%) in pre-school education for 3-year olds is slightly below their share in compulsory pre-school education (43%), suggesting that voluntary take-up of pre-school education for 3-year olds is slightly lower for immigrants than for native students. Given that the focus on learning to speak *Lëtzebuergesch* in pre-school is intended especially to help immigrant children, further efforts are needed to boost their participation in pre-school education for 3-year olds, possibly including making such participation compulsory.
- *Expand the availability of supplementary courses in German at the primary-school level for immigrant children.* The authorities report a positive experience with these courses to date and consider that they should be expanded.
- *Make more material available in bilingual form (French-German) in primary school to help immigrant children to follow the curriculum.*
- *Expand the availability of courses in French in the less advanced vocational education track (Régime professionnel) that leads to early labour-market participation.* While the recent reform enabling students in vocational education to be instructed in French or German without having to achieve a high level of competence in the other language is promising, its impact on immigrant children may not be great as most of them are from Romance-language households while most vocational-education courses (80%) are still only available in German, with the proportion being higher still in the less advanced track where many Portuguese children find themselves after having done poorly in primary school.

23. As noted above, intensive courses in German and/or French are available to newly arrived immigrant children. Secondary school programmes entirely in French are also available to such children. Unfortunately, such programmes do not lead to any national qualifications as these require competence in both German and French. The authorities are considering offering the International Baccalaureate in French in a public secondary school to avoid this problem. They are also considering creating a secondary school jointly with the neighbouring Saar region in which there would be much less emphasis on French, which would reduce barriers to achievement for native children experiencing difficulty learning in French. These reforms could be very helpful for reducing linguistic barriers to achievement for some students.

## Reforms to education practices to enhance achievement

### *Reducing the impact of tracking and streaming*

24. Luxembourg's education system is highly stratified: it has a high number (four) of tracks into which students are sorted; selection between tracks starts at a young age (12)<sup>16</sup>; academic and vocational programmes are generally separately provided; and the extent of grade repetition, which can be considered as a form of differentiation aimed at adapting curriculum content to student performance (OECD, 2005a, p. 401), is particularly high (*ibid.*, Table D6.1). (It should, however, be noted that the material taught in the academic (*Enseignement secondaire*, representing about 30% of students) and technical vocational (*Régime technique*, representing about 25% of students) tracks is at the same level of difficulty except for languages, which are less demanding in the technical vocational track. Both tracks lead to qualifications that have the same legal standing in the labour market and for access to university studies). Within tracks, students are also sorted according to performance. Based on the 2003 PISA mathematics results, the distribution of student performance between schools is wider and the impact of socio-economic background<sup>17</sup> on student performance is larger in countries with more differentiated systems (Table 2, row 9 and columns 1-3 and 6, row 10 and columns 8-9). On the other hand, stratification does not significantly affect a country's average score on the 2003 PISA mathematics scale (see Table 2, row 7), although it did so on the 2000 PISA reading scale (*ibid.*, p. 403; OECD, 2005b).

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16. See Figure A1.1. There seems to be an error in OECD (2005a, Table D6.1), where the first age of selection in the education system is reported as being 13.

17. Social selectivity in this analysis is derived by averaging the standardised (0,1) indexes of the first age of selection, the number of school types or distinct educational programmes available to 15-year olds, the proportion of grade repeaters at the different levels, and the proportion of 15-year olds enrolled in programmes that give access to vocational studies at the next vocational level or direct access to the labour market (OECD, 2005a, Table D6.1, footnote 3).

**Table 2 Intercorrelation matrix of averages of structural features across the OECD countries<sup>1</sup>**

	Number of school types or district educational programmes available to 15-year-olds.	Proportion of 15-year-olds enrolled in programmes that give access to vocational studies at the next programme level or direct access to the labour market	First age of selection in the education system	Proportion of repeaters in primary education	Proportion of repeaters in lower secondary education	Proportion of repeaters in upper secondary education	Performance on the mathematics scale- Mean score	Performance on the mathematics scale- standard deviation	Total variance in student performance between schools	Strength of the relationship between the index of economic, social and cultural background, and student performance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Number of school types or district educational programmes available to 15-year-olds.	1									
Proportion of 15-year-olds enrolled in programmes that give access to vocational studies at the next programme level or direct access to the labour market	<b>0.50</b>	1								
First age of selection in the education system	<b>0.76</b>	<b>0.52</b>	1							
Proportion of repeaters in primary education	<b>0.39</b>	0.27	0.23	1						
Proportion of repeaters in lower secondary education	0.22	0.02	0.11	<b>0.56</b>	1					
Proportion of repeaters in upper secondary education	<b>0.45</b>	0.22	<b>0.53</b>	0.23	0.27	1				
Performance on the mathematics scale- Mean score	0.09	0.26	0.23	0.21	0.17	0.40	1			
Performance on the mathematics scale- standard deviation	0.25	0.19	0.29	0.05	0.06	<b>0.58</b>	0.08	1		
Total variance in student performance between schools	<b>0.62</b>	0.63	<b>0.70</b>	0.15	0.16	<b>0.65</b>	0.14	<b>0.62</b>	1	
Strength of the relationship between the index of economic, social and cultural background, and student performance	<b>0.51</b>	0.24	<b>0.53</b>	0.29	0.17	<b>0.43</b>	0.19	<b>0.48</b>	<b>0.57</b>	1

1. Data marked in bold are statistically significant at the 0.05 level (2-tailed). The proportion of explained variance is obtained by squaring the correlations shown in this figure.

Source: OECD PISA 2003 database; OECD education database.

25. Hanushek and Woessman (2005) take this issue further by looking at the effects of tracking by comparing school outcomes in primary school (examined through the Progress in International Reading Literacy Study, PIRLS) with those in secondary school (based on PISA scores). In tracked school systems, inequality tends to increase between primary and secondary school, whereas this does not occur in comprehensive systems.

26. Possible explanations for the positive relationship between system stratification and variance in student performance include that: high-performing students may learn from each other in a homogenous environment and stimulate each other's performance whereas this may not happen so much where low

performers are together; students not meeting performance standards can be relegated to other schools, tracks or streams with lower expectations in a highly differentiated system instead of being helped to improve their performance; and teachers may be obliged to give more individual attention to students in an environment that has a greater variety of abilities and backgrounds (*OECD, 2005a*, p. 404). Concerning the greater impact of socio-economic background in a more differentiated system, this may be partly attributable to early selection (see Table 2, row 10 and column 3) when children are more dependent upon their parents and parental resources (*ibid.*, p. 404). In these circumstances, some able children from lower socio-economic backgrounds who develop their abilities late would find doors to academic development closed.

27. The authorities have long recognised that the high degree of stratification in the education system has drawbacks, notably in terms of social equity. For this reason, they seriously considered introducing comprehensive education in the 1970s, but did not do so owing to the linguistic complexity of the education system.<sup>18</sup> So as to enhance permeability between the different tracks and to increase social diversity, the government decided ten years ago that all new secondary schools would offer all three tracks (general academic education (*enseignement secondaire*), vocational secondary education (*enseignement secondaire technique*) and vocational training (*régime professionnel*)) in lower secondary education: there is too much diversity in programmes to offer all tracks beyond this level. Already established secondary schools, however, have refused to do likewise. Further efforts should be made to encourage these secondary schools to offer all three education tracks in lower secondary school.

28. Comprehensive education got a boost in 2005, when the government approved the creation of a publicly funded pilot school at the lower secondary level (*Neie Lycée*) that does not have separate education tracks or streams. The break with existing education practice, however, goes much further than this (Box 4.1). Education practices in this school, which opened at the beginning of this school year, are intended to address many of the weaknesses that have been identified in the education system. Experience with this school should provide inspiration for reforms that could be applied on a larger scale to improve education outcomes.

**Box 1. The new pilot school at lower secondary level (*Neie-Lycée*)<sup>19</sup>**

In order to break with the hierarchy of disciplines in the rest of education system and the partitioning that exists between them, courses are organised into interdisciplinary branches, such as “arts and society”, “science and technology”, and “physical education, health and values”. Only mathematics and languages -- French, German and English -- are taught as separate disciplines, as in the rest of the system.<sup>20</sup> Such organisation should help students to be able to draw the links between knowledge in different subjects and to use this knowledge to solve problems, strengthening core competences (see below).

Teachers give classes not only in the discipline in which they have specialised, but also in other subjects. The relative ignorance of teachers in these other subjects obliges them to work closely with other teachers who are specialised in these topics. In each interdisciplinary class, there are two teachers, one of whom is not a specialist in the material being taught. These arrangements are intended to reduce the distance between teachers and students – to some extent, they are all learning together. Presumably, a non-specialist teacher is more easily aware of difficulties that students may encounter in learning than a specialist.

18. The large differences in student command of the languages of instruction would have made teaching heterogeneous groups of children together particularly difficult.

19. This box draws heavily on Perucca (2005).

20. English lessons start one year earlier in the *Neie Lycée* than in other secondary schools.

Daily classes are organised into three sessions of 100 minutes instead of the periods of 45 minutes in the rest of the education system. This is intended to reduce interruptions as material is explored and developed. Given that such long classes are tiring for students, they are interspersed with complementary activities, such as theatre, led by professionals. The school day is longer in the *Neie Lycée* than in other schools (school finishes at 4:30 pm instead of 2 pm), making it an all-day school (*Ganztagsschule*). The extra time in the school day is for students to participate in activities intended to deepen their understanding of what was learnt in class or, as necessary, to participate in support activities. Staff are available to help students in these activities. They replace homework.

Students are not given grades in the *Neie Lycée* to determine whether or not they advance to the next level, *i.e.*, there is no grade failure.

29. In a further move to increase permeability between education tracks, the government is considering introducing a module corresponding to the first two years of secondary school during which the general and technical vocational programmes would develop in parallel; the module would define key competences to be acquired during this period. This reform would facilitate entry into the more prestigious academic track for some children who were oriented to the vocational track from the beginning of secondary school. The government is also considering offering exams that would enable students having gained a CATP (*Certificat d'Aptitude Technique et Professionnelle*; see Box 4.1) at the end of vocational secondary education (*régime professionnel*) to do extra exams to gain a Baccalaureate and hence, access to tertiary education. Increasing permeability between tracks is vital for reducing the adverse impact of the current system on social equity.

30. The authorities should reflect on whether it makes sense to continue to direct such a large proportion (45%) of students into the vocational tracks (*Régime de technicien and Régime professionnel*) that mostly lead to particular occupations and trades. However, the labour market for Luxembourg residents is dominated by the public sector and financial services. Accordingly, there is less demand for these occupations and trades than in other countries (although the question of the continued relevance of vocational education to modern labour-market requirements is arising everywhere). A general education involving good literacy and numeracy skills may therefore be more appropriate for most of the available jobs.

### ***Reducing grade repetition***

31. As noted above, Luxembourg has a high rate of grade repetition. Grade failure is particularly high in vocational secondary education (Table 3). Many children are older than the theoretical age for their grade (indicating that they have already repeated at least one year of schooling), especially in the vocational track of secondary education. As this track includes many students from Romance-language households (see above), it is probable that German language requirements are an important cause of failure (Berg and Weis, 2005, p. 90). Data on grade repetition by nationality in primary school show that it is higher for immigrants than for nationals and that it is highest (above 7%) for the Portuguese, Cape Verdians and ex-Yugoslavs (*Ministère de l'éducation nationale et de la formation professionnelle*, 2005, p. 69).

**Table 3 Grade failure, 2003/2004**

Per cent of students

	Primary school	Academic secondary	Vocational secondary
Repeating a grade in primary school or failing a grade in secondary school	20.0	21.2	62.2
Older than the theoretical age for their grade	5	8.5	22.0 <sup>1</sup>

1. This figure excludes students in the modular programmes in lower secondary school and students in tracks leading to a certificate rather than a diploma in upper secondary school (*ie.*, only students in the *Régime technique* and the *Régime de technicien* are included in upper secondary school).

Source: *Ministère de l'éducation nationale et de la formation professionnelle*, 2005, pp 37, 49 and 57 for students older than the theoretical age and 69, 73, 75, 77 and 79 for grade repetition or failure.

32. Recent reviews of international research evidence suggest that repeating years of study is a relatively ineffective means of helping students to catch up with their peers and that it tends to stigmatise those involved and is costly (Paul and Troncin, 2004). The Luxembourg authorities have come to similar conclusions in a recent study on the effects of repeating years ([http://www.gouvernement.lu/salle\\_presse/actualite/2005/09/28delvaux/index.html](http://www.gouvernement.lu/salle_presse/actualite/2005/09/28delvaux/index.html)).<sup>21</sup>

33. A longstanding factor contributing to the high rate of grade repetition is the system's focus on preparing an elite group for tertiary education. This has led to there being too much ambition for many children concerning the curriculum and the standards to be achieved. While criteria for advancement have not changed in primary school -- students must pass in French, German and mathematics --, they were made less restrictive in secondary school after 1990. Previously, students had to pass in each branch<sup>22</sup> or repeat the whole year. Since then, partial compensation has been possible,<sup>23</sup> but only in cases where the student only just failed in some branches provided that they were not critical to the overall track being followed.<sup>24</sup> In view of the continuing high rate of grade repetition, a further reform was introduced during the current academic year that allows a student with a clear failure in one branch to advance to the next grade provided that he/she has an overall average score of two-thirds. This reform is expected to reduce repetition markedly.

21. The main results of this study are that:

- statistics, opinions of national experts and international studies do not support grade repetition;
- grade repetition does not reduce the school drop-out rate;
- grade repetition remains too high in Luxembourg's primary and secondary schools; and
- grade repetition is rarely a satisfactory response to individual learning difficulties.

22. As noted earlier, branches in secondary school are listed in the annex to Berg and Weis (2005).

23. However, compensation is not permitted between fundamental branches in upper general secondary education.

24. Advancement decisions are based on assessment for the year, taking into account results by branch, the sum of the coefficients (1 to 4) used for weighting branches to reflect the importance of failed branches and the student's weighted average score. A score of less than 30 points out of 60 is classified as failed and a score of 25-29 (27-29 in the academic track) is classified as just failed. Compensation of just failed branches is allowed for advancing in the same track (in a lower track just failed falls to 20 points or more) provided that the weighted average score for all branches is greater than or equal to 35 (30), and the sum of the coefficients of the insufficient score is 6 (9) or less (Berg and Weis, 2005, p. 85).

34. The authorities direct more resources than average to students with learning difficulties so as to improve their level of achievement. The student-teacher ratio in classes for such students is much lower than for other classes.<sup>25</sup> Supplementary pay is offered to attract high quality teachers for classes of such students. Even so, the authorities report that there are not enough teachers trained for these children.<sup>26</sup> Schools also receive a teaching-hours credit to cover support courses and other activities to help weaker students. The school principal is responsible for deciding how to spend it. The allocation takes into account various factors, including the socio-economic background of students.

35. The government recently introduced remedial measures for all children falling behind. The teacher is obliged to propose remedial measures to such children identified after the first quarter of the academic year. These measures may include, for example, support courses and/or extra homework. This approach is intended to increase the responsibility of both students and teachers for performance. In certain cases, the measures may be proposed to parents for their agreement. Such an approach is intended to make them also feel more responsible for performance. There are also relay classes in vocational secondary education for students falling behind. If there are several students in this situation, they are taken out of class for six weeks and receive very intensive teaching to try to get them back to the required level.

36. Arrangements for children to be helped with their homework by teachers or tutors after school have been introduced in secondary schools in recent years. This is particularly important for children from lower socio-economic backgrounds as their parents are unlikely to be able or willing to provide the help with homework that is expected in the Luxembourg school system. Participation by children in these arrangements is voluntary. To ensure that all children that need help with their homework get it and to avoid the stigma of compulsory participation in such arrangements for children having difficulty coping with the curriculum, such arrangements should be integrated into an enlarged school programme, as has been done in the *Neie Lycée*. The government plans to extend such arrangements (which also include custodial services) to primary schools.

37. The government is considering reorganising primary (six years) education programmes into two-year modules with defined competences to be achieved at the end of each module. The curricula in these modules would be pared back, leaving an extra margin of 30% of course time for getting to the required level. Children not meeting the required standards in the first or second modules would at most be required to repeat one year while failure in the third cycle would result in children going into the modular vocational education track (*régime préparatoire*) that aims to equip them with the competences necessary to enter an apprenticeship at the minimum age for leaving school (15, soon to be 16).

### ***Providing extra help for unqualified school leavers***

38. Educational failure is the most important reason for students leaving school for a job, labour-market measure or inactivity before having obtained an end of secondary-school qualification (Barthelemy, Unsen, and Vallando, 2005, pp 12 and 15). Another reason frequently cited by such students is a lack of motivation to go to school (*ibid*). The measures discussed above to improve achievement amongst students experiencing the most academic difficulties should help to reduce academic failure, de-motivation and hence early school leaving. Nevertheless, more could be done to adapt school programmes to the needs of these students. Students aged 16 or more remaining in modular education (lower secondary school) could benefit more from moving up to preparatory classes for the *Certificate d'initiation technique et*

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25. For example, there are only 10-12 students per class in the modular vocational education track (*régime préparatoire*) for weaker students that aims to equip students with the competences needed to learn a metier at age 15.

26. Of the teachers giving support courses, only 57% are qualified (*Ministère de l'éducation nationale et de la formation professionnelle*, 2005, p. 104).



*professionnelle* (CITP) (Meyers and Plein, 2001, p. 40). Indeed, this is precisely the training that is offered by the *Centre national de formation professionnelle continue* (CNFPC) to youngsters aged 15-18 who have left school without a qualification and that lacked one or more modules at school to have access to classes leading to a CITP (*ibid.*, p. 38). Such a reform would be coherent with introducing a further two-year module into lower secondary education, taking children through to the end of compulsory education (soon to be at age 16).

39. Another important cause of early school leaving without qualifications is that many youngsters cannot find an apprenticeship, even though they fulfil the necessary conditions (*ibid.*, p. 40). More help with finding an apprenticeship should be provided to students (*ibid.*, p. 40). The reasons why there are not enough apprenticeship places should also be analysed with a view to providing solutions. It may be that the structure of apprenticeship courses offered at secondary school is no longer adapted to the structure of the economy.

40. For students who do leave secondary school without qualifications, there are second-chance arrangements, although they could be improved. Professional orientation and initiation courses (*Cours d'orientation et d'initiation professionnelle* (COIP) of the *Centre national de formation professionnelle continue* (CNFPC)) were created in the early 1980s for youngsters aged 15-18 leaving school without a qualification so as to facilitate the school-to-work transition for them. With only one half of students leaving such measures for a job, it may be time to re-orientate these arrangements more towards the acquisition and reinforcement of the basic competences that these students lack (*ibid.*, pp. 39-40). In addition to literacy skills, this includes elementary social skills. Such arrangements need to counter many characteristics of this population that inhibit the acquisition of competences.<sup>27</sup> As participation in courses offered by the CNFPC is strongly influenced by the availability of such a centre nearby (*ibid.*, p. 38), the government is considering offering such courses through distance learning arrangements.

41. A factor that may contribute to some young people leaving secondary school without qualifications for the labour market insertion training measure (*stage d'insertion*) is that it can be financially attractive. Participants are paid € 600 per month and qualify for an unemployment benefit (UB) after completing the training. UB in such cases is € 1200 per month (which is 80% of the minimum monthly wage). This seems generous, especially as most (94%) school leavers without qualifications benefiting from a labour-market measure have low living costs as they live with their parents (Barthelemy, Unsen, and Vallando, 2005, p. 14). It may be preferable to replace the training indemnity and UB for these persons with social assistance (the *Revenu minimum garanti*, RMG), which is means tested, thereby ensuring that such persons needing financial support receive it. So as to curtail such access to unemployment benefit, the Tripartite Co-ordination Committee recently agreed (Luxembourg Government, 2006a) that:

- ADEM should offer an active labour market measure to each young unemployed person no later than six months after registering as unemployed, and preferably after three months, with the Permanent Employment Committee to decide on the waiting period to apply between the end of the labour-market measure and the beginning of payment of unemployment benefit; and that

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27. Unqualified school leavers often share some of the following characteristics that inhibit the acquisition of competences: a negative self image, no personal project, the memory of particular teachers experienced as good or bad, a weak structuring of time and space, the refusal to be in a learning situation in the traditional school environment, major shortcomings in linguistic competences and oral expression, and weaknesses in terms of basic social competences (Meyers and Plein, 2001, p. 39).

- the duration of UB should be reduced for unemployed persons having worked for less than one year, the duration being made proportional to the length of previous employment.

The education cheque -- while helping to bring dropouts back into the school system – may also encourage some youngsters to leave secondary school prematurely. So as to reduce such incentives, this cheque should not be available until at least 12 months after the last attended school year.

### **Improving teaching skills**

#### *Enhancing second-chance arrangements for teachers to certify*

42. Approximately one quarter of teachers are not certified, with this proportion being higher in secondary school than in pre-school or primary school (Table 4). These teachers normally have passed the initial exams but have failed to pass the final exams for pre-school or primary teachers or vocational secondary teachers or, in the case of teachers in the academic track of secondary school, have failed to complete successfully the training period.<sup>28</sup> There is a particular shortage of qualified teachers giving support courses. The relatively high proportion of uncertified teachers is a cause for concern because empirical evidence suggests that this has an adverse effect on achievement (as measured by the 2003 PISA results).<sup>29</sup>

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28. To become a pre-school or primary school teacher, candidates must first pass an exam in linguistic competences (German, French and orally in *Lëtzebuergesch*) and then gain a Certificate of Pedagogical Studies (*certificat d'études pédagogiques*) with a specialisation in pre-school education or primary education, respectively. The course to obtain this certificate takes three years, but will soon be converted into a four-year degree programme. To become a teacher in the academic track of secondary education, applicants must have gained a four-year degree (soon to be a five-year master's degree) in the discipline that they plan to teach and have passed an exam in linguistic competences in the three national languages (only oral competences are required in *Lëtzebuergesch*). Then, applicants must pass the recruitment exam in the discipline that they plan to teach. Passing this exam opens access to the three-year training period that must be successfully completed to become a certified teacher in the academic track of secondary education. In vocational secondary education, applicants must pass the exam in linguistic competences and then successfully complete teacher training in the area that they plan to teach: for example, in science or in engineering and architecture.

29. This statement is based on the following regression estimates (t-statistics in brackets):

$$\text{ACH} = 0.942 \text{ GR} + 0.480 \text{ GN} + 0.347 \text{ ESCS} - 0.424 \text{ IMM} - 0.257 \text{ ABG} + 0.091 \text{ AMA} + 1.857 \text{ PCT} + e$$

$$(5.51) \quad (3.22) \quad (4.02) \quad (-8.59) \quad (-3.09) \quad (1.04) \quad (3.49)$$

No. of observations = 2268; R<sup>2</sup> = 0.355

Where:

ACH is instrumented PISA 2003 scores in mathematics, reading, science and problem solving;

GR is grade (-1 for a lower grade than the theoretical grade for the age; 0 for the same grade as the theoretical grade for the age; and 1 for a higher grade than the theoretical grade for the age);

GN is gender (1 for female, 2 for male);

ESCS is socio-economic background (based on parental education and occupation status and on cultural possessions in the home; a higher value reflects higher a socio-economic background);

IMM is immigrant status;

ABG is ability grouping;

AMA is additional mathematics activities; and

**Table 4. Certified teachers, 2003-04**

	% of total	Total teaching staff
Pre-school	76.4	1089
Primary	79.3	2666
Special teaching <sup>1</sup>	72.3	47
Support courses <sup>2</sup>	57.0	165
Secondary	73.0	3359

1. Special teaching includes welcome classes, waiting classes and special classes.

2. Support courses are for children with learning difficulties. Teachers giving these courses hold a certificate to do so but are not necessarily certified teachers

Source: Ministère de l'éducation nationale et de la formation professionnelle (2005)

43. Another problem with the relatively high proportion of uncertified teachers is that it will no longer be possible to hire them on fixed-term contracts that can be renewed indefinitely following a recent court case. Rather, such contracts will be subject to the same rules as in the private sector – a contract may not exceed two years and can only be renewed once. The government will be obliged to transform many of these contracts into indefinite-term contracts or to change the law to exempt the Ministry of Education from the constraints on rolling over fixed-term contracts.

44. In view of these problems, the government should enhance access to second-chance opportunities through continuing education to enable more uncertified teachers to certify. In view of the limited arrangements for teacher performance evaluation,<sup>30</sup> the government should also focus more strongly on outcome results evaluated on in-class performance.

#### *Helping teachers to communicate with children from lower socio-economic- and immigrant backgrounds*

45. Almost all teachers are natives of Luxembourg, partly because immigrants (including first- and second generation immigrants) rarely speak the three official languages well enough to enter the profession. Moreover, the vast majority of teachers come from middle-class households. At the same time, some 40% of students in younger age cohorts are from immigrant households, most of which are in the lower socio-economic categories. This situation creates much room for misunderstanding between teachers and students, resulting in poor communication and undermining the effectiveness of teaching. Teachers need to be given more training to overcome cultural differences between them and immigrant children that could otherwise stand in the way of effective learning. Efforts should also be made to overcome these differences directly by recruiting more students with immigrant backgrounds into the profession. This would also encourage immigrant children to improve their performance by providing them with positive role models.

#### *Basing school programmes on key competences*

46. As discussed above, mean test scores for Luxembourg students in the 2003 PISA were below the OECD country average. Given that the PISA study tests students' ability to apply knowledge to solve problems, the results suggest that there are weaknesses in key competences, *i.e.*, in students' demonstrated ability to apply knowledge in key areas to solve real-world problems. Such weaknesses could inhibit the

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PCT is the instrumented (proportion of certified teachers in PISA 2000, school size, GR) proportion of certified teachers.

All variables except AMA are significant at the 5% level.

30. Perucca (2005, p. 56) reports that teachers are left in peace after qualifying as there is no teaching inspectorate.

capacity of future cohorts of workers to adapt and thrive in the labour market, notably by continuously updating skills. Against this background, it is vital that students learn how to learn.<sup>31</sup>

47. The Ministry of Education is currently revising education programmes so that they lead students to acquiring key competences (Luxembourg Government, 2006b). Moving to education programmes based on key competences represents a major paradigm shift for teachers – it makes it clear that their role is not just to impart knowledge but to ensure that students know how to use it to solve real-world problems. Equally, such programmes make it clear to students that they must learn to apply the knowledge they acquire to solve problems. Such an approach should also motivate students by making it clear to them how the things they are learning can help them to solve problems of interest to them. With a more positive experience of learning at school, more students are likely to take with them a lifelong thirst for learning, which would support subsequent skill development. Once the revised programmes have been developed, they need to be implemented. Subsequently, the reform will be evaluated to see how performance can be improved. This is an important reform that should help the education system to equip young people with the skills that they will need to prosper in the labour market.

### **Box 2. Policy recommendations to strengthen education achievement and attainment**

#### **Overcoming challenges arising from trilingual education**

*Encourage more participation in early pre-school education by immigrants.* If this does not result in a satisfactory increase in participation, consider making it compulsory in 2009, when such education facilities must be available in all parts of the country.

*Encourage more children of Portuguese and Cape Verdian origin to participate in pre-school courses to help them master their mother tongue.* Consider extending the availability of such courses to other immigrant groups, notably those from ex-Yugoslavia.

*Make more primary-school-course material available in French or in bilingual (German-French) form.* This would help children from Romance-language households to follow the curriculum.

*Increase the participation of immigrant children in supplementary German-language courses at the primary-school level.* This would increase these children's command of German, making it easier for them to follow the curriculum.

*Make intensive German- or French-language classes available to immigrant students who began their education in a French- or German-speaking country, respectively.* The French courses would only be needed for German-speaking immigrant children arriving after the third year of primary school.

*Increase the proportion of courses in the vocational track of secondary education that are taught in French, especially in the less advanced vocational track (Régime professionnel), to facilitate achievement of children from Romance-language households.* This would build on the recent reform that created the possibility for students to be instructed in French or German without having to achieve a high level of competence in the other language.

*Make classes in which German is taught as a foreign language or which provide extra help for students having difficulty with German more widely available in secondary schools.* Experience with such classes in pilot projects has been positive.

*Implement the reforms currently being considered which would entail offering the International Baccalaureate in French in a public secondary school and creating a German-oriented public secondary school in co-operation with the neighbouring Saar region in which there would be less emphasis on French-language competence.* The first of these reforms would overcome on a local or regional level the current problem for newly arrived immigrant children who participate in secondary school programmes entirely in French that do not lead to any national qualifications as these require competence in both German and French. The other reform would reduce barriers to achievement to native children having difficulty with French who are able to attend this school.

31. This could entail, for example, a guided approach to problem solving. Students would endeavour to solve a problem, note how they had gone about doing so, and then reflect on the results of the different approaches. This could help students to recognise and acquire the knowledge they need to solve problems more quickly in the future.

### **Reforming education practices to enhance achievement**

*Oblige already established secondary schools to offer all three education tracks (academic, advanced and less advanced vocational) in lower secondary school, as is already the case for all new schools since the mid-1990s.* This would enhance permeability between the different tracks and increase social diversity at schools, which should help to narrow the distribution of achievement without affecting the average level of achievement.

*Implement the other reforms being considered to increase permeability between education tracks:* introduce a module corresponding to the first two years of secondary school during which the academic and advanced vocational programmes would develop in parallel; and offer exams that would enable students having gained a CATP (*Certificat d'Aptitude Technique et Professionnelle*) at the end of vocational secondary education to do extra exams to gain a diploma and hence, access to tertiary education.

*The authorities should reflect on whether they should direct a higher proportion of students into general education.* Such an education leading to good literacy and numeracy skills may be appropriate than vocational education given modern labour-market requirements and the structure of Luxembourg's economy.

*Implement the reform being considered to reorganise primary education into three two-year modules with defined competences to be achieved at the end of each module.* This would reduce grade repetition to at most one year, thereby helping to reduce the variance of achievement.

*Expand school hours so as to integrate after-school support arrangements into the regular programme, as is done in the Neie Lycée and, as planned, extend such arrangements to primary school.* Such measures would enhance achievement, notably of weaker students.

*Enhance second-chance arrangements for unqualified school leavers.* More help should be given to help students find an apprenticeship and, if necessary, the structure of apprenticeship courses offered at secondary school should be adapted to the structure of the economy. CNFPC (*Centre national de formation professionnelle continue*) courses should be reoriented towards the acquisition and reinforcement of basic competences that early school leavers lack.

*Adapt financial incentives for poorly performing students to leave school prematurely for the labour-market-insertion measure (stage d'insertion) followed by a spell on unemployment benefit in order to strengthen responsibility and motivation.* This would entail replacing the training indemnity and access to unemployment benefit that follows with social assistance (the *Revenu minimum garanti*, RMG), which is means tested. As most such children live with their parents, they would not be eligible for the RMG. The recent agreement of the Tripartite Committee goes in this direction by limiting access to unemployment benefit and its duration for young unemployed persons.

*Enhance second-chance arrangements for uncertified teachers, provide more training for teachers to overcome cultural differences between them and immigrant children, and recruit more students from immigrant backgrounds into the profession.* These measures should increase both average achievement and narrow its distribution, including by providing positive role models for immigrant children.

*Complete the reform underway to base school programmes on key competences.* This will help to focus the education system on the acquisition of skills that will help future cohorts of Luxembourg residents to adapt and prosper in the labour market.

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## *Annex A1.*

### **Structure of the Luxembourg education system**

1. Participation in the Luxembourg education system begins with early preschool education (*enseignement précoce*) at the age of three (Figure A1.1). Such education is optional. Preschool education (*enseignement préscolaire*) begins at the age of four and lasts for two years. It is compulsory. Primary school (*enseignement primaire*) education starts at the age of six and continues for six years.

2. At the end of primary school, students are oriented into one of three main tracks in lower secondary education: academic general education (*enseignement secondaire*, ES, 30.3% of students in 2003-04), vocational secondary education (*enseignement secondaire technique*, 58.2% of students in 2003-04), and, for the students having more educational difficulties, modular vocational education (*régime préparatoire modulaire*, 11.5% of students in 2003-04). Lower secondary education lasts three years.

3. At the end of lower secondary education, students are again oriented into the different education tracks in middle- and upper secondary school: academic general education (*enseignement secondaire*), technical vocational secondary education (*Régime technique*), technician training courses (*Régime de technicien*) and vocational training (*Régime professionnel*). Academic general education lasts four more years and prepares students for university studies. The technical branch (*régime technique*) of vocational (middle- to upper-) secondary education lasts four or five years<sup>32</sup> and leads to a Baccalaureate-level qualification (*diplôme de fin d'études secondaires techniques*) that gives access to university studies. There are three sub-branches in this track: general technical division (*division Technique générale*); commerce and administration division (*division administrative et commerciale*); and health professions division (*division Professions de santé*). The technician branch (*régime technicien*) of vocational (middle-to-upper) secondary education lasts four years and leads to a qualification (*diplôme de Technicien*) that prepares students for tertiary vocational education at a less advanced level than university (corresponding to that offered by the institutions formerly known as poly-technical institutes in the United Kingdom) in the area of specialisation. There are nine sub-branches in this track: commerce and administration; agriculture; arts; chemical; electro-technical; civil engineering; hotel services and tourism; computing; and mechanical. Finally, the branch in middle- to upper- secondary school in which students acquire vocational qualifications through dual (study-work) arrangements (*régime professionnel*) lasts three years and leads to either the vocational skills certificate (*Certificate d'Aptitude Technique et Professionnelle*, CATP) or the manual skills certificate (*Certificat de Capacité Manuelle*, CCM). Persons with a CATP or CCM can continue their vocational education to obtain an advanced trade qualification (*maîtrise*). Students experiencing educational difficulties continue for two years in modular vocational education and can extend this for another two years. This path leads to the certificate of technical and vocational initiation (*Certificat d'Initiation Technique et Professionnelle*, CITP). Persons with a CITP can subsequently prepare for a CCM or CATP, either in the context of continuing vocational education or initial education.

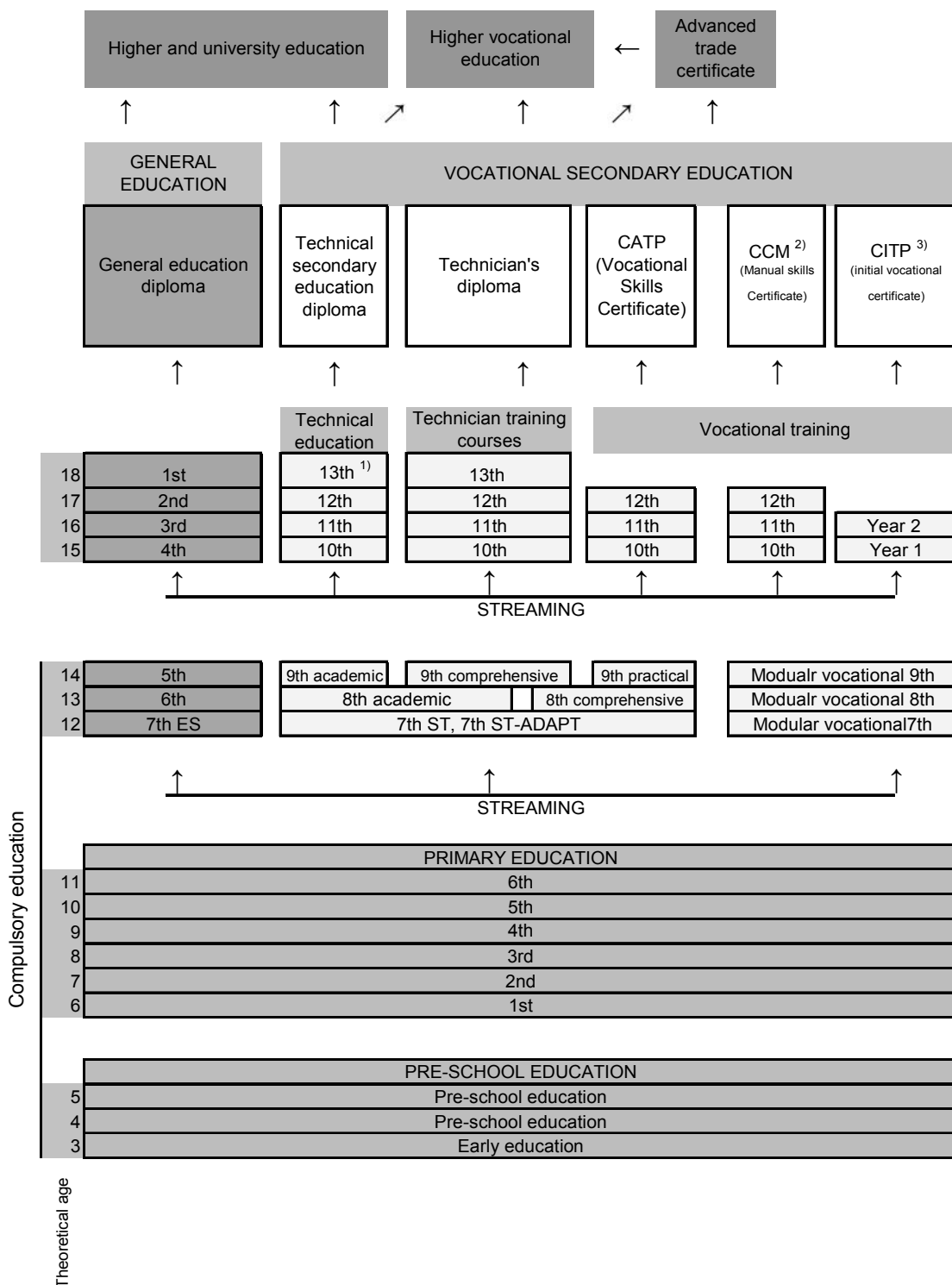
4. The minimum school-leaving age is 15 but will soon be raised to 16.

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32. The duration is five years for the health professions division.



Figure A1.1 Structure of the school system



1. 14<sup>th</sup> for the healthcare and social work stream.  
 2. After the CCM, students can move on to a CATP course in adult education.  
 3. The CITP is generally a two-year course, with an optional two-year extension. Students may then attend a CCM or CATP course in either vocational further educational or initial education.  
 \* Differentiated education (for children with special learning needs) exists at all levels.

5. At the tertiary level, Luxembourg has institutions that teach shorter, vocational courses, such as for primary-school teacher training. Since the 2004-2005 academic year, Luxembourg also has a research university. It offers mainly post-graduate programmes, although it will also offer four-year degree programmes for primary-school teachers.<sup>33</sup> The new university only has three faculties: human sciences; law, economics and finance; and science, technology and communications. These faculties have been chosen for their relevance to the Luxembourg economy. In contrast to the school system, university teachers are not civil servants - they are hired on fixed-term contracts that are subject to the same regulations as in the private sector except that the university may renew these contracts indefinitely (instead of just twice). Most students will still need to go abroad for university studies.

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33. The current three-year diploma programme is to be upgraded into a four-year degree programme.

## *Annex A2.*

### **Analysis of the 2003 PISA results for Luxembourg**

#### **Introduction**

6. This Annex describes the econometric analysis of Luxembourg data in the 2003 PISA study (OECD, 2004a, 2004b) that lies behind the results presented in Table 1. The annex begins with a description of features of the 2003 PISA database that have a bearing on the appropriate estimation methodology to use and on statistical inference. In the second section, the estimation methodology is discussed while in the third section, the results of the preferred specification are presented. As this specification is subject to a potential endogenous variable bias, an instrumental variable estimation that addresses this problem is presented in the final section.

#### **The 2003 PISA database<sup>34</sup>**

##### *Sampling design*

7. The sampling design used for the PISA assessment was a two-stage stratified sample in most countries, where stratification in the case of Luxembourg was based on whether the school was public or private or the European school. The first-stage sampling units consisted of individual schools having 15-year-old students. The second-stage sampling units in countries using the two-stage design were students within sampled schools.

8. A minimum of 150 schools (or all schools if there were fewer than 150 schools in a participating jurisdiction) had to be selected in each country. Within each participating school, a sample of the PISA eligible students was selected with equal probability. The within-school sample size (sometimes referred to as the “target cluster size”) was usually 35 students. In schools where there were fewer eligible students than the target cluster size, all students were sampled. In total, a minimum sample size of 4 500 assessed students was to be achieved. It was possible for countries to negotiate a different target cluster size, but if it was reduced then the sample size of schools was increased beyond 150, so as to ensure that at least 4 500 students in total would be assessed. The target cluster size had to be at least 20 so as to ensure adequate accuracy in estimating variance components within and between schools – an analytical objective of PISA. Hence, given the size of Luxembourg, all students were sampled.

##### *Plausible values*

9. Education tests such as PISA aim at measuring proficiencies of both individual students and the population at large. Student proficiencies (or measures) are not directly observed; they are missing data that must be inferred from the observed item responses. There are several possible alternative approaches for making this inference. PISA uses the imputation methodology, usually referred to as plausible values.

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34. For a detailed overview of the set-up and the structure of the PISA database, see OECD (2005a).

10. Plausible values are a selection of likely proficiencies for students that attained each score based on posterior distributions that have been estimated using the student's replies to the PISA questionnaire. They can be described as a representation of the range of abilities that a student might have. Instead of directly estimating a student's ability, a probability distribution of a student's ability is estimated. That is, instead of obtaining a point estimate of his or her ability, a range of possible values for a student's ability is estimated along with an associated probability for each of these values. Plausible values are random draws from this (estimated) distribution of a student's ability (Wu and Adams, 2002). The probability distribution from which a student's plausible values are drawn has been based both on the cognitive data, *i.e.*, the item response pattern, and on additional information (student gender, social background). Overall, this methodology aims at building a continuous measure of a student's proficiency level from a collection of discontinuous variables (*i.e.*, the test score). It is meant to prevent biased inferences occurring as a result of measuring an unobservable underlying ability through a test using a relatively small number of items.<sup>35</sup>

### Estimation methodology

11. Instead of estimating individual equations for scores in each of the four test fields -- mathematics, reading, science and problem solving --, information regarding student performance has been summarised across them using principal components analysis. This can be justified on the grounds that the interest of this analysis lies with the overall design of the school system and the student's success within this system independently of the field of excellence. Moreover, the first component of each plausible value captures between 92.4% and 95.2% of the total variance across test fields, *i.e.*, the student's performance across fields is highly correlated overall and a single measure captures quite well the student's success in school.

12. Each student-level equation has to be estimated for each of the five plausible values that are available in PISA.<sup>36</sup> In order to obtain the corresponding coefficient for the different variables, a simple arithmetic average can be taken from these five estimates. The standard error of the coefficient, however, is equal to the square root of the error variance, which itself is the (weighted) sum of the sampling variance and the imputation variance. The sampling variance is simply the arithmetic average of the variances of the five different coefficient estimates. The imputation variance is related to the fact that the five different coefficient estimates have to be considered as random draws from a sample (much as the plausible values are random draws from the posterior distribution around the student's test score) and is calculated as the variance of the five coefficient estimates.

13. In the process of running the regressions for the different plausible values, the estimations have to be adjusted for the sample design as observations (students) have not been drawn randomly. As all schools in Luxembourg were included in the sample, tracks (general or vocational) were first selected (instead of schools in countries large enough to sample schools) and then, within each track (selected school in larger countries), classes or students were randomly sampled. One of the differences between simple random sampling and such two-stage sampling is that for the latter, selected students in the same track (attending the same school in larger countries) cannot be considered as independent observations. This is because students within a track (school) will usually have more common characteristics with each other than with students from different tracks (educational institutions).

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35. This approach reflects the greater importance accorded to reducing errors in inferences about the target population than to minimizing the measurement error associated with each individual's estimate.

36. For a discussion of how to use the PISA database for bi- and multivariate analysis, see OECD (2005b)

## Results

### *Baseline equation*

14. Table A2.1 presents the results of the baseline equation using the variables found to be most relevant in the international comparison of educational surveys. The baseline equation only includes the relative grade of the student (in years relative to the normal grade at age 15, taking a negative value if the student has repeated one or more grades), gender (one for a girl, two for a boy) and the student's socio-economic background. For comparative reasons, the same equation is also presented for all four test fields; note, however, that the coefficients of the equations for the different test fields are not comparable to those obtained by estimating the equation on the summary performance scores owing to the principal components variable transformation. Both the coefficients of the variable indicating the relative grade of the student and the variable reflecting the socio-economic background are highly significant for all five equations. Whether the student is a boy or a girl plays a role for three of the four different sub-fields (and in opposite directions) but not for the student's test score on problem solving nor on the overall test score across all four fields (a positive coefficient indicates that being a boy leads to better test scores in the respective domain). Replacing the variable on the socio-economic background with alternatives in the PISA database such as the highest occupational status of parents or parental education level did not alter the resulting baseline equation.

**Table A2.1. Baseline equation: Principle components and four test fields<sup>1</sup>**

	Baseline	Test fields			
		Mathematics	Science	Reading	Problem solving
Grade	1.010*** (4.03)	50.033*** (4.14)	50.944*** (4.10)	45.113*** (3.69)	47.677*** (4.08)
Gender	0.149 (1.19)	24.145*** (3.99)	19.849*** (3.09)	-26.193*** (-4.07)	8.990 (1.57)
Economic, social and cultural status	0.602*** (3.76)	27.451*** (3.61)	32.086*** (3.94)	30.825*** (3.96)	25.801*** (3.46)
Number of observations	3865	3865	3865	3865	3865
R square	0.30	0.30	0.28	0.28	0.26

1. t-Statistics are in parentheses. Significance levels are indicated by asterisks: \*\*\*: 1% level, \*\*: 5% level, \*: 10% level

Source: PISA 2003, Secretariat's calculations

### *Full specification*

15. Many other variables in the PISA database representing school-level and student characteristics were also tested for significance. After discarding insignificant variables, the preferred specifications shown in Table A2.2 remained. The first adds to the baseline specification immigration status (0 for a native student, 1 for a first or second generation immigrant), quality and quantity of educational resources (such as libraries), extra-curricular mathematics activities (number of different activities to promote engagement with mathematics per school), and ability grouping (*i.e.*, grouping students into different classes according to the past performance) at the school level (taking the value zero if there is no grouping, one if there is grouping only in some classes, and two if there is grouping in all classes). The second adds to the first specification the proportion of certified teachers as an indicator of teacher quality. Immigration status and ability grouping both have negative impacts on PISA scores in both specifications, while school infrastructure has a positive effect. The proportion of certified teachers has a positive effect on scores, but the mathematical activities variable loses significance in this specification. Unfortunately, the coefficient of the certified teachers variable may be biased owing to endogeneity problems in the selection of teachers and their attribution to different schools. In the case of Luxembourg, this seems indeed to be a problem as teachers who have passed the final pedagogical exam appear on a ranking, which can be used as a

guideline by the central authorities when they attribute teachers to available posts. The severity of this problem is assessed in the next section.

**Table A2.2 Joint impact equation<sup>1</sup>**

	Baseline	Joint impact	
		1	2
Grade	1.010*** (4.03)	0.954*** (6.35)	0.937*** (6.91)
Gender	0.149 (1.19)	0.218* (2.00)	0.204* (1.73)
Economic, social and cultural status	0.602*** (3.76)	0.426*** (3.36)	0.371*** (3.11)
Immigration status		-0.288*** (-4.18)	-0.278*** (-4.12)
Certified teachers (%)			1.722*** (6.56)
School infrastructure		0.427*** (4.86)	0.392*** (4.76)
Mathematical activities		0.203** (2.60)	0.123 (1.48)
Ability grouping		-0.229*** (-3.87)	-0.200*** (-3.10)
Number of observations	3865	3759	3391
R square	0.30	0.37	0.37

1. t-Statistics are in parentheses. Significance levels are indicated by asterisks: \*\*\*: 1% level, \*\*: 5% level, \*: 10% level.

Source: PISA 2003, Secretariat's calculations

## Sensitivity analysis

### *Instrumental variable analysis*

16. In order to assess the severity of the endogeneity problem for the proportion of certified teachers variable, the preferred specification was rerun substituting an instrument for the proportion of certified teachers. The instruments used are the size of the school and its geographical location (rural vs. urban schools) as reported in the 2000 PISA study:<sup>37</sup> bigger schools in cities are likely to attract more certified teachers than smaller schools in remote villages. The results of the instrumental variable regression are reproduced in the Table A2.3 and show that the instrumented variable for the proportion of certified teachers remains (weakly) statistically significant but increases considerably in economic importance (the coefficient more than triples), with the main controls -- the student's grade, socio-economic and immigrant background and the school infrastructure -- keeping their significance level whereas mathematical activities and ability grouping are no longer significant. However, given the considerable loss in observations owing to the inclusion of instruments, this should not be taken as a reason for concern about the preferred specifications shown in Table A2.2.

37. The 2000 PISA database was used to find instruments because most of the school-level variables in the 2003 PISA database are highly correlated with students' test performance, with the exception of the size of schools.

**Table A2.3 Joint impact instrumental variable regression<sup>1</sup>**

	Grade	Gender	Economics, social and cultural status	Immigration status	School infrastructure	Mathematical activities	Ability grouping	Certified teachers (iv)
Coefficient	0.900***	0.191	0.330***	-0.298***	2.414***	-0.082	0.109	5.521*
t-Statistic	(5.41)	(1.65)	(3.10)	(-4.34)	(3.06)	(-0.49)	(0.57)	(1.91)
R <sup>2</sup>	0.30							
Number of observations	2392							

1. t-Statistics are in parentheses. Significance levels are indicated by asterisks: \*\*\*: 1% level, \*\*: 5% level, \*: 10% level.  
Source: PISA 2003, Secretariat's calculations

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