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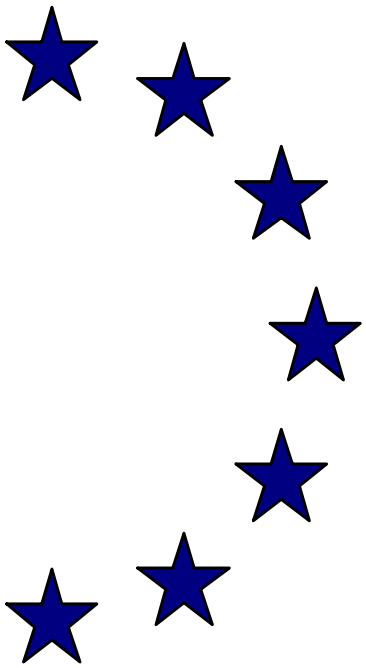

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Investment in education: the implications for economic growth and public finances

by
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Abstract

This paper analyses the demographic and institutional influences underlying public spending on education, as well as the consequences for average educational attainment and economic growth. The issues are topical given, on one hand, EU objectives for increased investment in human resources and, on the other, increasing concerns about the sustainability of public finances, particularly in view of ageing populations. The paper presents methodologies for projecting educational attainment and public expenditure on education. Tentative numerical results suggest that the growth of average educational attainment is likely to slow slightly, compared to recent decades. Nevertheless, education is set to continue making a substantial contribution to economic growth in the EU as a whole, though the impact varies widely among Member States. As regards public expenditure, although demographic trends mean a reduction in the potential number of students, this is offset by two factors: increasing enrolment rates at upper-secondary and tertiary level (projected taking into consideration either past developments in enrolment or the expected future evolution of labour force); and increasing expenditure per student (projected on the basis of recent trends). Thus, few savings – if any – are expected from reductions in expenditure on education due to changes in the demographic structure.

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1 Introduction

Education is attracting growing interest from economic policy-makers, including at EU level, perhaps for two main reasons. First, the best available economic evidence suggests that rising educational attainment is an important influence on economic growth. Secondly, education accounts for a sizeable share – around 11 per cent in the EU as a whole – of public expenditure.

This paper addresses two main issues: what impact might education have on growth in the future, and how is public spending on education likely to evolve, in particular given the changing demographic structure of the population? It presents methodologies for addressing these questions, as well as some tentative answers, and in doing so brings together two separate areas of work undertaken recently by Commission services. These are, first, the technical work underlying the projections of public expenditure on education that were undertaken in the framework of the EU Economic Policy Committee's Ageing Working Group (see: Economic Policy Committee, 2003).[1] Secondly, the EU Economy 2003 Review contained a chapter on 'Education, training and growth' in which similar projections of educational attainment were made for the EU as a whole (European Commission, 2003).

The present paper refines and presents in more detail the methodologies underlying these exercises. In the case of attainment projections, it extends the analysis to the individual Member State level. It also brings together the two pieces of analysis to address additional questions, such as what might happen to expenditure on education if enrolment continues to increase rapidly; or how much more enrolment might be possible if expenditure per student is kept under control.

The new Member States are not covered in this paper mainly because the EPC Ageing Working Group exercise – which provided some of the underlying data – was limited to the former EU-15. However, it should be straightforward, given the necessary information, to extend the exercise to 25 Member States.

The paper restricts itself to education – including pre-primary, basic, upper-secondary and tertiary education, but not including continuing vocational training or workplace training. Training merits a separate treatment in its own right, but the main reasons for excluding it here are: first, it is difficult to compare with formal education in terms of years of schooling; secondly, since employers and individuals pay a large share of the costs, the implications for public finances are relatively limited; and, thirdly, the available data allow at best a very partial coverage.

The paper is structured as follows. Section 2 briefly reviews the economic literature on education and growth before presenting projections of future educational attainment. This is done on the basis both of constant enrolment and of projected increases in upper-secondary and tertiary attainment. Section 3 discusses some methodological issues to be considered in making long term projections for public education expenditures. It presents a general model

[1] The Economic Policy Committee (EPC) is composed of senior officials from national economics and finance ministries and central banks and serves to prepare the ECOFIN Council. The EPC's Ageing Working Group was established to study the implications of ageing populations for public finances in areas such as pensions, health and education.

that could be applied in projecting public education expenditures, drawing on the experience of the Economic Policy Committee and taking on board some peculiarities of the European educational systems. It then presents an empirical application of the model through three different approaches, showing how results are sensitive to the modelling approach but that, in general few savings are foreseen in the future as a result of ageing population. Section 4 draws together the main conclusions.

2 Education and growth

2.1 Introduction

This section is mainly concerned with the projection of enrolment in education and consequent educational attainment. Attainment generally refers to the successful completion of a given level of education and is usually measured in effective *years of schooling* – the sum of the standard lengths of studies successfully completed. Thus, a person who has completed upper-secondary education in a country where the standard length of basic education is 10 years and the standard length of upper-secondary is 3 years will have 13 years of schooling, even if he or she took more or fewer than 13 years to complete upper-secondary level.

The variable 'average years of schooling' is not an ideal proxy for the stock of human capital. It takes no account, for example, of workplace training or the quality of education provided. Nevertheless, this is generally the variable used in studies of the impact of education on economic growth. In order to motivate the projections of educational attainment, we first present a very brief overview of the literature on education and growth and some benchmark estimates of the impact of an extra year of schooling on growth, before going on to present the projections methodology in detail.

2.2 Education and growth: a brief overview

There are several excellent recent surveys of the economic returns to education and its contribution to economic growth.[2] European Commission (2003) also provides a review of the main findings, with a focus on key European results. The present section therefore confines itself to providing a very brief recapitulation of the main points, drawing in particular on a study that was undertaken for the European Commission (de la Fuente and Ciccone, 2002; de la Fuente, 2003).

In the economic literature on education and growth, the stock of education or human capital is usually proxied by average years of schooling in the working-age population (or quite often the population aged 25-64, thus excluding most of those still in education). The 'macroeconomic return' to investment in education can then be expressed as the estimated impact of an extra year of schooling on GDP (or sometimes labour productivity).

Estimating the macroeconomic return to education is fraught with both conceptual and econometric difficulties, most of which we will not enter into here. One of the most fundamental is to do with how exactly education is supposed to affect growth. On one hand, education seems an obvious influence on common-or-garden productivity in the labour force, allowing employees to perform more complex functions with available technology. On the other hand, education must also be a key driver of technological progress – whether it is a question of high-productivity economies on the technological frontier, or of lower-productivity economies catching up with the frontier. Partly related to this is the question of whether it is the *level* of education at time *t* that influences future growth, or the *change* in the level of education over time that influences GDP. If we consider the change in the level of

[2] See, among others, Card (1999), Harmon et al. (2003), Krueger and Lindahl (2001), Pritchett (2004), Psacharopoulos and Patrinos (2002), Sianesi and Van Reenen (2003), Temple (2002) and Topel (1999).

education over time, there is still the question of whether this has a more or less immediate direct impact, or rather a longer-term, endogenous growth effect, or both.

These issues, and others, are far from being fully resolved. Nevertheless, Table 1 presents a relatively optimistic view that is representative of a recent strand in the literature which utilises improved data on years of schooling.[3] When the results are corrected for presumed measurement error, an extra year of schooling (in OECD countries) is associated with an increase in aggregate productivity of over 6 per cent.[4] Moreover, there might even be a further effect, attributed to longer-term technical progress, of an additional 3 per cent.

Table 1. Benchmark estimates of the social returns to education

Parameter	**Value**	**Source and interpretation**	**Implied productivity impact of an extra year's schooling in the EU**
α_H 'minimum'	0.394	Elasticity of output per worker with respect to average years of schooling. Raw coefficient from de la Fuente and Doménech (2002)	4.1%
α_H 'baseline'	0.587	Same, but adjusted for likely remaining measurement error (see footnote 8).	6.2%
γ 'rate effect'	0.2%	Impact on growth of total factor productivity (imputed from studies that find $\alpha_S >$ 0.587)	+ 3.1 % in the long term

Source: de la Fuente (2003).

Some studies have produced higher estimates of the impact of education on the rate of economic growth, suggesting that an extra year of schooling might lead to an increase in the rate of GDP *growth* of one percentage point or more. Results that suggest strong endogenous growth effects must be taken with a liberal pinch of salt. First, there is usually a strong suspicion of reverse causation or bias due to omitted variables. Secondly, such results are basically inconsistent with the data – which show a substantial increase in average attainment in recent decades, while GDP growth potential has remained constant or even declined (Jones, 2002; Pritchett, 2004). Thirdly, if schooling has such a large effect, then in a growth accounting exercise that includes human capital as a factor, this would imply very low or even negative total factor productivity growth – i.e. the unexplained part of growth that might be due, for instance, to research and development, use of ICTs or transport networks.

[3] See, for instance, de la Fuente and Doménech (2001, 2002), Cohen and Soto (2001) and Barro and Lee (2001).

[4] These results are based on several recent studies, including Bassanini and Scarpetta (2001) and Jones (1996), as well as those mentioned in the previous note. De la Fuente adopts the pragmatic approach of setting a plausible maximum for the direct effect, and inferring the longer-term rate effect from studies that find a larger direct effect. Measurement error is addressed by estimating the same relationship for several datasets of differing quality, then determining a relationship between estimated coefficients and the signal-to-noise ratio of the dataset used, and finally extrapolating to the hypothetical case of zero measurement error.

Other observers continue to emphasise the methodological problems underlying the cross-country evidence on the determinants of growth. Pritchett (2004) shows that, depending on the functional form assumed, a variety of plausible empirical estimates of macroeconomic returns to schooling is possible. Returns can be made to roughly match the private returns to schooling – i.e. the impact of an extra year of schooling on an individual's wages. Or they can be much smaller. Pritchett argues that there is no compelling evidence that macroeconomic returns exceed the private returns, however.

De la Fuente's results, presented in Table 1, are not dissimilar to many estimates of the private returns to education. For example, Harmon *et al.*'s (2001) results suggest that, in the EU as a whole, an extra year of schooling raises an individual's wages by around 8 per cent (though this varies considerably among Member States). Thus, unless one believes that education serves largely to signal ability, as opposed to something that actually enhances productivity, then a macroeconomic rate of return of around 6 per cent does not appear unreasonable. It can be characterised as a plausible benchmark, albeit still on the optimistic side for some.

De la Fuente (2003) gives estimated returns for individual EU countries. Here, it is useful to note the implications of the assumed functional form: the impact of an extra year of schooling on productivity depends inversely on current average years of schooling. Given an empirical estimate of the elasticity of output with respect to schooling capital which is common for all countries, the implied macroeconomic return to an extra year of schooling is relatively low in countries where average years of schooling are relatively high.

The next section considers future increases in educational attainment. Before attempting any inference about the possible impact of this on growth, several caveats must be considered. In particular:

- **Future returns?** Estimates of the macroeconomic returns to an extra year of schooling apply to the past. There is no guarantee that similar returns will apply in future. In particular, returns may have been exceptionally high in the last few decades owing to rapid technical progress.

- **Quality**. Average years of schooling tell us nothing about the quality of education provided. Yet quality – at least as proxied by scores in standardised achievement tests in maths, literacy and science – varies considerably between countries, and the available evidence suggests that quality may be at least as important an influence on growth as quantity (Hanushek and Kimko, 2000).

- **Heterogeneity**. An extra year of schooling on average might yield a macroeconomic return of around 6 per cent, but this may vary both between types of education and individuals. Some studies (e.g. Temple, 2001) suggest that returns decline with the level of schooling. Another question is whether extending tertiary enrolment to academically less able students will yield higher or lower returns.

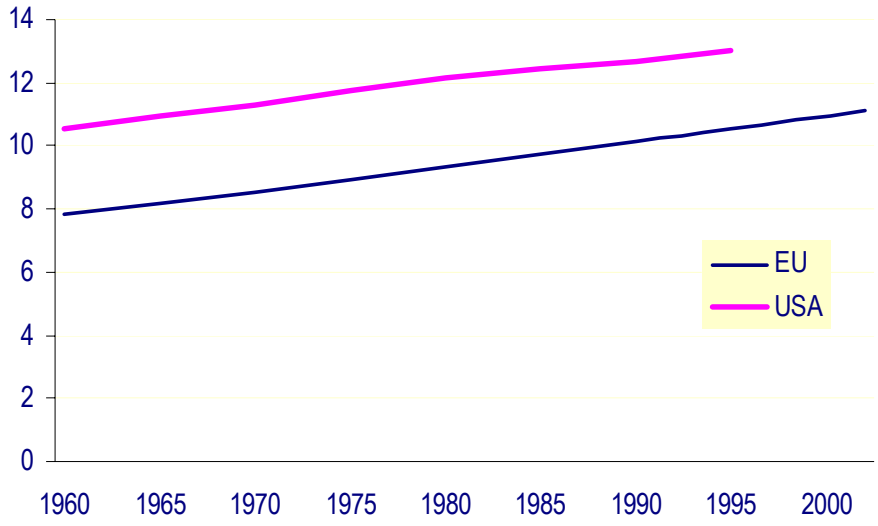
In sum, it is plausible to think that increasing educational attainment – measured by average years of schooling in the 25 to 64 population – has had a substantial impact on economic growth in recent decades. It may continue to have such an impact, though this cannot be taken wholly for granted.

2.3 Current enrolment patterns

With some idea of the possible impact of an extra year of education on growth, we now turn to the more technical question of how much average attainment might grow over the next 10 years and over the next 50 years.

Figure 1 shows average years of schooling in the population aged 25-64 over the past four decades. This is the variable used in the growth regressions described in Section 2.1. Over the past 30-40 years, average years of schooling have tended to grow linearly at the rate of about 0.8 per decade in the EU as a whole (compared to 0.7 in the USA, where a slight slowdown is apparent since about 1980).

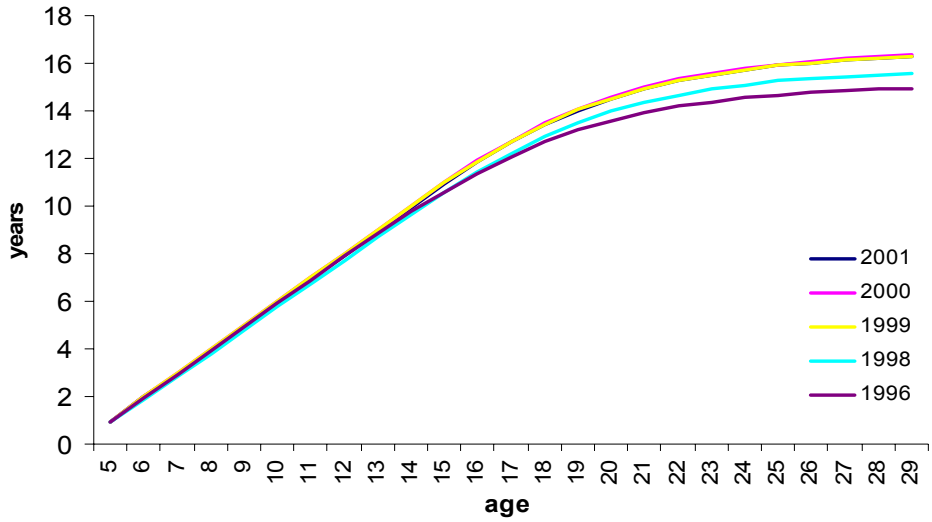
Figure 1. Average years of schooling in the EU and US, 1960-2002



Source: de la Fuente and Doménech (2001); Commission services for EU 2002.

Figure 2 illustrates the pattern of enrolment in the EU by graphing age against cumulative enrolment. Initially, the graph is a line with almost 45° slope, reflecting the fact that between the ages of 5-15, enrolment is virtually universal. Thus, by the age of 15, cumulative enrolment is almost 11 years. From the age of 16 onwards, the slope begins to fall off. After 29 (not shown), the curve almost flattens out. Average enrolment rises only another 0.7 years between the ages of 30 and 65, to reach an estimated total expected enrolment (or school life expectancy) of 17.1 years.

Figure 2. Cumulative enrolment, 5-29 year-olds, EU-15



Source: Eurostat.

Even in upper-secondary and tertiary education, there may be limits to increased participation. The EU Education Council recently set a benchmark stating that, by 2010, 85 per cent of 22-year-olds should have completed upper-secondary education. In some countries, education is already compulsory up to the age of 18. In tertiary education, the position of the United States suggests some scope for further increases in participation in most EU countries. Beyond this, it is unclear whether tertiary participation will become saturated, or whether it can continue to grow. Table 2 provides indicators of participation at upper-secondary and tertiary level, which are consistent with the benchmarks for increased enrolment derived below.

Table 2. Indicators of participation in upper-secondary and tertiary education

	Upper-secondary (2002) % 18-24 year-olds qualified or in further training	***Tertiary (2001)*** Enrolment as % of 20-29 population
EU-15	81.5	25.4
Belgium	87.6	27.4
Denmark	91.6	27.2
Germany	87.4	21.8
Greece	83.9	30.1
Spain	71.0	28.0
France	86.6	26.0
Ireland	85.3	26.0
Italy	75.7	22.5
Lux.	83.0	4.4
Netherlands	85.0	24.4
Austria	90.5	26.2
Portugal	54.5	24.2
Finland	90.1	44.0
Sweden	89.6	32.5
UK	82.3	26.7
USA	n.a.	36.6

Note: tertiary participation is low in Luxembourg because most students study abroad.
Source: Eurostat, OECD.

2.4 Projections of educational attainment

2.4.1 Constant enrolment

In order to establish a baseline we begin by looking at what would happen to average years of schooling in the 25-64 population if enrolment remained fixed at 2002 levels. Clearly, average attainment would continue to increase in most countries since the attainment of younger cohorts is higher than that of older cohorts.

The calculation is less straightforward than it might seem at first, since it is difficult to establish a clear link between the data on enrolment and those on attainment. Although the flow of enrolment is closely related to the stock of attainment, there are important differences. First, there is a time lag between enrolment and attainment when the latter is measured by the highest qualification achieved (as reported by individuals in a census or other survey). Secondly, owing to drop-outs, repeat years and part-time studies, the average year of enrolment results in less than a year of effective attainment. Attainment is only registered when the qualification in question has actually been awarded so that, for example, a 22 year-old who is about to graduate from university would still only be recorded as having upper-secondary level education. Moreover, if an individual spends three years at university but fails to graduate, these three years are recorded as enrolment but do not count as attainment. All of this means that lifetime attainment is considerably lower than school life expectancy. Thirdly, even given some information on part-time studies and drop-outs, the enrolment data (from administrative sources) and the survey-based LFS data on attainment do not appear to be entirely consistent.

Since the LFS data is available on a comparable basis for all countries, we opt for a relatively simple methodology to make rough projections of increased attainment on the basis of this. This approach is described in more detail in Box 1. In essence, it involves estimating years of schooling by age group, and then predicting future attainment using a cohort approach. To predict attainment in ten years' time, for instance, the 55-64 age group is 'retired' and all the other groups are shifted up by ten years. On top of that, allowance is made for the increase in attainment that will result from current enrolment (especially in the 15-24 and 25-34 year-old groups).

Box 1. Methodology for constant enrolment projections

We first estimate average years of schooling by age group, using data from the Labour Force Survey. Data on the number of people by highest level of education attained are combined with de la Fuente and Doménech's (2001) figures on the number of years corresponding to each level of education. We use the broad classification of educational attainment – low, medium and high, corresponding to ISCED 1997 levels 0-2, 3-4 and 5-6 respectively – in order to obtain estimates for most EU countries going back 10 years. (LFS data on attainment by the finer ISCED 1997 classification are available for a few recent years only. European Commission (2003) finds that the estimate of average years of schooling for 2002, at least for the EU as a whole, is similar using either the broader or finer classification.) In a few cases where the data do not extend back to 1992, linear extrapolation is used.

The data for the UK are corrected for a break in the series around 1997, which appears to be due to the UK's decision to count success in the GCSE exams (General Certificate of Secondary Education, which pupils usually sit at age 16 shortly after the end of compulsory

schooling) as upper-secondary attainment. The data reported respect that choice, but adjust the earlier part of the series accordingly. This means that the increase in attainment over the decade 1992-2002 in the UK is considerably less than it first appears from the raw data. This has a significant impact, reducing the apparent 1992-2002 increase in years of schooling in the UK by 1.2 years and in the EU as a whole by 0.17.

Based on these data, we make rough projections of average years of schooling in 2012 as follows. For a **lower bound**, we assume that 15-24 year-olds in 2002 will reach the same level of attainment as 25-34 year-olds in 2002, and that the older groups will remain at 2002 levels of attainment. Thus, 45-54 year-olds in 2012, for example, would have the same level of attainment as 35-44 year-olds in 2002. For an **upper bound** we suppose that attainment will rise in each age group in the same proportion as it did between 1992 and 2002. Thus, for example, attainment of 35-44 year-olds in 2012 is estimated by: attainment of 35-44 year-olds in 2002 × (attainment of 45-54 year-olds in 2002 / attainment of 35-44 year-olds in 1992).[5] The rough projections reported below are the mid-points between the lower- and upper-bound estimates, and using Eurostat's population projections for 2010. The difference between the mid-point and the lower bound is thus, in effect, taken to reflect the impact of current enrolment on attainment.

The long-run estimates (for 2052 and beyond) take the 2012 result for 25-34 year-olds and add to this the increase in attainment due to current enrolment for older groups. Thus the long-run attainment profile under constant enrolment is slightly increasing with age. In the text, it is assumed that the increases in enrolment from 2002 to 2012 and 2052 are the same as the increases from 2000 to 2010 and 2050. (These could not be estimated directly using the above methodology since the LFS data goes back only to 1992.)

Table 3. Years of schooling by age group, 2002

	15-24	*25-34*	*35-44*	*45-54*	*55-64*	*25-64*
Belgium	10.2	12.2	11.5	10.8	10.0	11.2
Denmark	9.3	13.0	12.6	12.6	12.1	12.6
Germany	9.4	12.7	12.9	12.7	12.2	12.7
Greece	10.1	11.8	11.1	10.1	9.2	10.6
Spain	9.7	11.0	9.9	8.8	7.8	9.6
France	10.0	12.0	11.1	10.5	9.8	10.9
Ireland	10.4	12.1	11.2	10.4	9.6	11.0
Italy	9.3	10.8	10.1	9.4	8.3	9.7
Netherlands	10.0	12.4	12.1	11.6	11.0	11.8
Austria	9.9	12.5	12.4	11.8	11.1	12.0
Portugal	8.5	9.2	8.3	7.9	7.5	8.3
Finland	9.8	12.8	12.6	11.8	10.7	12.0
Sweden	10.2	12.5	12.2	11.8	11.2	12.0
UK	11.7	12.5	12.3	11.8	11.2	12.1
EU-15	9.9	11.9	11.5	10.9	10.2	11.2

Source: Commission services.

[5] It turns out that, for a few combinations of countries and age-groups (especially the 15-24 age group), estimated attainment in 2002 is actually slightly lower than estimated attainment in 1992, which means that the 'upper bound' is below the 'lower bound'. This is puzzling given the available evidence on enrolment, which suggests that participation especially in tertiary education rose during the 1990s. Moreover, educational reforms in recent years have, if anything, aimed to reduce course durations and drop-out rates. In these cases, we constrain the upper bound estimate to the lower bound one.

Table 3 shows estimated years of schooling by age group. Average attainment is highest in the 25-34 age group and, as would be expected, declines thereafter with age. Country differences are striking: attainment ranges from just over 8 years in Portugal to almost 13 years in Germany. Here, a word of caution is in order, since education systems in different countries are not fully comparable. The figures cannot take into account the fact that attainment is higher in some countries in part because courses last longer, while it is debatable whether the quality of outcomes increases in proportion with the length of studies. The age profile of attainment ranges from a steep incline in the case of Spain – where attainment of 25-34 year-olds is over three years higher than that of 55-64 year-olds – to almost a plateau in Germany.

Table 4 presents projected years of schooling under constant enrolment. It should be clear that these are rough projections rather than precise forecasts, intended to illustrate developments at the EU level and the nature of cross-country differences. It is possible that a detailed examination of national sources on enrolment and attainment would yield slightly different results for some individual countries.

Table 4. Projected years of schooling in the 25-64 population with constant enrolment

	2002	2012	2052
Belgium	11.2	11.7	12.3
Denmark	12.6	12.8	13.0
Germany	12.7	12.8	12.7
Greece	10.6	11.3	12.1
Spain	9.6	10.6	11.9
France	10.9	11.4	12.1
Ireland	11.0	11.8	12.8
Italy	9.7	10.4	11.1
Netherlands	11.8	12.1	12.4
Austria	12.0	12.6	13.1
Portugal	8.3	8.8	9.4
Finland	12.0	12.8	13.7
Sweden	12.0	12.3	12.8
UK	12.1	12.4	12.9
EU-15	11.2	11.7	12.2

Source: Commission services.

Under constant enrolment rates, the current age profile of attainment largely determines any future increase in attainment. The potential for this varies a great deal between countries where older workers are already relatively well-educated and those where the replacement of older workers by better-educated younger cohorts will substantially increase average attainment.

2.4.2 Benchmarks for increased enrolment

In practice, of course, enrolment may well continue to increase. This section focuses on upper-secondary and tertiary education, since this is where most of the scope for increased enrolment lies. We do not include pre-school education or most of adult education and training here, for the following reasons. First, these types of education are mostly not included in the average years of schooling variable used in the econometric studies discussed in section 2.2. Secondly, it is not clear whether, conceptually, they should be included. While some studies suggest that early child care and education has a positive impact on

cognitive abilities, it could arguably be seen as something that influences the quality of formal education, rather than something to classify as part of formal education. As discussed earlier, adult education and training merits a separate discussion in its own right. Adult education that leads to a formal educational qualification (in the ISCED[6] classification), however, is included in the data on years of schooling and, implicitly, in the benchmarks discussed below.

Thirdly, even if these areas were included, the impact on average years of schooling would be relatively small compared to increased upper-secondary and tertiary enrolment (see European Commission, 2003, Table 7). In the case of preschool education, it takes more than 20 years for this to have any impact on average schooling in the 25-64 workforce. The impact of hitting the EU Education Council benchmark for increased adult education and training (12.5% of 25-64 year-olds participating at any given time by 2010) would be larger, though progress towards this target has been slow thus far. Fourthly, as regards adult education and training, the available information on costs is very limited. Nevertheless, it is clear that the extent of private financing (enterprises and individuals) is much greater than for other types of education, which means that adult education and training is of less relevance for the public expenditure projections in section 3.

Projecting enrolment in **tertiary education** is inevitably a tentative exercise. One might imagine that it will follow a similar path to that of enrolment in primary and secondary education, approaching universality in the long run. On the other hand, some commentators have raised concerns about 'over-education', some even predicting that tertiary enrolment may fall towards what they consider more reasonable levels.[7] This would suggest saturation of tertiary enrolment well below universality.

Another issue is how to specify the enrolment rate and in particular its denominator. One possibility would be to use the 'official' age ranges reported by Member States in the context of the Ageing Working Group. Enrolment rates thus expressed would then be closely related to the (eventual) share of graduates in the cohort in question. However, the problem here is that the share of the actual distribution of enrolment covered by the official age brackets varies widely from country to country (according to Eurostat data on enrolment). Another possibility is to select a reasonably wide age bracket and to specify (gross) enrolment as a share of population in this bracket. Thus, for example, tertiary enrolment may be expressed as a share of the population aged 20-29 in all countries. It should then be clear that, if two countries have the same tertiary enrolment rate but degree courses are longer in country A than in country B, then the share of people who participate in tertiary education at some point in time is lower in country A than in country B.

We adopt the latter approach and the following procedure. Over long periods of time, enrolment rates may be observed to follow an S-shaped adoption curve similar to that which characterises the diffusion of many goods and services. We estimate such a curve for US data (since this is the country with the highest tertiary enrolment rate for which a sufficiently long series is available), imposing a maximum enrolment rate of 50% (compared to an actual rate

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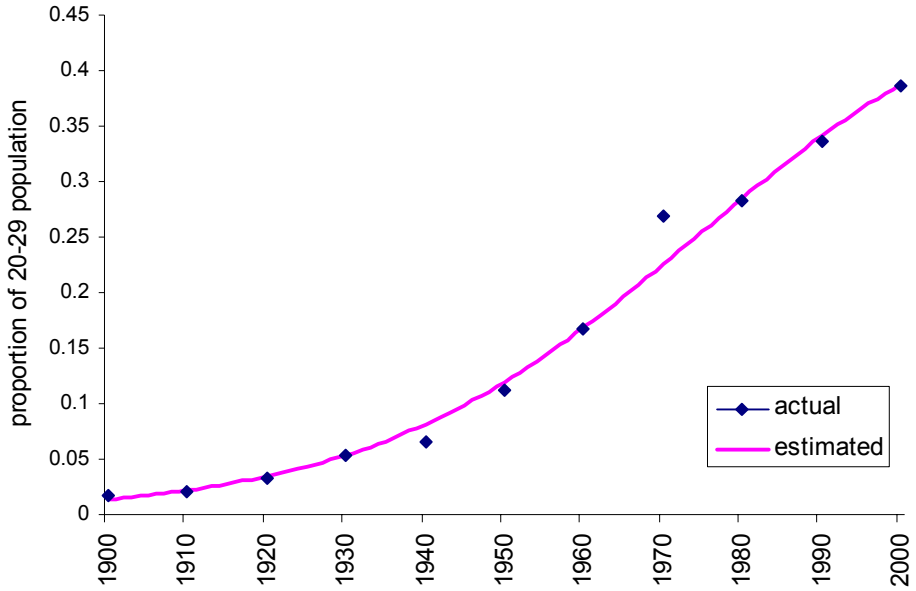
[6] International Standard Classification of Education, developed by the UN. See section 3.2.3 for details on the different levels of education.

[7] See, for instance, Paul Krugman, 'Getting Ahead; White Collars Turn Blue', *New York Times*, 29 September 1996.

of 38.6% in 2000). A 50% rate would imply that, if only 20-29 year-olds attended university and degrees lasted for 5 years, then in the long run 100% of the population aged 30 and above would graduate (assuming no drop-outs, repeat years or part-time studies). In practice, since some under-20s and over-29s are enrolled, and many people study for longer than 5 years, the long-run share of graduates will be well below 100%. The estimated relationship between enrolment rate and time (shown in Figure 3) is then used to project tertiary enrolment in the EU, given data on enrolment rates in 2001.

Figure 3. US enrolment in degree-granting institutions, 1900-2000



Source: US Department of Education, Census Bureau and Commission services.

Notes: A logistic specification was used to capture the S-shape: $y = \frac{y_{\max}}{1 + e^{at+b}}$, where y is the enrolment rate, $y_{\max}$ is the maximum enrolment rate (in this case 0.5, or 50% of the 20-29 year-old population), t is time in years (0 = 1900) and a and b are parameters. This was estimated by OLS with dependent variable $\hat{y} = \ln\left(\frac{y_{\max}}{y} - 1\right)$. The estimated curve was then used to project future enrolment rates given today's enrolment rate. The estimated parameters are a = -0.048 and b = 3.557.

This implies that tertiary enrolment for the EU as a whole would rise from 25.4% of the 20-29 population in 2000 to 30.7% in 2010. It could be argued that, given widespread recognition of the importance of tertiary education for the knowledge-based economy, and the presence of national-level targets for more substantial increases in enrolment in a number of Member States, a more ambitious benchmark for 2010 would be appropriate. If such targets are considered plausible, then the estimates of increased attainment and expenditure should be regarded as conservative.

In **upper-secondary education**, the natural assumption is 100% attainment in the long term. Upper-secondary education is already compulsory and near-universal in some EU Member States. For simplicity, we assume a similar curve to that used for tertiary education, with the implication that enrolment rates follow a concave path (increasing at a decreasing rate)

towards the long-run maximum. The age range 18-24 is used for comparison with the Lisbon target to halve the number of 18-24 year-olds with below upper-secondary level education who are not in further education or training by 2010. In 2000, around 19.4 per cent of 18-24 year-olds were in this position.[8] A liberal interpretation would be for an additional 9.7% of 18-24 year-olds to reach upper-secondary attainment by 2010 (in practice, it could be less than 9.7%, since the target refers to enrolment and not all of those enrolled will necessarily graduate). In that case, the EU-15 enrolment rate would reach 90.3% in 2010, which is significantly above the 87.8% shown in the table below. Thus, again, the present scenario may be regarded as slightly on the conservative side compared to publicly announced targets.

Given an increased rate of attainment for 18-24 year-olds in each country, the increase in enrolment (for the purpose of expenditure projections) is determined as follows. The length of upper-secondary schooling in years is taken from de la Fuente and Doménech (2001). In the case of the EU-15 as a whole, excluding Luxembourg, this is 3.46 years. For each additional person aged 18-24 who achieves upper-secondary attainment, there are then 3.46 extra years of attainment. Since the range 18-24 spans seven years, and assuming that the increase in attainment is distributed evenly across the 18-24 population, enrolment increases by an equivalent of 3.46/7 multiplied by the increase in the attainment rate. (The additional enrolment need not actually take place between the ages of 18 and 24, of course; indeed, much is likely to occur between 15 and 18.)

The table below summarises the benchmarks for increased enrolment in both upper-secondary and tertiary education. These figures are not to be regarded as forecasts, but rather as 'plausible benchmarks', with a view to judging what might happen to economic growth and public spending on education *if* enrolment continued to increase. What actually happens in individual Member States will depend on precise policy measures. For example, a country might see a sharper increase in upper-secondary enrolment if it decided to make upper-secondary education compulsory; or tertiary enrolment might rise by much less if spending on higher education were capped.

[8] By 2003, this had fallen to an estimated 18.0 per cent. See Eurostat Structural Indicators (available at http://europa.eu.int/comm/eurostat/).

Table 5. Benchmarks for increased enrolment, 2010 and 2050

	Tertiary level				Upper-secondary level			
	enrolment as a % of the population aged 20-29				*% of 18-24 year-olds with upper-secondary level or in further studies*			
	2000	2010	2030	2050	2000	2010	2030	2050
Belgium	27.1	32.8	41.6	46.4	87.5	91.9	96.7	98.7
Denmark	26.6	32.4	41.4	46.3	88.4	92.5	97.0	98.8
Germany	21.5	27.4	38.0	44.6	85.1	90.2	96.0	98.4
Greece	26.6	32.4	41.4	46.3	82.9	88.7	95.3	98.2
Spain	27.7	33.4	42.0	46.6	71.2	80.0	91.2	96.5
France	25.7	31.5	40.8	46.0	86.7	91.3	96.5	98.6
Ireland	24.9	30.8	40.3	45.8	83.6	89.2	95.6	98.3
Italy	22.2	28.2	38.6	44.9	74.7	82.7	92.6	97.0
Lux.	4.2	6.5	14.0	25.2	83.2	88.9	95.4	98.2
Netherlands	23.4	29.4	39.4	45.3	84.5	89.8	95.8	98.4
Austria	25.3	31.1	40.6	45.9	89.8	93.4	97.4	99.0
Portugal	23.2	29.1	39.2	45.2	57.1	68.3	84.9	93.6
Finland	42.7	45.2	48.0	49.2	91.1	94.3	97.7	99.1
Sweden	31.3	36.5	43.8	47.4	92.3	95.1	98.1	99.2
UK	26.2	32.0	41.1	46.2	81.7	87.8	95.0	98.0
EU-15	24.9	30.7	40.2	45.7	80.6	87.8	94.8	97.9

Notes: tertiary enrolment projections based on convergence to a long-run maximum of 50% along a curve estimated on US data; upper-secondary projections based on convergence to 100% along a similar logistic curve.
Source: Commission services.

2.4.3 Enrolment as a complement to the labour force participation

A possible alternative approach to quantify the evolution of enrolment rates may be based on the interactions between the education system and labour market at the later stages of the education path. The evolution of the enrolment rate over time is contingent on several factors. Legislation in force defines the age at which education is compulsory, the ownership regime of the educational entities and ways to finance them. Availability of financial resources allows people to enrol in non-compulsory education or additional courses, as well as to pay for longer or more specialised studies. Developments in the labour market may constitute both incentives (in case of large unemployment longer education is seen as a way to avoid the pain of searching for the job) and disincentives (necessity to maintain family pushes young people out of the education path) to continue education. Finally, the changing cultural background, attitudes towards education, personal ambitions and prevailing life style may alter the interest and demand for educational services.

Given the importance of interactions between the labour market and education systems as well as difficulties to quantify most of the mentioned factors, only labour market developments are taken into account in another alternative approach to modelling enrolment rates. The basic idea behind it is to look at education as an alternative to professional work and at enrolment in the education as a complement to the participation rate in the labour force. Even though, enrolment rates projections should take into consideration institutional differences among education levels. In fact, education is compulsory up to a certain age, while for following ages and education levels people basically may decide to stay in the education system, to take up a paid job, to combine those two activities, or to be inactive. Thus, the

methodology to project enrolment rates differs between age groups. For pre-primary and basic level of education, where students are not included in the labour force and the education is compulsory, a no-policy change scenario projection implies that future enrolment rates remain constant at the level of the base year.

In the case of non-compulsory education, the projection of enrolment rates has to be linked to labour market developments because education is alternative to working activity. However, since there are a certain number of professionally active students, one cannot calculate the enrolment rate as a mere complement to the participation rate, so that:

$$e \neq 1 - p \qquad [1]$$

where e is the enrolment rate and p is the participation rate. In addition, this approach does not consider those who are neither in education nor in the labour force. The total enrolment rate may be therefore decomposed into the enrolment rate relative to 'full time' students (e_{FT}) and the enrolment rate relative to 'part time' students (e_{PT}):

$$e = e_{FT} + e_{PT} \qquad [2]$$

Enrolment rate relative to 'full time' students is a complement to participation rate:

$$e_{FT} = 1 - p \qquad [3]$$

while enrolment rate relative to 'part time' students can be considered as a constant share c of total enrolment rate:

$$e_{PT} = c * e \qquad [4]$$

Substituting both (5) and (6) into (4), total enrolment rate may be expressed as:

$$e = (1 - p) + c * e \qquad [5]$$

After some modifications, the final equation for calculating enrolment rate for age group x in year t is the following:

$$e = (1 - p) / (1 - c) \qquad [6]$$

Thus, c is given by:

$$c = 1 - (1 - p) / e \qquad [7]$$

To smooth short-term changes, the average past value of participation and enrolment rates are used for p and e in equation 8. This allows us to obtain a "structural" share of part-time students and to keep this constant in a no policy change scenario. The factor c allows us to account for cases where the sum of participation and enrolment rates is less than one owing to the presence of those that are neither in the labour force nor in education.

Table 6. Participation rates in the age groups relative to tertiary and upper secondary education (in %), 2000-2050

	Tertiary level			Upper-secondary level		
	2000	**2050**	***Change 2000-2050***	**2000**	**2050**	***Change 2000-2050***
BE	61.0	63.3	*2.4*	10.7	10.5	*-0.1*
DK	72.4	76.5	*4.1*	57.9	59.7	*1.9*
DE	72.7	67.0	*-5.7*	34.1	27.0	*-7.1*
EL	70.8	70.8	*0.0**	13.8	13.8	*0.0**
ES	55.0	54.4	*-0.6*	6.0	6.5	*0.5*
FR	64.0	64.0	*0.0**	10.0	10.0	*0.0**
IE	61.4	57.5	*-3.9*	34.4	34.4	*0.0*
IT	54.6	52.3	*-2.3*	14.0	13.4	*-0.6*
NL	70.8	70.8	*0.0**	13.3	13.3	*0.0**
AT	69.4	64.7	*-4.7*	36.5	37.2	*0.8*
PT	50.3	51.7	*1.4*	9.6	10.7	*1.1*
FI	63.3	63.0	*-0.3*	33.0	33.0	*0.0*
SE	49.3	49.9	*0.6*	25.1	25.1	*0.0*
UK	69.9	66.2	*-3.6*	15.0	12.4	*-2.6*

* National projections assuming constant participation rate
Source: Own calculations on Eurostat and EPC working group on Ageing Population data.

Table 7. Enrolment rates in tertiary and upper secondary education (in %), 2000-2050

	Tertiary level			Upper-secondary level		
	2000	**2050**	***Change 2000-2050***	**2000**	**2050**	***Change 2000-2050***
BE	46.5	43.7	*-2.8*	107.7	107.8	*0.2*
DK	62.6	53.2	*-9.3*	140.9	134.6	*-6.2*
DE	39.4	47.6	*8.2*	100.2	111.1	*10.9*
EL	28.7	28.7	*0.0**	77.3	77.3	*0.0**
ES	40.7	41.2	*0.5*	121.6	121.0	*-0.6*
FR	44.4	44.4	*0.0**	90.0	90.0	*0.0**
IE	35.0	38.5	*3.5*	56.7	56.7	*0.0*
IT	41.3	44.3	*3.0*	89.0	90.7	*1.7*
NL	59.0	59.0	*0.0**	83.5	83.5	*0.0**
AT	46.5	53.7	*7.1*	105.5	104.2	*-1.3*
PT	47.0	45.7	*-1.3*	124.2	122.7	*-1.5*
FI	56.7	57.2	*0.5*	80.8	80.8	*0.0*
SE	64.5	69.1	*4.5*	102.8	102.8	*0.0*
UK	46.4	52.0	*5.6*	80.3	82.8	*2.5*

* National projections assuming constant participation rate
Source: Own calculations on Eurostat and EPC working group on Ageing Population data.

Tables 6 and 7 present the projected developments in the participation and enrolment rate for some countries, for which available data was sufficient to run projections.[9] The projections for the period 2000-2050 are not unequivocal. For the upper-secondary education age cohort,

[9] In several countries gross enrolment rate exceeds 100%. This is due to the fact that the numerator (number of students enrolled in a given level of education, regardless of age) may exceed the denominator (population in the age group relevant for that level of education) where there is a significant number of students enrolled who are older or younger than the official age range for that level.

participation rates tend to remain constant or slightly decrease (with one outlier, Germany, where the participation rate is expected to decrease by 7.1%), but enrolment rates present very divergent trends (from a 6.2% decrease in Denmark to 10.9% increase in Germany). The situation is clearer in case of the tertiary education age cohort. In most countries the participation rate will decrease (the most in Germany, by 5.7%, and in Austria, by 4.7%) and consequently the enrolment rate in tertiary education will increase significantly (by 8.6% in Germany and 7.1% in Austria). The exceptions are Denmark (4.1% increase in participation rate and 9.3% decrease in enrolment rate), Belgium (+2.4% and -2.8% respectively) and Portugal (+1.4% and -1.3% respectively).

2.4.4 The impact of increased enrolment on average attainment

In order to determine the potential impact of increased enrolment on growth – at least according to the models presented in section 2.2 – the benchmarks must be expressed in terms of increased years of schooling. This is straightforward in the case of upper-secondary education, since the chosen benchmark is already in terms of attainment. In the case of tertiary education, allowance must be made for high drop-out rates and study durations beyond (or below) the standard length, which mean that years of enrolment are significantly higher than years of attainment in some cases. This is done by inferring a "drop-out rate" in terms of years of enrolment from the available data on enrolment and the number of graduates (see Box 2). Increased attainment in tertiary education is then estimated by multiplying the increase in enrolment by the above 'drop-out rates' for each country.

In the case of upper-secondary education, the benchmarks for increased enrolment are already expressed in terms of attainment, which makes things relatively straightforward. Since, as noted in the main text, we have assumed that one year of enrolment results in one year of attainment, we avoid the potential complication of drop-outs.[10]

Box 2. "Drop-out rates" in tertiary education

The available data suggest that drop-out rates in tertiary education vary considerably among countries and in some cases are very high. Figures reported in the OECD's *Education at a Glance* publication, for instance, suggest that in a couple of countries more than half of those who begin a tertiary programme fail to graduate.[11]

If enrolment were constant over time and all students remained enrolled for the same number of years, the relationship between the number of graduates and the number enrolled in a given year could be expressed as:

$$G_t = \frac{1}{l} E_t (1 - d),$$

[10] In practice, drop-outs at upper-secondary level are likely to be significant and to vary considerably among countries, so this may be an important issue. This is not incorporated into the present analysis owing to the lack of consistent data.

[11] See, for instance, *Education at a Glance*, 2003, p. 52.

where G_t is the number of graduates in year t, l is the length of the course, E_t is the number of students enrolled in year t and d is the "drop-out rate" in years (i.e. the share of years of enrolment that do not result in a year of attainment, which is the variable of interest for present purposes.) If enrolment is growing, then a relatively large share of students is in the earlier years of study. In this case, l in the above formula may be replaced by:

$$\sum_{i=1}^{l-1}(1+g)^i ,$$

where g is the (constant) rate of growth of enrolment.

Applying this formula to the 2001 Eurostat figures on enrolment and graduates in tertiary education as a whole, and taking de la Fuente and Doménech's figures on duration of full-length tertiary courses for l, we obtain the following results for d. (Figures from the previous three years are used to estimate g.)

Table 6. Tertiary duration and 'drop-outs'

	d	*years*
Belgium	20%	4
Denmark	17%	4
Germany	42%	4
Greece	14%*	4
Spain	10%	5
France	-7%	4
Ireland	-10%	4
Italy	33%	5
Netherlands	-2%	5
Austria	57%	4
Portugal	35%	4
Finland	30%	5
Sweden	50%	4
UK	-21%	4
EU average	14%	4.4

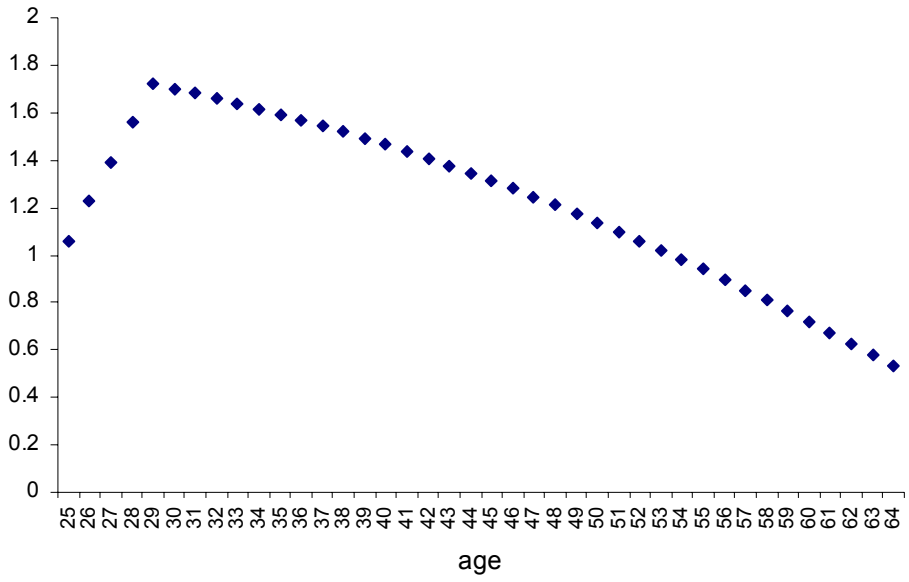
Notes: * data n.a., assumed same as EU average;
EU average is weighted by enrolment.
Source: Commission services.

It must be stressed that d here is not the same as the OECD indicator, which compares the number of graduates to the number of entrants in the typical year of entry. A high level of d may result not only from drop-outs in this sense, but also from studies lasting longer than the standard number of years. For example, if a student takes 6 years to complete a degree, but the standard length – for the purpose of estimating years of schooling – is 4 years, then this represents a 'drop-out' of 2 years out of 6, or 33%. The negative estimates of d in some countries may be partly explained by average degree courses being *shorter* than the standard lengths (taken from de la Fuente and Doménech) used to estimate years of schooling. It should also be noted that, although these figures are from the same statistical source, there may still be inconsistencies between numbers enrolled and numbers graduating, as well as cross-country differences in data collection and so forth.

The estimated increases in attainment in each age group must then be translated into increases in average attainment in the 25-64 labour force. For this purpose, we assume that attainment or enrolment rates rise gradually along the path assumed in the S-shaped projections. The

implications of this for tertiary education are illustrated in the following figure 4. By 2050, the enrolment rate of 20-29 year-olds has increased by over 20 percentage points compared to 2000. 29-30 year-olds have the highest cumulative increase in enrolment as they are the youngest age group to have completed tertiary enrolment (25-29 year-olds are still enrolled). From 30 onwards, the increase in cumulative enrolment declines because when the people in question were enrolled (i.e. when they were aged 20-29), the enrolment rate had not increased by as much.

Figure 4. Projected increase in years of tertiary education by age (EU-15, 2050)



Source: Commission services.

We now turn to the main results, presented in the following table.[12]

[12] The results for the EU as a whole differ slightly from those presented in the 2003 EU Economy Review (European Commission, 2003). The correction to the UK data described in the annex significantly reduces the estimated increase in attainment under constant enrolment (by 0.1 to 2010 and 0.4 to 2050, for the EU as a whole). Secondly, the benchmarks for increased attainment here are less ambitious than those assumed in the Review.

Table 7. Projected effective years of schooling in the 25-64 population

		increase with constant enrolment		increase due to upper-secondary		increase due to tertiary		total attainment *(increase since 2000)*			
	2000	*2010*	*2050*	*2010*	*2050*	*2010*	*2050*	*2010*		*2050*	
Belgium	11.1	0.5	1.1	0.01	0.26	0.06	1.06	11.6	*(0.6)*	13.5	*(2.4)*
Denmark	12.5	0.2	0.4	0.02	0.32	0.06	1.12	12.9	*(0.3)*	14.4	*(1.9)*
Germany	12.6	0.1	0.1	0.02	0.30	0.04	0.87	12.8	*(0.2)*	13.9	*(1.3)*
Greece	10.5	0.8	1.5	0.02	0.35	0.07	1.16	11.3	*(0.9)*	13.5	*(3.0)*
Spain	9.4	1.0	2.2	0.04	0.74	0.07	1.16	10.5	*(1.1)*	13.5	*(4.1)*
France	10.8	0.5	1.2	0.02	0.27	0.08	1.49	11.4	*(0.6)*	13.7	*(2.9)*
Ireland	10.7	0.8	1.8	0.02	0.34	0.11	1.57	11.7	*(0.9)*	14.4	*(3.7)*
Italy	9.8	0.6	1.3	0.04	0.82	0.05	0.98	10.5	*(0.7)*	12.9	*(3.1)*
Lux.						0.02	0.85				
Netherlands	11.7	0.3	0.6	0.01	0.21	0.07	1.49	12.1	*(0.4)*	14.1	*(2.3)*
Austria	11.9	0.6	1.1	0.02	0.28	0.03	0.59	12.5	*(0.6)*	13.9	*(2.0)*
Portugal	8.3	0.5	1.1	0.05	1.05	0.05	0.97	8.8	*(0.6)*	11.4	*(3.1)*
Finland	11.9	0.8	1.7	0.01	0.19	0.02	0.34	12.8	*(0.8)*	14.2	*(2.3)*
Sweden	11.9	0.4	0.8	0.01	0.16	0.03	0.57	12.3	*(0.4)*	13.4	*(1.5)*
UK	12.0	0.4	0.8	0.02	0.37	0.09	1.64	12.5	*(0.5)*	14.8	*(2.9)*
EU-15	11.1	0.5	1.1	0.02	0.43	0.06	1.19	11.7	*(0.6)*	13.8	*(2.7)*

Source: Commission services.

These results suggest that average educational attainment among 25-64 year-olds is set to continue increasing in the EU as a whole, but at a declining rate compared to previous decades. The intuition that increased average attainment over the next 10 years is dominated by the replacement of older workers with better-educated younger counterparts is confirmed. The impact of further increases in upper-secondary and tertiary enrolment on average attainment among 25-64 year-olds is limited in the first decade (also partly because most of those in the relevant age groups are below the age of 25). In the longer term, however, the potential for further increases in average educational attainment clearly depends on increasing enrolment, especially in tertiary education.

Cross-country differences are striking. Over the next decade, the projected increase in average attainment in Germany is less than one fifth what it is in Spain. It may be worth recalling the main reasons for these differences:

- **Cohort effects**. If a country has experienced a rapid increase in enrolment in recent decades, so that young people's attainment is much higher than that of older working-age people, then the predetermined increase in average attainment is correspondingly high. This is mostly the case in countries where attainment is relatively low (though the same is true for Finland where, despite high average attainment, enrolment of young people has increased rapidly).

- **Scope for further increases in enrolment**. The methodology for the projections assumes that countries converge to long-run (i.e. beyond 2050) maximum enrolment rates, so that those with relatively low rates to begin with have greater scope for further increases.

- **Length of upper-secondary studies**. The benchmarks here refer to the number of people completing upper-secondary education (long-run maximum of 100%), so the effect of increased enrolment on effective years of schooling is higher in countries where the standard length of upper-secondary studies (taken from de la Fuente and

Doménech, 2001) is longer. The standard length is 3 or 4 years in most countries, except Italy (5 years) and Netherlands (2 years).

- **Enrolment/attainment ratio in tertiary education**. In tertiary education, the benchmark refers to the share of people enrolled. This implies a trade-off between the length of studies and the number of graduates. The effect of increased enrolment on effective years of schooling is lower in countries where the number of years enrolled is significantly higher than the standard length of studies needed to achieve a degree (owing to a high drop-out rate or repeat years, for example). This effect also partly explains the relatively large impact of increased tertiary enrolment in France, Ireland, the Netherlands and the UK, where the available data indicate that the average time taken to successfully complete studies is *shorter* than the standard length given in de la Fuente and Doménech (2001).

The pure demographic effect of a falling share of (relatively high-achieving) young people in the population has a small impact for the EU as a whole. For example, the increase in average attainment due to higher tertiary enrolment by 2050 would be 1.22 years instead of 1.19 years if, all else equal, the structure of the population remained as it was in 2000. The demographic effect makes very little difference to cross-country comparisons.

As regards the different areas of the education system, the results suggest that increased upper-secondary enrolment may still have a significant contribution to make to raising average educational attainment. In most cases, however, the potential contribution of tertiary education far outweighs that of upper-secondary, with the notable exception of Portugal.

2.5 The possible impact of increased attainment on growth

If the findings of recent research on the link between education and growth were taken at face value, then the results presented here would have significant implications for growth potential in the EU as a whole and for cross-country differences. *If* one extra year of schooling in the labour force aged 25-64 leads to an increase in GDP of around 6 per cent and *if* the assumptions behind the attainment projections hold, then the main results could be summarised as follows.

In the EU as a whole the contribution of education to growth looks set to decline. The projections suggest that average years of schooling will increase by around 0.6 years in the coming decade, compared to 0.8 per decade over the past 40 years. This implies that the contribution of education to rising GDP in the EU as a whole would fall from almost 0.5 percentage points of GDP per year in recent decades to 0.35 percentage points up to 2010, and falling slightly further thereafter. This varies a great deal between countries, owing mainly to variance in the scope for increased attainment, but also to different estimated rates of return. The following table sums up the implications for growth, using de la Fuente's (2003) estimates of raw macroeconomic returns to schooling in individual EU countries.

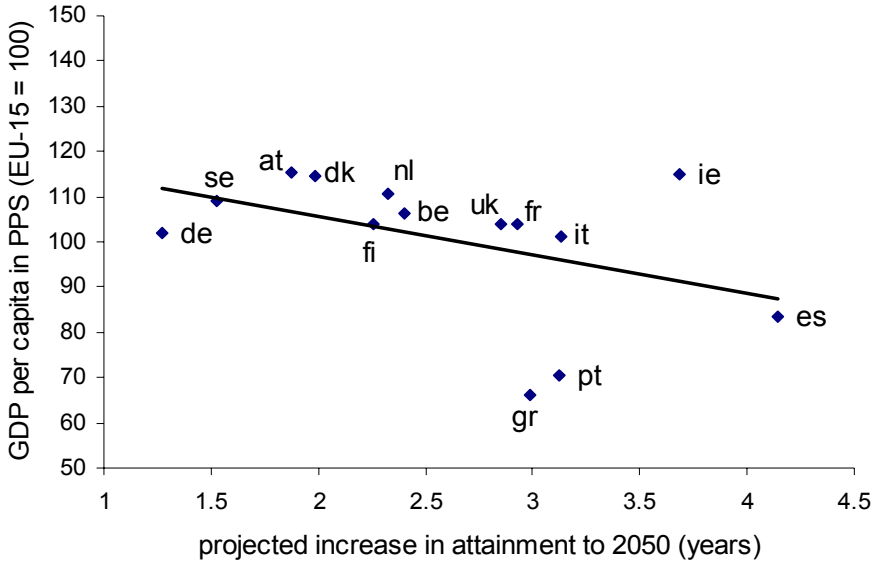
Table 8. Possible impact of increased attainment on GDP

	Projected increase in attainment (years)		Macro return	Implied annual % increase in GDP	
	2010	2050	(1990 data)	2010	2050
Belgium	0.57	2.40	5.82	0.33	0.26
Denmark	0.32	1.88	5.00	0.16	0.18
Germany	0.19	1.27	4.53	0.08	0.11
Greece	0.86	2.98	7.42	0.62	0.40
Spain	1.07	4.14	8.27	0.85	0.59
France	0.60	2.93	5.62	0.33	0.31
Ireland	0.92	3.69	6.24	0.56	0.42
Italy	0.71	3.13	7.30	0.51	0.41
Netherlands	0.38	2.32	5.36	0.20	0.24
Austria	0.64	1.98	5.19	0.33	0.20
Portugal	0.57	3.12	9.16	0.51	0.50
Finland	0.83	2.26	5.35	0.44	0.23
Sweden	0.41	1.53	5.53	0.22	0.16
UK	0.49	2.85	5.58	0.27	0.30
EU	0.58	2.68	6.17	0.35	0.31

Note: implied annual increase in GDP is calculated as the compound annual growth rate required to yield the implied increase in the level of GDP by 2010 or 2050.
Source: Commission services and de la Fuente (2003) for macro returns.

There is a negative correlation between the projected increase in attainment and GDP per capita, suggesting that education plays a role in economic catch-up. This is not surprising since current attainment is clearly linked to GDP (with causality almost certainly running in both directions), while long-term upper bounds on average attainment are (plausibly) imposed in the projections. Apparent outliers include Ireland (a greater projected increase in average attainment than expected given current GDP), Greece and Portugal (both with a lower projected increase in average attainment than would be expected).

Figure 5. Projected increase in attainment versus current GDP per capita



Source: Commission services.

Since the 'ifs' mentioned at the beginning of this section are big ones, we recap the essential caveats which suggest that these results should be interpreted with caution, and in any event as possible projections rather than forecasts in any sense:

- The future impact of education on growth depends on quality and efficiency, as well as quantity. Evidence suggests that an improvement in the quality of school education of one standard deviation could in fact have a larger effect than an extra year of schooling. At tertiary level, effective years of schooling could be increased without even raising enrolment by reducing the number of drop-outs and excess years of study.

- The absolute level of average attainment may be relevant to growth, perhaps especially when it comes to extending the frontier of technical progress. In that case, countries like Germany may still enjoy advantages.

- On the other hand, there are some reasons to fear that a macroeconomic return of around 6% – i.e. an extra year of schooling raises aggregate productivity by 6% – may be optimistic for the future. These include the possibility of slower technical progress, and the likelihood of diminishing returns, given that the scope for increased enrolment now lies mainly in tertiary education.

- The difference between estimated rates of return in different countries depends on the assumed form of the aggregate production function – in the case of de la Fuente's estimates, returns are in fact constrained to diminish as years of schooling increase, so that countries with high current attainment have relatively low returns by assumption.

- The attainment projections for individual Member States should be seen as tentative, both on account of the underlying data and because of the inevitable degree of arbitrariness in establishing benchmarks for increased enrolment.

- The projection methodology effectively sets an upper bound on tertiary enrolment, which may not apply in practice. Some countries (Finland in particular) have increased enrolment by more than would be expected according to this methodology. Adult education and training could also contribute to raising effective attainment.

- In the shorter term, the projections might be seen as slightly conservative compared to publicly announced targets for increased upper-secondary and, in some countries, tertiary participation.

Despite all these caveats, the basic results have a ring of truth about them. There is quite strong evidence that the change in educational attainment over time is important for growth, and the scope for further increases in average years of schooling clearly varies a good deal among countries. Nevertheless, some of the caveats may be important in the context of education and training policies: for example, greater attention to quality and efficiency may be required in some countries, or the design of policies and reforms may need to take into account a country's position relative to the forefront of technical progress (Aghion and Cohen, 2004).

3 Modelling long-term trends in public education expenditure

3.1 Introduction

The education sector presents specific features among publicly provided goods and services and this requires a sector-specific model to project future trends in expenditures. First, education is not only public. The State can directly provide education through a system of public institutions entirely carried on by the State itself or it can finance private institutions through transfers to families or to private institutions. Education can also be carried out by private institutions which are not funded by the State. In this case, education represents an investment for households and not a cost for the State.

Secondly, there is not a straightforward definition of education. It could include schooling solely or it can embrace also tertiary education, adult education, training etc. For the purpose of modelling long term trends of expenditures, the education sector can be divided into at least two sub-sectors. In a first sub-sector education is compulsory and virtually all of the population in the relevant age group are enrolled. Nevertheless, even if education is compulsory, a small part of the targeted population may not be enrolled owing to frictions in the system. In a second sub-sector education is instead an alternative to work. This implies that any future projections on enrolment have to take properly into account the likely development of the labour force in the relevant age groups. This of course does not rule out that there are still frictions in the education sector and in the labour markets so that a share of the targeted population may end up neither in education nor in the labour force. In addition, education is not only an alternative to work but it can be seen as a complementary activity because part time jobs can coexist with (part-time or full-time) education. This requires assumptions on the number of workers that are also students, so that they can be included when modelling education expenditure.

Thirdly, public education expenditure can take the form of transfers or public consumption (direct expenditure). The two ways of financing and providing public education require different modelling approaches: while the latter is demand-driven and depends on eligibility criteria, the former needs a cost-based approach to capture institutional factors.

3.2 A proposed approach

Experiences of long term education projections are rather limited. A few examples are available in Canada, the US and several European countries.[13] In all cases the methodology differs according to different data availability and objectives. In the US, projections are carried out each year by the National Center for Education Statistics (NCES, 2002) with the main aim of making medium term projections (10 years) on enrolment and graduates. The Canadian projections focus instead on budgetary trends (Conference Board of Canada, 2002). Education per student is modelled as a function of a constant and a trend variable where the latter aims to capture the effect of technological changes in the education system. Given

[13] A recent example is the projection exercise carried out at the EU level by the EPC on which this paper is largely based. See: Economic Policy Committee (2003).

constant enrolment rates, education expenditures are thus calculated over time.[14] Another method is used in generational accounting and has been applied for instance by the HM Treasury (2002) to assess the impact of an ageing population on public finances. The basic assumption is that the distribution of education expenditure per age remains unchanged. Once the age-specific profile is calculated from the past, this is simply applied to demographic projections in order to obtain changes in total cost.

Building on these experiences, it is possible to set up a series of basic principles on which any projection of education expenditure should be based. First, demographic changes are not the only driving force. As underlined by Balassone and Franco (2000), 'demographic change is just one of the several factors affecting public expenditure dynamics. […] The continuation of structural expenditure trends [*is one of the factors which*] are considered because they are consistent with a constant policy approach'. Thus, there is a fundamental difference between public consumption and public transfers, in particular pensions: the latter can in principle be projected assuming that the unitary cost remain unchanged (or indexed to some macroeconomic variable as income per capita, prices, wages etc.) and the major role is played by demographic factors. Given the eligibility criteria for access to transfers, once the criteria are matched, money starts to be transferred from the State to the single citizen.

The case for public consumption is different. Here, the state provides directly the good through established institutions (schools, hospitals etc.) and takes care of the fixed costs of such institutions. Also the total wage bill is, at least in the short to medium term, a fixed cost: the number of staff (as teachers or doctors) cannot be adjusted instantaneously to changes in demand for education and an oversupply of staff can hold for some time if there is a declining demand due to demographic changes.

Secondly, any projection should rely on past trends, either of enrolment rates or education per capita, or both. Assuming the constancy of enrolment rates implies a change in the behaviour of the target population, while assuming constant education expenditure per capita (in real terms) does not take properly into account institutional factors and fixed costs or changes due to changes in income per capita levels. Thus, the constancy of one or both of these variables implies a "policy change" scenario[15] that, unless well motivated from announced or implemented structural reforms, should be avoided when expenditures are projected in the long term.

3.2.1 The model

The following model provides the basis for long term projections for public education expenditures. The advantage of the proposed framework is that it is flexible enough to adapt to data availability and to different objectives of the projections. The model is based on the definition of a cost function for public education and it takes explicitly into account demographic factors as one of the driving forces of expenditure. However, if the aim is not

[14] This methodology has been applied to all education level except the so-called school boards (between 5 and 14 years of age). The projected trend of expenditure per capita was negative and, given that it seemed unrealistic, the trend of expenditure per capita has been projected taking as reference value the average growth recorded in the last 4 years before the projection period.

[15] On the other hand, it is difficult to define exactly what a "no policy change" would involve, since the continuation of past trends in enrolment, for example, is likely to require additional policy commitments.

only to look at pure demographic factors but also to the impact of institutions, the model can incorporate factors such as changes in enrolment rates, the role of the state in providing education and the impact of institutional inertia on unit costs of education sector.

Public expenditure on education as a share of GDP (*EXP*) in a specific year *t* is equal to:

$$EXP = \sum_{x=1}^{n} EXP_x \qquad [8]$$

i.e. the sum of expenditures for each age *x*. Clearly, for some ages expenditure is zero since no one is enrolled in education. This can be decomposed as follows:

$$EXP_x = \frac{ES_x}{\pi} * \frac{POP_x * e_x}{N} * PUB_x \qquad [9]$$

where:

- ES_x is the total (public and private) average expenditure per beneficiary (student) of age *x*;
- π is labour productivity;
- POP_x is the dimension of total population with age *x;*
- e_x is the net enrolment rate;
- N is employment;
- PUB_x indicates the share of publicly funded education at the level(s) of education (primary, secondary, tertiary) relevant to cohort *x*.

As shown in equation [9], GDP is decomposed as usual into productivity and employment. Four dependent variables explain total expenditure in education for cohort *x* in year *t*: expenditure per student, the dimension of the target population, the enrolment rate and the share of publicly funded education.

Expenditure per student (ES_x)

Expenditure depends on both salaries and other compensations to teaching and non-teaching staff, investment in infrastructures such as buildings, teaching material, technical equipment etc. and other current costs. Broadly speaking, these expenses can be grouped into two categories: compensations to staff and other costs. In a specific year *t*, expenditure per student for a specific age *x* can thus be defined as follows:

$$ES_x = \frac{T}{POP_x * e_x} * w + \frac{K}{POP_x * e_x} \qquad [10]$$

where:

- T is the total number of teachers and non-teaching staff;

- w is the average compensation;
- K is other costs.

This functional form captures relatively well the different factors which affect expenditure per student. Demographic factors are taken into account through the population variable which, other things being equal, has an inverse effect on expenditure per student. Also, most of the institutional components behind the expenditure to student ratio are included. First, the dynamics of enrolment may amplify or alternatively offset the impact of the demographic changes. Secondly, in a unionised sector such as education, wage setting procedures can affect expenditure trends so that these do not reflect labour productivity. Thirdly, this functional form implies that the human capital input of the education "production function" does not adapt immediately to changes in the demand for education. Assume there is a decline in schooling population due to purely demographic factors. The student to teacher[16] ratio would remain constant if the number of teachers declines accordingly, but in practice this is unlikely to happen. Thus, when the number of students falls, total expenditure does not fall at the same pace, leading to an increase in expenditure per student[17]. However, it is reasonable that, sooner or later, the student to teacher ratio will adjust to the new population structure. Fourthly, the proposed formulation takes explicitly into account other costs apart from compensation for employees which reflect depreciation of capital, new investment and the impact of technological changes.

In the following sections three different approaches are proposed to project empirically expenditure per students. They all simplify equation [10], trying to capture different forces behind its dynamic. A first approach (applied to the "pure-demographic" model, see later) takes expenditure per student to be constant as a share of GDP in order to keep neutral all non-demographic factors likely to affect education spending. In the "labour force" model, expenditure per student varies in line with the changes in GDP per worker. It is implicitly assumed that wages increase in line with labour productivity and the student to teacher ratio remains constant. In the "labour force / trend expenditure" model expenditure per student takes on board past trends, assuming that the yearly rate of change of expenditure per student converges from the average yearly rate of change observed in the past to the rate of change in labour productivity. From 2020 onwards it evolves in line with changes in labour productivity.

Enrolment rates (e_x)

For the purposes of the present project enrolment rate is defined as the gross rate, i.e. the ratio of students enrolled in a given level of education, regardless of age, to the total population in the relevant age group. While calculating it, three alternative approaches, presented in section 2.4 can be taken. The first one assumes constant enrolment rates at 2000 levels[18]. The second

[16] Henceforth, "teacher" is used to mean both teaching and non-teaching staff.

[17] The similar effect of increasingly expensive education may result from the falling education productivity, due to the lack of some basic capabilities required for a successful education among the disadvantaged social groups (e.g. the poor or the immigrants). See: Gundlach, Wossmann and Gmelin (2001).

[18] For the sake of comparability between different approaches, the base year for calculating expenditure on education has been set at year 2000.

one takes into account the close link between the labour market developments and education enrolment at upper-secondary and tertiary level, by letting the enrolment rates develop in line with participation rates. Finally, the third one consists in projecting enrolment rates directly, using benchmarks described in section 2.4.2.

Direct projections of increased enrolment may differ significantly from those derived from labour force projections. Suppose for instance that enrolment is projected to increase by more than what is implied by the labour force projections. For consistency within the model, this implies that either the labour force must be reduced and/or the share of students who work part-time (*c* in equations 4 to 7) must be increased.

Share of publicly funded education (PUB_x)

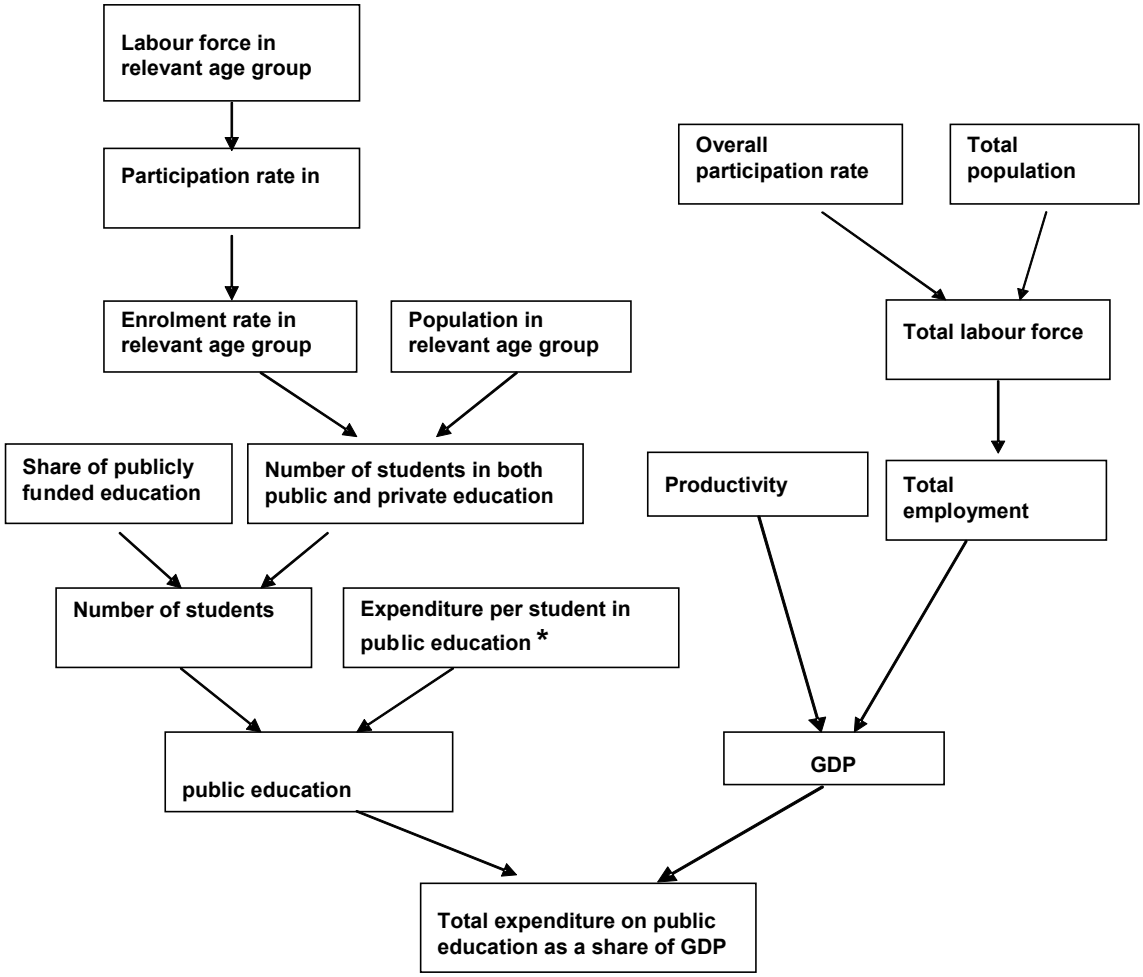
As noted, not all education expenditure is public. In order to project public expenditure, one should first subtract the component that is entirely financed from private sources. In a no policy change scenario, the share of publicly funded education remains constant at the current level.

Transfers to households

So far, we have discussed a model to project direct public expenditure in education, i.e. expenditures carried out through public consumption. However, part of public education can be financed through transfers (either to households or to private education institutions). As with other age-related transfers, assuming a no-policy change scenario would imply that the demographic shift affects directly the number of beneficiaries – and thus expenses. A simple way of modelling education-related transfers is to take the current share of transfers over total public education expenditure and to apply it to projected direct expenditures, taking this share as constant over time. In other words, such a methodology implies that there are no legislative interventions leading to a change in the balance between direct expenditures and transfers and that transfers are driven by the trend in direct expenditures.

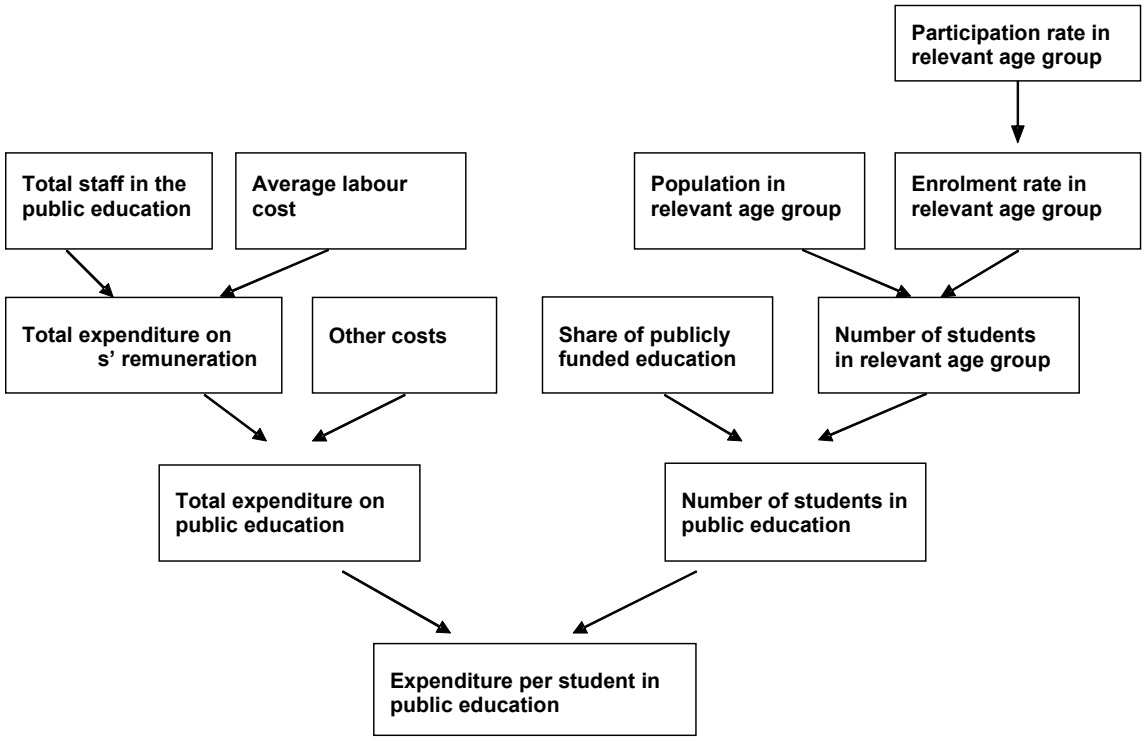
To sum up, the following two figures depicts the general methodology proposed.

Figure 6. Schematic presentation of the underlying methodology



* see figure 7 below

Figure 7. Implicit decomposition of expenditure per student



3.2.2 The model and its applications: four different approaches

On the basis of the general model depicted above, several approaches can be followed according to the aim of the projections and given data availability. Data availability is, at least in the European countries, one of the main practical limitations. In cases where data are not available, some simplifying assumptions are needed in order to perform the projection exercise.

Also, the aim of the projection might be to look only at the demographic impact on spending, without including the effects of institutional inertia or labour market changes. In this case, the model should isolate the demographic factor, holding constant the rest of the education system.

The model is presented as a static model. In order to make projections, the corresponding dynamic form of the equations has to be used.

The pure demographic approach

This sub-model assumes that the only driving factor of public education expenditure is demography. The economy (labour productivity and employment) evolves according to exogenous assumptions, expenditure per student evolves in line with GDP growth, enrolment rates do not change and the only variable which affects education expenditure is the variation in the target population. Thus, when differentiating equation [9], changes in expenditure as a

share of GDP depend on differences between GDP growth and labour productivity growth, and on the evolution of the ratio of the targeted population to total employment, with all other factors held constant.

The labour force approach

This sub-model considers the impact of labour market developments on enrolment in education. Changes in the skill composition of labour demand could lead to additional education if there is a general need for upgrading skills in the labour markets. Enrolment rates can change as well because of modifications in the behaviour of the agents, caused by changes in personal income and other personal factors. Thus, if forecasts on future labour market developments are available for young population in non-compulsory schooling age, they can be used to link the trend of enrolment rates in non-compulsory education to these labour market trends and this way to add implications of changing participation to the impact of demographic change.

In terms of equation [9], the total number of students ($POP_x * e_x$) is affected directly by demographic changes and indirectly by labour market trends which ultimately influence the enrolment rate for those in non-compulsory schooling age. Enrolment rates then develop over time according to equation [6] calculated in differences.

For the sake of simplicity, and in view of data availability, enrolment rates are defined as gross rates, i.e. the number of students enrolled in the given level of education, regardless of age, expressed as a percentage of the population in the relevant official age-group. The alternative would be to use net enrolment rates, i.e. the number of students of a given age enrolled divided by the number of people of the same age in the population. This however requires accurate data on enrolment by age, which are not easily available on national basis.

This model assumes that expenditure per student is constant relative to labour productivity, which is equivalent to assuming that wages in the education sector evolve in line with labour productivity in the whole economy and that the student to teacher ratio remains constant. This assumption has a strong economic foundation since public consumption (as it is public education) tends to show the same long-term trend as some indicators of per-capita income[19].

The labour force / trend expenditure approach

This sub-model includes both demographic and non-demographic factors as driving forces for education expenditures in the long run. It models, in addition to demographic and labour force developments, changing expenditure per student as a function of past trends. These trends incorporate institutional inertia, which means that the system adapts only slowly to changes in the number of students and to labour productivity developments. Therefore, in the short to medium-term, wages can develop at a different pace from that of labour productivity and pupil-teacher ratios can vary over time.

[19] The so-called Wagner law. See: European Commission (2002), Public Finances in EMU, European Economy, no.3.

This reflects the observation that education spending includes a significant component of quasi-fixed costs and that the number of teachers tends to adjust slowly compared to changes in the number of students. Any decrease in the student-teacher ratio, other things being equal, implies that expenditure per student tends to increase, while the opposite holds if there is an increase in the ratio. Full details on student-teacher ratios during the last 10-15 years are not always available for all EU countries. Information collected by the EPC's Ageing Working Group show that – on average – the ratio tends to decline slightly. For instance, the student-teacher ratio in France decreased from 16.5 in 1992 to 15.0 in 1999, and in Portugal from 15.6 in 1993 to 13.5 in 1999. For basic education only, it fell from 8.1 in 1990 to 7.8 in 1999 in Italy and from 17.4 in 1993 to 16.0 in 1999 in the Netherlands. For that level of education some relevant increase is registered only in Germany (from 15.0 in 1993 to 15.8 in 1999) and Finland (from 10.1 in 1990 to 10.5 in 1999).

As a practical implementation of the model, the rate of change of expenditure per student in the first year of the projection period equals the average annual rate of change during the second half of 1990s and it converges linearly in 2020 to the rate of change of labour productivity. Taking an average value for expenditure per student in the past reduces the volatility of the variable. Volatility can result from instability of wages in education sector, legislative changes with an impact on the cost structure, or changes in investment policies.

From 2020 onwards expenditure per student and labour productivity develop at the same rate, as in the labour force approach. The approach is equivalent to assuming that some structural changes are needed to adapt to a different (usually lower) number of students and that these changes need time to occur. However, it does not invalidate the main assumption that in the long run expenditure per student and labour productivity follow a similar trend.

In a dynamic version of equation [9], the only constant variable is the share of publicly funded education, while expenditure per student, enrolment rates and population in the specific age-cohort evolve over time. Productivity and total employment also evolve according to available forecasts (see section 3.2.4 below).

A trend increase in enrolment

The final approach estimates the expenditure impact of a continued trend increase in enrolment in upper secondary and tertiary education. Rather than inferring enrolment developments from labour force projections, this approach uses the results of section 2.4 to project increased enrolment directly. This may be done, first, on the assumption of constant expenditure per student as a share of GDP and, secondly, on the assumption that expenditure per student is influenced by recent trends, as in the previous approach.

3.2.3 Taking into account different education levels.

Education is classified according to a standard international classification system (ISCED) into seven different levels. For the purpose of the projection exercise, these levels have been aggregated into four different education levels: pre-primary, basic, upper-secondary and tertiary.[20] This aggregation takes into account the key difference between compulsory and

[20] Pre-primary education. Level 0 of ISCED classification. It is defined as the initial stage of organised instruction, designed primarily to introduce very young children to a school-type environment. Such programmes

non-compulsory education, which is important when producing long term expenditure projections since this allows the links between the education system and the labour market to be taken into consideration.

Table 9. 'Official' age brackets between levels of education

	Pre-primary	Basic	Upper-secondary	Tertiary
BE	3-5	6-13	14-17	18-22
DK	3-6	7-15	16-18	19-23
DE	3-5	6-15	16-18	19-25
EL	4-6	7-15	16-18	18-22
ES	3-5	6-11	12-17	18-24
FR	3-5	6-14	15-17	18-22
IE	4-5	6-14	15-17	18-22
IT	3-5	6-13	14-18	19-24
NL	4	5-15	16-17	18-21
AT	3-5	6-14	15-18	19-24
PT	3-5	6-14	15-17	18-23
FI	3-6	7-15	16-18	19-23
SE	3-6	7-15	16-18	19-23
UK	3-5	5-10	11-17	18-21

Note: DE: tertiary education includes post-secondary; UK: no distinction between secondary and upper-secondary
Source: Economic Policy Committee working group on ageing population.

Each country sets up its own education system, with specific age-breaks, which therefore differ across Member States. In Table 9, the different age-breaks currently in force in EU Member States and used to produce the projections are presented. Compulsory education (so-called basic education, i.e. primary plus lower secondary) starts in general at the age of 6 years and ends at the age of 14-15 years. Upper-secondary education ends around at the age of 17-18 years, while for tertiary education there is no 'legal' upper age-limit. Therefore, while comparing the data for different Member States, it should be borne in mind that the effective upper age-limit can differ considerably from the usual one.[21]

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are designed in general for children of at least 3 years. Basic (primary plus lower secondary) education. Level 1 and 2 of ISCED classification. Level 1 is the start of compulsory education (the first stage of basic education) with a legal age of entry usually no lower than five years old and no higher than seven years old. This level covers in principle six years of full-time schooling. Level 2 is lower secondary school (or the second stage of basic education). The end of this stage is usually after nine years of schooling after the beginning of primary education and often coincides with the end of the compulsory education. It includes general education as well as pre-vocational or pre-technical education and vocational and technical education. Upper-secondary education. Level 3 and 4 of ISCED classification. Level 3 is upper-secondary school and the entry age is typically 15 or 16 years old. It also includes vocational and technical education. Level 4 is post-secondary non-tertiary education and these programmes are typically designed to prepare students for the following level (university). Tertiary education. Level 5 and 6 of ISCED classification. Level 5 covers at least two years of education and the minimal access requirement is the completion of level 3 or 4. A cycle of at least three full-time years of education gives access to advanced research education. However a Masters course that entails up to 6 years of tertiary education is included in level 5. Level 6 includes tertiary programmes which lead to the award of an advance research qualification. See UNESCO (1997).

[21] A notable example here is Denmark, where according to national estimates approximately 2/3 of tertiary education students are over the 'official' age of 19-23. It is also the case for several other countries, e.g. Sweden.

3.2.4 Data source and macroeconomic assumptions

Expenditure on education in the EU Member States has been projected using different sources. The following data has been taken from Eurostat database for the period 1990-1999:

- nominal and real GDP levels and rates of change;
- GDP deflator;
- total population;
- population in the age cohorts relevant to each education level;
- total labour force in whole economy.

Demographic projections for the period 2000-2050 have also been used.

The OECD education database provided the following items:

- expenditure on education as a share of GDP in the base year (2000);
- transfers and other benefits in kind provided to the households in the framework of education system as a share of total public expenditure on education (2000).

The Ageing Working Group of the Economic Policy Committee provided additional data, not available in official statistics. For the period 1990-1999 they cover:

- enrolment rate in the respective levels of education;
- labour force in the respective age cohorts;
- share of publicly funded education;
- nominal expenditure per student in respective age cohorts;
- and for the projection period 2000-2050:
- real GDP rate of change;
- labour force.

As for GDP and labour productivity, for the sake of consistency with actual developments and in order to take into account most recent available figures, in the first years of the projection the following data has been used:

- 2000-2002: actual data from Eurostat sources;
- 2003-2005: official data provided by the Member States in the 2002 Updates of the Stability and Convergence Programmes.

Table 10. Assumptions on labour productivity and real GDP growth (average annual change, in %)

	Productivity		Real GDP	
	2000-2005	2000-2050	2000-2005	2000-2050
BE	1.0	1.8	1.8	1.6
DK	1.6	1.6	1.4	1.6
DE	1.3	1.7	1.6	1.3
EL	3.0	2.1	3.5	2.0
ES	0.9	1.9	2.8	1.7
FR	1.1	1.7	1.9	1.7
IE	3.5	2.1	5.4	2.6
IT	1.0	1.7	1.9	1.3
NL	0.9	1.6	1.7	1.7
AT	1.5	1.8	1.8	1.6
PT	1.4	1.8	1.9	1.9
FI	2.2	1.8	2.8	1.5
SE	1.2	1.7	2.1	1.7
UK	1.9	1.8	2.1	1.7

Source: Eurostat and EPC working group on Ageing Population.

The general assumption concerning the projection period is a constant 2% inflation rate over the entire 2000-2050 period in conformity with the price stability objective of the European Central Bank.

In what refers to specific assumptions concerning the education systems, the one which covers all the approaches is the constant share of publicly funded education at the level of the base year.

As discussed in the introductory comments, budgetary impact of the developments in the educational sector depends largely on the share of the education system being financed from the public sources. Since the present projections aim only at public expenditure, the share of publicly funded education has been estimated. It reflects the financial rather than organisational aspect of the education. What counts as a publicly financed education is not only publicly owned education entities and services provided for free or partially refunded to the society, but also transfers, both financial and in kind, provided to people enrolled in any kind of private schools and universities. Consequently, in most countries all or at least most of the educational system is financed by the State, while in the others (the UK, Spain, Portugal, the Netherlands, France) the share of public financing is smaller, being replaced by private schools and universities, financed from the fees paid by the students. The highest share of private financing applies to tertiary and pre-primary education, while compulsory basic and upper-secondary levels use mostly the public funds (see Table 11).

Table 11. Share of publicly funded education (in %)

	Pre-primary	Basic	Upper-secondary	Tertiary
BE	100.0	100.0	100.0	100.0
DK	82.0	100.0	100.0	100.0
DE	62.0	100.0	100.0	92.3
EL	100.0	100.0	100.0	100.0
ES	78.2	92.7	93.9	84.2
FR	95.8	92.7	92.7	85.4
IE	n.a.	100.0	100.0	100.0
IT	72.3	94.4	94.7	93.1
NL	n.a.	96.4	92.6	71.2
AT	100.0	100.0	100.0	100.0
PT	72.9	90.9	86.7	65.2
FI	85.2	100.0	100.0	100.0
SE	100.0	100.0	100.0	100.0
UK	91.2	90.4	89.1	63.4

Source: Economic Policy Committee working group on Ageing Population.

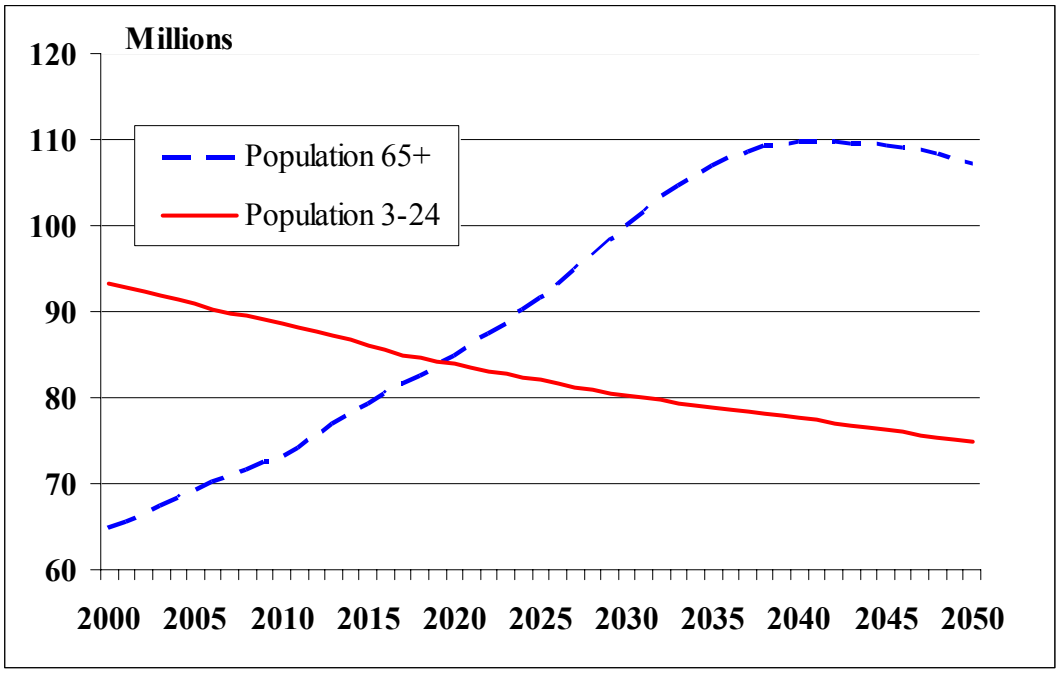
It should be borne in mind that the presented approach is a static model with a clear division between exogenous and endogenous variables. In the projections most macroeconomic variables, i.e. GDP, rate of inflation, demographic trends, labour force and employment and share of publicly funded education are exogenous. Obviously, there are reciprocal interrelations between them and the variables defined as endogenous. Arguably, demographic trends and consequently labour force and level of GDP depend on the educational attainment of population, their career path and revenues. Nevertheless, such links being difficult to include into the framework of the simple model presented, it has been decided to stick to the one-way causal relationships.

3.3 Results

3.3.1 Demographic trends

According to the official Eurostat baseline demographic scenario, the first half of the 21st century will be a period of substantial changes in both the number and the age composition of the EU Member States' populations. The total population of the EU is expected to grow slowly from 376 million in 2000 to reach a peak of 386 million around 2020-2025, and will then start declining down to 365 millions in 2050. Deep change in the age composition will affect mostly the youngest and oldest cohorts of the population. The number of 3-24 year-olds (the age range relevant to the four levels of education) is expected to decline steadily over the entire projection period, from over 97 million in 2000 to 78 million in 2050. At the same time, developments in health care efficiency, growing life expectancy and the ageing of the baby-boom generation mean that the number of over-65s is projected to increase from 65 million in 2000 to 107 million in 2050, with a peak of nearly 110 million around 2040). According to these trends, the number of elderly people will exceed the number of 3-24 year-olds by the early 2020s (see figure 8).

Figure 8. Number of people aged 3-24 and over 65 in the EU-15, 2000-2050



Source: Eurostat.

The overall trend hides many differences across Member States of the EU. Although the youngest group of population is expected to decrease in all but two countries (Denmark and the Netherlands), the extent of the change varies considerably between Spain (decrease by 36%), Italy (33%) and Austria (29%), on the one hand, and the Netherlands (increase by 2%), Denmark (broadly constant) on the other hand. The significant fall in the youth dependency ratio, calculated as the ratio of the population aged 3-24 to the total population, reflects the reduced burden of maintaining the non-working young population by the working and retired population. This relief will be highest in Ireland (decrease by 10.8%) and Spain (7.6%) while again in Denmark and the Netherlands the structure of the society will not change much.

Table 12. Population target of the education policies* (in millions), 2000-2050

	2000	2010	2030	2050	*Change 2000-2050*
BE	2.4	2.3	2.2	2.1	*-0.4*
DK	1.3	1.4	1.3	1.3	*0.0*
DE	20.5	19.9	17.6	16.0	*-4.5*
EL	2.5	2.0	2.0	2.0	*-0.5*
ES	10.6	8.8	7.7	6.8	*-3.8*
FR	15.2	14.6	13.8	13.0	*-2.2*
IE	1.1	1.0	1.0	0.9	*-0.2*
IT	13.5	12.1	10.2	9.1	*-4.5*
NL	3.6	3.9	3.6	3.7	*0.0*
AT	2.1	1.9	1.6	1.5	*-0.6*
PT	2.6	2.5	2.4	2.3	*-0.3*
FI	1.4	1.3	1.2	1.1	*-0.3*
SE	2.3	2.2	2.1	2.0	*-0.3*
UK	14.4	14.2	13.1	12.5	*-1.9*

* Number of population in age cohorts representative for each one of the four levels of education
Source: Own calculations on Eurostat and EPC working group on Ageing Population data.

3.3.2 Education expenditure projections under the pure demographic approach

Under the pure demographic scenario, the shrinking school-age population leads to a fall in education expenditure as a share of GDP in all countries except the Netherlands and Denmark. The largest falls in the number of students are expected in Spain (32%), Italy (31%), Austria (29%), Finland (23%), and Germany (23%). Under such circumstances the total expenditure per student would decrease over the period 2000-2050 in nearly all countries. In the Netherlands and Denmark, expenditure increases sharply during the first decade but then falls to reach broadly the initial level by 2050. The other countries would experience a broadly similar drop of 0.4%-1.7% of GDP, which would constitute a reduction in the range from less than 10% (in Portugal and Sweden) to around 30% (in Spain, Italy and Austria) of their current education expenditure.

Table 13. Pure demographic approach.
Total expenditure on education as % of GDP, 2000-2050

					Change 2000-2050 due to:				
	2000	**2010**	**2030**	**2050**	***Pre-primary***	***Basic***	***Upper-secondary***	***Tertiary***	**Total change**
BE	5,7	5,5	5,1	4,9	*-0,1*	*-0,2*	*-0,3*	*-0,2*	-0,8
DK	8,6	9,3	8,4	8,6	*-0,2*	*-0,1*	*0,2*	*0,1*	0,0
DE	5,4	5,2	4,7	4,2	*-0,1*	*-0,6*	*-0,3*	*-0,2*	-1,2
EL	4,0	3,1	3,0	3,1	*0,0*	*-0,1*	*-0,4*	*-0,3*	-0,9
ES	5,0	4,3	3,7	3,3	*-0,1*	*-0,3*	*-0,6*	*-0,6*	-1,7
FR	6,4	6,1	5,8	5,5	*-0,1*	*-0,4*	*-0,2*	*-0,2*	-0,9
IE	4,7	4,3	4,4	4,0	*n.a.*	*-0,2*	*-0,1*	*-0,4*	-0,7
IT	4,8	4,6	3,8	3,4	*-0,2*	*-0,5*	*-0,3*	*-0,4*	-1,4
NL	5,0	5,4	5,0	5,1	*n.a.*	*-0,1*	*0,1*	*0,1*	0,1
AT	6,0	5,5	4,7	4,3	*-0,2*	*-0,8*	*-0,4*	*-0,3*	-1,7
PT	5,6	5,5	5,3	5,2	*0,0*	*0,0*	*-0,1*	*-0,2*	-0,4
FI	6,1	5,8	5,2	4,7	*-0,1*	*-0,6*	*-0,3*	*-0,4*	-1,4
SE	7,8	8,1	7,2	7,1	*0,0*	*-0,7*	*-0,1*	*0,1*	-0,7
UK	5,3	5,2	4,8	4,5	*0,0*	*-0,2*	*-0,3*	*-0,1*	-0,7

Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

Since all the age cohorts are subject to similar demographic shifts, it is not surprising that all levels of education contribute to a broadly equal extent to the total fall in expenditure. One may distinguish a larger impact of basic education in a few countries, such as Germany, Austria or Sweden, but this is due to the relatively larger share of that level in the total cost of education.

Factors driving changes in public spending on education

To get a better understanding of the factors driving changes in the ratios of education expenditure to GDP, it is helpful to decompose the results into four explanatory factors,[22] namely:

[22] The decomposition follows closely the methodology used for decomposing pension spending in the EPC report, Economic Policy Committee (2001), pp.24-27.

- A benefit effect which measures changes over the projection period of the ratio between expenditure per student and labour productivity (*benefit ratio*).
- An eligibility effect which measures changes in the ratio between the number of students and the population aged 3-24 (*eligibility ratio*).
- A pure demographic effect which measures changes over the projection period in the ratio of the persons aged 3-24 to the total population (*young-age dependency ratio*).
- A labour market effect which measures changes in the (inverse of) employment as a share of employment over total population (*activity ratio*).

This decomposition can be algebraically expressed as:

$$\frac{EDU}{GDP} = \frac{ES}{\pi} * \frac{S}{POP_{3-24}} * \frac{POP_{3-24}}{POP_{tot}} * \frac{POP_{tot}}{N} \qquad [11]$$

where:

- *EDU/GDP* is total public expenditure in education as a share of GDP;
- *ES* is expenditure per student;
- π is GDP per worker;
- *S* is the number of students;
- $POP_{3\text{-}24}$ is population aged 3-24;
- POP_{tot} is total population;
- *N* is employment.

Table 14. Pure demographic approach.
Decomposing changes in expenditure on education as % of GDP between 2000 and 2050

	Benefit ratio	Eligibility ratio	Dependency ratio	Activity ratio	Total*
BE	-0,3	0,0	-0,8	0,3	-0,8
DK	-0,3	0,1	-0,5	0,5	0,0
DE	-1,0	-0,1	-0,9	0,6	-1,2
EL	-0,1	0,2	-1,1	0,3	-0,9
ES	-0,5	0,3	-1,6	0,0	-1,7
FR	0,0	0,0	-1,2	0,3	-0,9
IE	1,1	0,0	-1,6	-0,1	-0,7
IT	-0,9	0,1	-0,9	0,0	-1,4
NL	0,2	0,0	-0,4	0,3	0,1
AT	-0,1	0,1	-1,5	0,3	-1,7
PT	0,1	0,3	-0,9	0,2	-0,4
FI	-0,7	0,0	-1,2	0,4	-1,4
SE	0,1	0,0	-1,1	0,2	-0,7
UK	-0,3	-0,1	-0,9	0,5	-0,7

*including changes in public subsidies to households and residual factors
Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

Table 14 presents the effect of each of these components on public education expenditure as a share of GDP. Given that the pure demographic approach attempts to reflect the effect of demographic changes on expenditure, it is no wonder that the strongest factor reducing the expenditure over the next 50 years is youth dependency ratio. As stated before, the ratio of young people to the total population is expected to decrease significantly and this trend will have a great impact on the number of students and the education activity. On the other hand, the activity ratio is expected to have a positive, though much smaller, effect. This factor, reflecting the shrinking share of employment in the total population, translates into a growing share of students. The benefit ratio affects expenditure in proportion to the difference between the GDP growth rate (which is, according to the assumptions, the rate at which expenditure per student is evolving) and the labour productivity growth rate. Since in most countries (except for Sweden, Portugal, the Netherlands, and in particular Ireland) labour productivity growth exceeds the growth of overall economy, the effect of the benefit factor is mostly negative. Finally, as the discussed approach attempts to take into account only demographic factors, eligibility ratio appears to have no significant effect.

It should be mentioned that the aggregate results of the decomposition slightly differ from the results obtained in the long-term projection exercise. Such discrepancies result from a difference in the items taken into consideration in the two calculations. While the decomposition includes solely direct financial expenditure made by the public sector on education infrastructure and staff revenues, long-term projections have been run taking into consideration also transfers to the students, families and other benefits in kind related to the enrolment in education. The differences are thus particularly high in the countries where such transfers account for a large share of total expenditure (Denmark, Austria, Italy).

3.3.3 Education expenditure projections under the labour force approach

The labour force approach attempts to reflect the effect of labour market trends on the developments in the number of students and consequently expenditure on education, as presented in section 2.4.3. It assumes the enrolment rate evolving adversely to the changes in the labour market participation rate (higher participation rate in the labour market leading to a lower enrolment rate in education). At the same time, expenditure per student is supposed to develop in line with labour productivity.

Given the trends in the underlying factors, the total number of students in the respective levels of education is projected to decrease in all age groups in most countries. The only exceptions are the Netherlands and Denmark where the number of students will increase in both upper-secondary and tertiary education and Germany, Sweden and the UK, where only tertiary education entities will receive more students. However, given clearly negative developments in the number of students enrolled in pre-primary and basic education, the total number of students is going to decrease in all the countries. The range of change is wide and varies from less than 1% in the Netherlands to 32% in Spain and 31% in Italy.

Table 15. Labour force approach. Total number of students (in millions), 2000-2050

	2000	2010	2030	2050	*Change 2000-2050*
BE	2.2	2.1	2.0	1.9	*-0.3*
DK	1.3	1.4	1.2	1.2	*-0.1*
DE	15.7	15.3	14.0	12.7	*-3.0*
ES	7.8	6.8	5.8	5.2	*-2.6*
IE	0.7	0.6	0.6	0.6	*-0.1*
IT	9.7	9.1	7.5	6.7	*-3.0*
AT	1.7	1.5	1.3	1.2	*-0.5*
SE	2.0	1.9	1.9	1.8	*-0.2*
UK	9.5	9.4	8.8	8.3	*-1.2*

Source: Own calculations on Eurostat and EPC working group on Ageing Population data.

In this scenario, expenditure on public education is projected to fall in most EU Member States. The only exceptions are Denmark, where expenditure grows by around 6% and Germany where it remains broadly constant over the entire period. The other countries may all expect smaller (the Netherlands 2%, the UK 5%) or larger (Ireland 32%, Spain 26%) savings on education. In most cases (with the notable exceptions of the UK, Denmark and the Netherlands) expenditure is expected to decrease in the first two to three decades of the century and then either to continue falling or to start growing in the last two decades of the analysed period.

Table 16. Labour force approach.
Total expenditure on education as % of GDP, 2000-2050

	2000	2010	2030	2050	*Change 2000-2050 due to:*				Total change
					Pre-primary	*Basic*	*Upper-secondary*	*Tertiary*	
BE	5.7	5.3	5.2	5.1	*0.0*	*-0.1*	*-0.2*	*-0.2*	-0.6
DK	8.6	9.3	8.8	9.1	*-0.1*	*-0.1*	*0.4*	*0.3*	0.5
DE	5.4	5.3	5.5	5.5	*0.0*	*-0.2*	*0.1*	*0.3*	0.1
ES	5.0	3.8	3.4	3.7	*-0.1*	*-0.2*	*-0.5*	*-0.5*	-1.3
IE	4.7	3.7	3.3	3.2	*n.a.*	*-0.6*	*-0.3*	*-0.6*	-1.5
IT	4.6	4.3	3.9	4.0	*-0.1*	*-0.2*	*-0.1*	*-0.2*	-0.6
AT	6.0	5.5	5.1	5.0	*-0.1*	*-0.6*	*-0.3*	*0.0*	-1.0
SE	7.8	7.5	7.1	7.0	*0.0*	*-0.7*	*-0.1*	*0.1*	-0.8
UK	5.3	5.3	5.1	5.0	*0.0*	*-0.2*	*-0.2*	*0.1*	-0.2

Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

Factors driving changes in public spending on education

Table 17 presents a decomposition of changes in total expenditure on education into different underlying factors. By definition, in the labour force approach presented here, expenditure per student increases in line with labour productivity and therefore the contribution of the benefit ratio to changes in spending is zero. On the contrary, the strongest negative effect is exerted by the pure demographic component (dependency ratio), which in fact is the same as in the pure demographic approach.

The eligibility effect, which measures the change in the ratio between the number of students and the school-age population, has a weak positive effect on spending. The difference, compared to the pure demographic approach, results from the change in upper-secondary and tertiary enrolment rates, related to the interrelations between labour market and education

system, not analysed in the previous approach. Finally, the labour market component has a clear positive effect on spending as a share of GDP. It should be borne in mind, however, that it operates through decrease in labour market participation, employment and falling GDP (denominator), instead of having any direct effect on education spending (numerator).

Table 17. Labour force approach.
Decomposing expenditure on education as % of GDP between 2000 and 2050

	Benefit ratio	Eligibility ratio	Dependency ratio	Activity ratio	Total*
BE	0,0	0,0	-0,8	0,3	-0.6
DK	0,0	-0,1	-0,5	0,5	0.5
DE	0,0	0,2	-0,9	0,6	0.1
ES	0,0	0,3	-1,6	0,0	-1.3
IE	0,0	0,1	-1,6	-0,1	-1.5
IT	0,0	0,1	-0,9	0,0	-0.6
AT	0,0	0,0	-1,5	0,2	-1.0
SE	0,0	0,0	-1,1	0,2	-0.8
UK	0,0	0,1	-0,9	0,5	-0.2

*including changes in public subsidies to households and residual factors
Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

3.3.4 Education expenditure projections under the labour force / trend expenditure approach

In the previous two approaches, expenditure per student has been broadly neutral relative to the education system and the way it is financed. It has been simply assumed to change in line with the general developments of GDP and labour productivity in the national economy. While this assumption would appear broadly reasonable in the long run, it does not take into account certain characteristic features of the education system which may cause expenditure per student to deviate from this path in the short to medium term.

The labour force / trend expenditure approach focuses on the implications for public expenditure on education when expenditure per student is influenced by recent trends rather than adjusting immediately to labour productivity growth. Past trends in education are proxied by the average change in expenditure per students in publicly funded education over the last 4-5 years (depending on data availability). Institutional inertia is represented by gradual convergence from the past trend to labour productivity growth by 2020. The enrolment rate evolves as in the labour force approach, i.e. roughly as the complement to the participation rate in the labour force.

Table 18. Labour force / trend expenditure approach.
Total expenditure on education as % of GDP, 2000-2050

	2000	2010	2030	2050	*Change 2000-2050 due to:*				Total change
					Pre-primary	*Basic*	*Upper-secondary*	*Tertiary*	
BE	5.7	5.0	4.7	4.6	*0.0*	*-0.2*	*-0.5*	*-0.4*	-1.0
DK	8.6	9.4	8.9	9.2	*-0.4*	*-0.2*	*1.0*	*0.2*	0.6
DE	5.4	6.0	6.6	6.6	*0.0*	*0.0*	*0.2*	*0.9*	1.2
ES	5.0	5.0	4.7	5.2	*-0.2*	*0.3*	*0.5*	*-0.4*	0.1
IE	4.7	4.3	4.1	4.0	*n.a.*	*-0.2*	*-0.2*	*-0.3*	-0.7
IT	4.6	5.1	4.9	5.1	*0.1*	*0.2*	*0.3*	*0.0*	0.5
AT	6.0	5.1	4.7	4.5	*-0.1*	*-0.7*	*-0.4*	*-0.3*	-1.5
UK	5.3	5.4	5.2	5.1	*0.2*	*-0.2*	*0.5*	*0.4*	-0.2

Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

The results presented in Table 18 show a much less optimistic picture compared to the two previous approaches. Only four out of seven countries for which the available data was reliable enough to run projections can expect any savings by 2050.[23] In these countries, expenditure per student (in at least some of the main areas of education) has grown relatively slowly in relation to long-term expectations for labour productivity and GDP. In the case of Austria, Belgium and the UK, expenditure per student has grown yearly by 1-4% on average in all levels of education. In Ireland, initial growth in expenditure is higher (in the range of 4-6% yearly), but relatively high GDP growth is expected to compensate for both the rise in expenditure per student and the projected increase in enrolment.

The composition and changes in structure of expenditure differ considerably among countries. Whereas in Austria, Ireland and Belgium all levels of education contribute to the overall falling trend (in the last case only a small increase is projected for expenditure on pre-primary education) in the other countries trends are mixed.

[23] It is worth mentioning that in some countries in the late 1990s reforms of the education system were implemented. These have had one-off strong impact on the public expenditure and the consequent sharp increase in the expenditure cannot be considered as a reliable data to be extrapolated into the future. The most outstanding example is Portugal, where expenditure per capita in basic and upper-secondary education rose between 1995 and 1999 by more than 8% a year and in pre-primary education by more than 25% a year. As the model presented does not distinguish between cyclical developments and one-off measures, the cases where significant reforms have been introduced in the period covered by the calculations have been passed over, as the year-to-year extrapolation of large increases in the past would lead to unlikely explosive increases over the next 20 years.

Table 19. Labour force / trend expenditure approach.
Average annual rate of change in expenditure per student as compared to the average annual rate of change in labour productivity, 1995-1999 and 2000-2050

	Pre-primary		Basic		Upper-secondary		Tertiary		*Labour productivity*	
	1995-1999	2000-2050	1995-1999	2000-2050	1995-1999	2000-2050	1995-1999	2000-2050	*1995-1999*	*2000-2050*
BE	2,8	1,9	0,9	1,6	0,2	1,5	0,4	1,5	*1,9*	*1,8*
DK	-1,9*	1,0	1,2	1,6	4,3	2,2	1,1	1,5	*2,5*	*1,6*
DE	2.2	1.8	2.8**	1.9	3.3**	2.0	3.2	2.0	*1.0*	*1.7*
ES	0,1	1,6	5,5	2,7	6,8	2,9	2,9	2,2	*2,3*	*1,9*
IE	n.a.	n.a.	6,2	2,6	4,5	2,3	5,9	2,6	*6,0*	*2,1*
IT* **	5,2	2,4	3,5	2,1	5,2	2,4	3,5	2,1	*3,2*	*1,8*
AT	2,1	1,8	1,6	1,7	0,4	1,5	-0,6	1,3	*2,0*	*1,8*
UK	6,2	2,6	1,5	1,7	0,2	1,4	4,5	2,3	*2,2*	*1,8*

* 1998-1999
** 1997-1999
*** For Italy, different periods apply for the entire table: 1997-2001 and 2002-2050
Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

Table 19 shows the annual rate of change of expenditure per student in all four levels of education in two periods: the period 1995-1999 which constitutes the basis for future extrapolation and the whole 2000-2050 period where the average rate of change is affected by both long term trends (labour productivity) and past evolution of changes. Countries which have experienced fast growth in expenditure in the recent past may expect continuation of that trend for at least a certain time, even if their labour productivity increases at a slow rate. The opposite applies to the Member States which have been spending relatively little and have not increased their expenditure much over the last five years. It is natural, that in the first years of projections the changes are relatively more divergent between countries and in most cases higher than productivity growth. Further, however, in conformity with the real convergence theory, the rates of change in labour productivity are supposed to converge, which entails the similar trend in the rates of change of expenditure per student. Thus, the difference between the slowest and the fastest growing expenditure item will shrink from over 6% annually for the period 1995-1999 to as little as 1.5% annually in 2050.

Factors driving changes in public spending on education

Table 20 breaks down these results into the four components discussed in previous sections. The main difference relative to the previous approaches is in the benefit component, which reflects the large variation across Member States in the ratio between expenditure per student and labour productivity. While in Belgium and Austria the benefit factor has a clear negative effect, reflecting recent expenditure growth below labour productivity growth, most other countries which have experienced faster increases in education spending in recent years will continue to feel their effects over the next two decades as well. Furthermore, while comparing the total effect of falling number of students (dependency ratio plus eligibility ratio) with the effect of evolution in spending on education driven by institutional arrangements (benefit ratio) one can discover that in most countries the former outweighs the latter. Only in two already mentioned countries both factors add up to affect spending negatively, while in the other two (Italy and Germany) the positive benefit effect exceeds by little negative enrolment effect.

Table 20. Labour force / trend expenditure approach.
Decomposing change in expenditure on education as % of GDP between 2000 and 2050

	Benefit ratio	Eligibility ratio	Dependency ratio	Activity ratio	Total*
BE	-0.6	-0.1	-0.8	0.4	-1.0
DK	0.6	-0.2	-0.5	0.7	0.6
DE	0.7	0.3	-0.9	0.6	0.7
ES	1.1	0.3	-1.6	0.1	0.1
IE	0.9	0.1	-1.6	-0.1	-0.7
IT	1.2	0.1	-0.9	0.0	0.5
AT	-0.6	0.1	-1.5	0.3	-1.5
UK	0.4	0.0	-0.9	0.5	-0.2

*including changes in public subsidies to households and residual factors
Source: Own calculations on Eurostat, OECD and EPC working group on Ageing Population data.

3.3.5 Education expenditures with a trend increase in enrolment

As argued in section 2.4, different approaches may be taken to project enrolment in education. Two of them – constant enrolment, and enrolment as a complement to labour force participation – have been used to calculate total expenditure on education in the approaches discussed previously. The third alternative approach is to use benchmarks for increased enrolment which were discussed in section 2.4.2. The results of applying such scenario are presented in tables 21 and 22. Again, to estimate the sensitivity of the model to different trends in expenditure per student, two different approaches are explored. The first one (Table 21) assumes, similarly to the pure demographic scenario, expenditure per student which is constant in terms of GDP. The second one (Table 22) – just like the trend expenditure approach – allows expenditure per student to follow the trend from the recent (5 years) period of time.

As the results show, total expenditure on education is expected to increase faster than under the pure demographic and labour market approaches. This results from the faster increase in the number of students under the benchmark scenario (compare tables 5 and 7). Since the benchmarks cover only upper-secondary and tertiary education, these two levels contribute mostly to the overall increase. Pre-primary and basic education, characterised by constant enrolment rates and thus a falling number of students have a negative effect, which is however much weaker and in most cases more than offset by increases in the higher levels of education.

If one adds the recent trend in expenditure per student (trend expenditure approach), this difference becomes even more striking. All countries are expected to experience increases in total expenditure, some of them (Spain, Italy, Germany, the UK, Denmark) quite significantly so, in the range of 2-3% of GDP. This is the consequence of the strong increase in both the number of students and expenditure per student (see Table 19), with developments in pre-primary and basic education again partially offsetting increased expenditure at upper-secondary and tertiary levels.

Table 21. 'Trend increase in enrolment' approach.
Total expenditure on education as % of GDP, 2000-2050

					Change 2000-2050 due to:				
	2000	**2010**	**2030**	**2050**	***Pre-primary***	***Basic***	***Upper secondary***	***Tertiary***	**Total change**
BE	5.7	5.9	6.5	6.7	*-0.1*	*-0.2*	*0.2*	*1.2*	1.1
DK	8.6	9.4	9.9	10.2	*-0.2*	*-0.1*	*0.2*	*1.7*	1.6
DE	5.4	5.6	5.8	5.8	*-0.1*	*-0.6*	*0.2*	*0.9*	0.3
EL	4.0	4.3	4.9	5.0	*0.0*	*-0.1*	*0.2*	*0.9*	1.1
ES	5.0	5.3	5.3	5.3	*-0.1*	*-0.3*	*0.2*	*0.5*	0.2
FR	6.4	6.7	7.1	7.2	*-0.1*	*-0.4*	*0.2*	*1.2*	0.9
IE	4.7	5.3	6.1	6.3	*0.0*	*-0.2*	*0.1*	*1.6*	1.6
IT	4.8	5.2	5.1	5.0	*-0.2*	*-0.5*	*0.3*	*0.5*	0.2
NL	5.0	5.6	6.2	6.7	*0.0*	*-0.1*	*0.1*	*1.7*	1.7
AT	6.0	5.9	6.1	6.0	*-0.2*	*-0.8*	*0.1*	*1.0*	0.1
PT	5.6	6.4	6.8	7.1	*0.0*	*0.0*	*0.6*	*1.0*	1.5
FI	6.1	6.1	6.3	6.1	*-0.1*	*-0.6*	*0.1*	*0.5*	0.0
SE	7.8	7.5	8.3	8.4	*0.0*	*-0.7*	*0.1*	*1.3*	0.6
UK	5.3	5.6	6.2	6.4	*0.0*	*-0.2*	*0.2*	*1.2*	1.2

Source: Own calculations on Eurostat. OECD and EPC working group on Ageing Population data.

Table 22. 'Trend increase in enrolment / trend expenditure' approach.
Total expenditure on education as % of GDP, 2000-2050

					Change 2000-2050 due to:				
	2000	**2010**	**2030**	**2050**	***Pre-primary***	***Basic***	***Upper secondary***	***Tertiary***	**Total change**
BE	5.7	5.3	5.9	6.4	*0.0*	*-0.2*	*0.0*	*1.0*	0.8
DK	8.6	9.6	10.5	10.7	*-0.3*	*-0.1*	*0.8*	*1.7*	2.1
DE	5.4	6.0	7.3	8.1	*0.0*	*0.0*	*0.9*	*1.7*	2.6
ES	5.0	6.1	6.7	8.0	*-0.2*	*0.2*	*2.0*	*0.9*	3.0
IE	4.7	5.6	6.4	6.5	*0.0*	*0.3*	*0.0*	*1.5*	1.7
IT	4.8	5.9	6.9	7.7	*0.1*	*0.2*	*1.5*	*1.2*	2.9
AT	6.0	5.5	6.0	6.2	*0.0*	*-0.5*	*0.1*	*0.7*	0.2
UK	5.3	5.7	6.9	7.4	*0.5*	*-0.2*	*-0.1*	*2.0*	2.2

Source: Own calculations on Eurostat. OECD and EPC working group on Ageing Population data.

4 Conclusions

The rise in average attainment in the 25-64 population is projected to be slightly less than in recent decades: in the region of 0.6 years of schooling compared to 0.8 (for the EU-15). Nevertheless, assuming similar rates of return, education seems set to continue making a substantial contribution to economic growth (in the order of 0.35 percentage points of annual GDP growth over the next decade, according to the projections, and assuming a constant rate of return). This does not take into account the possible contribution of a high average *level* of educational attainment to technical progress (evidence on the magnitude of any such effect being more mixed).

The prospective contribution of education to growth varies widely among countries (by a factor of more than 1:8 over the next decade and almost 1:6 over the next 50 years). This is mainly because current average attainment varies widely, and countries at the lower end of the distribution have greater scope for increasing average attainment in future. In many cases (exemplified by Spain), the average attainment of younger workers is significantly higher than that of older workers, and therefore a significant rise in average attainment is already pre-programmed. In other countries (exemplified by Germany), the major growth impact of rising average attainment may already have occurred; older workers are almost as well educated as younger ones, and therefore further increases in enrolment would be required to generate a significant rise in average attainment.

Education represents a sizeable share of public spending and an even larger share (around one quarter) of age-related expenditure – i.e. items on which spending as a share of GDP is susceptible to change with the ageing of the population.

The pure demographic effect – a reduction in the number of young people aged 3-24 – leads to savings in the order of 1.0% of GDP. However, there are two offsetting effects. First, labour force projections imply (barring an increase in youth inactivity) that enrolment in upper-secondary and tertiary education is set to continue increasing in most countries. Secondly, as the size of the school-age population has fallen in recent years, expenditure per student has risen significantly in several countries, and this trend may well continue in the short to medium term. Once these factors are taken into account, the results suggest that any reductions in public education expenditure between now and 2050 are likely to be small (in the order of 1% of GDP or less), and that expenditure may well rise in some countries.

Direct projections of increased enrolment at upper-secondary and tertiary levels, based on the continuation of recent trends, suggest that educational expenditure in the EU may continue to grow (by 0.7% of GDP on average between now and 2050, and by as much as 2.4% if the trend increase in expenditure per student continues). This of course marks a clear departure from a 'no policy change' scenario. Nevertheless, targets have been set at EU level and in several Member States for increased enrolment in upper-secondary and/or tertiary education. These are often more ambitious than the benchmarks for increased attainment presented in this paper. Therefore, if these targets represent serious intentions on the part of policy-makers, then expenditure may increase by even more. With several Member States aiming to facilitate private investment especially in tertiary education, however, this does not necessarily mean that public expenditure would rise by the same amount.

It is interesting to compare the decrease in costs due to the demographic fall in the number of students (on average -0.9% of GDP) with the extra costs of 'institutional inertia' (on average

0.7% of GDP) – whereby expenditure per student does not, partly for quite understandable reasons, decline in line with student numbers. Although those extra costs are still lower than potential savings due to trends in demography and enrolment policies, it is obvious that, by limiting further increases in expenditure per student, governments could pay for a large increase in enrolment. In practical terms, one way to avoid the increase in expenditure per student in this context might actually be to raise the number of students. The true cost of raising, for example, upper-secondary enrolment at present might be significantly lower than current expenditure per student.

This paper does not offer conclusions about the case for more or less public investment in education. This depends on the private benefits to individuals as well as the social benefits. In countries where the projected increase in attainment is relatively small, some observers might see the need for investments in education to stimulate growth, but it is impossible from the results presented to draw any conclusions about the efficiency of such investments compared to other uses of public funds. However, two points are worth noting. First, even in countries where the scope for raising average attainment is limited, there remains scope for measures to increase the quality and efficiency of education systems. Such measures need not be expensive. Secondly, given the substantial projected increases in other age-related expenditure items (see: Economic Policy Committee, 2003), there may be strong pragmatic reasons for seeking greater private involvement in investment in education in order to avoid under-funding.

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