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VOLUME MEASUREMENT OF EDUCATION

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Remarks:
The views expressed in this paper are those of the authors and not necessarily reflect the policies of Statistics Netherlands. Paul Konijn has left Netherlands Statistics; he now works at Eurostat. Foske Kleima is working as a trainee on the project "Volume measurement of services".

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1. Summary

The figure for economic growth is one of the most important indicators calculated in the national accounts. Since economic growth is equal to the change of total value added generated in the whole economy corrected for price changes, the value of each goods or service transaction is decomposed in a price and a volume component. However, for public services like education such a decomposition is not easy to achieve, since there is no genuine market price. In the national accounts the output of public education is by convention equal to the expenses made by the government. Important disadvantages of such a (input) method are that quality and productivity changes are not recorded, possibly leading to a bias in the figure for overall economic growth. Therefore, Statistics Netherlands is looking for possibilities to improve the volume measurement of education following European initiatives in this respect.

In this paper the question how to measure the output volume and quality of education is discussed. In principle the output of education should be defined as “the amount of knowledge transferred”. Since this cannot directly be measured, indicators like for example numbers of pupils or numbers of graduated pupils have to be used. For each type of education possible volume indices are calculated and evaluated. In the last part of the paper volume indices per type of education are weighted together using cost shares. Overall indices that are calculated in different ways are presented and the consequences for labour productivity and GDP-growth are evaluated. A so-called combination index based on pupil numbers, number of graduates and number of pupils moving up seems to give the best result. According to that index, the output of subsidised education in the Netherlands increases 1.2% each year over the period 1991-1998 and labour productivity increases 0.5%.

2. Introduction

The figure for economic growth is one of the most important indicators that is calculated in the national accounts. Economic growth is a volume figure: it is equal to the change of total value added generated in the economy corrected for price changes. For this, the value of each goods or service transaction is decomposed into a price and a volume component.

For a transaction of a market product this is relatively easy because there exists a market price. For public services such as education there is no market price, so that another method has to be found.

For calculating the value of the output of public education (and other non-market services) national accountants use a convention: output is equal to the expenses made by the government. The government is at the same time the consumer of this output. For the calculation of the volume of education output many countries use a similar convention: the volume of output is equal to the volume of the inputs (a so-called 'input method'). In that way, the change in the volume is equal to the change in real costs. For example, an increase in the number of teachers will lead to an increase in the volume of output.

However, the results of such an input method give no information on possible productivity changes in education, because inputs and outputs are equal by convention, and hence productivity does not change. There will also be a bias in the figure for overall economic growth if productivity is systematically under- or overestimated.

An important aspect of volume measurement is the valuation of changes in quality. Changes in the characteristics of a product (i.e. the 'quality') have to be included in the volume component. If for the same price a product of a better quality can be bought, or if at the same costs a product of a better quality can be produced, the value to the consumer, or the output of the producer increases. The current methods for volume measurement of education do not pay attention to quality changes in education.

Statistics Netherlands therefore is looking for possibilities to improve the volume measurement of government services in general, and education in particular, following European initiatives in this respect. Eurostat organised in 1998 three Task Forces devoted to the volume measurement of non-market services, aiming for improvement of the reliability and the comparability of volume data. One of the three Task Forces concentrated on education. Statistics Netherlands participated in this Task Force. At the meeting of the National Accounts Working Party of February 1999 the Member States agreed to continue practical research into the implementation of the recommendations of the Task Force, in particular on the measurement of quality changes.

This report describes the investigations of Statistics Netherlands. In preparing this report, various education experts were visited to hear their views on the issues. These were experts from the Ministry of Education, from the Inspection for

Education and from universities. Also, there were discussions in the Advisory Committee for Education Statistics, in which the whole Dutch education 'field' is gathered.

These discussions yielded many ideas that were explored further. The main issues discussed were how to measure output and quality of education. This report analyses some alternative methods for volume measurement, using different indicators.

Section 2 discusses the definition of output of education and ways to incorporate quality changes. In section 3, the various possible indicators are compared for each school type. Section 4 gives the cost shares of each type of education that are used as weights in the calculation of overall volume indices in section 5.

Section 6 analyses the various derived indices on their effect on labour productivity, while section 7 analyses the effect on GDP growth. Section 8 concludes and gives some ideas for future developments.

3. The definition of output of education

3.1 The Task Force definition

The Task Force defined the output of education as follows:

> "The educational output is the quantity of teaching received by the students, adjusted to allow for the qualities of the services provided, for each type of education. The quantities should be weighted together using data on the costs of (or prices for) the education provided."

Concerning the implementation of this definition, the Task Force says:

> "(..) that the preferred measure of educational output, for both market and non-market education services, is the number of hours spent by students in being taught."

The Task Force therefore explicitly chooses an output method, using the number of pupil-hours[1] as output indicator. An input method is not recommended by the Task Force, because of the impossibility to measure productivity in an independent way.

In practice, numbers of pupils could be used instead of numbers of pupil-hours. It is then assumed that the number of hours that a pupil receives teaching is constant over time, or at least does not change substantially. It is rather difficult to verify this assumption, due to the difficulty of defining the number of hours of teaching. For example, a few years ago new teaching methods were introduced in secondary education, in which pupils receive less class teaching and work more hours out of

[1] The term 'pupil-hours' is used here to indicate both pupil-hours and student-hours. The same holds for 'pupil numbers'.

class on projects. In any case, the *formal* study load (class teaching plus project work) is in the Netherlands reasonably constant over time. There are no data on the *actual* study load.

The Task Force attaches great importance to a detailed stratification of data on pupil numbers. The rule should be that types of education that have significantly different costs per pupil – which serve as the weights to aggregate the pupil numbers of different types of education – have to be distinguished. Hence, an increase in the number of students in higher education will have a greater influence on the total volume change than a similar increase in primary education.

3.2 Quality

The definition of the Task Force is clear in stating that changes in the quality of the teaching should also be taken into account. The example that is most often used to illustrate the importance of quality adjustments is that of a reduction of class size. If the volume of output of education would be defined solely as the number of pupils, then a reduction in class size (for example by an increase in the number of teachers) would be registered as a productivity decline (since productivity = output/input = pupils/teachers). However, class size reductions might be an important instrument for quality improvement.

A good method of volume measurement would capture quality changes. *If* a reduction of the average class size leads to better teaching, this should be registered[2]. If the teaching has indeed improved, this should be reflected in the pupils achievements. They should have learned more in the same amount of time. Thus, one could say that the quality of education is determined by the efficiency in transferring knowledge to the pupils. One could therefore restate the definition of output of education as follows:

> *The output of education is equal to the total amount of knowledge transferred to pupils and students by schools in a certain period.*

One could argue that this definition is limited in the sense that other functions of education are not reflected. However, in the end transfer of knowledge is the basic function of education. Hence, it is transfer of knowledge that we would like to measure. Theoretically, the measure should be the difference in knowledge of pupils between the end and the beginning of the year. Such a measure would take changes in the starting level of knowledge into account. However, there are abundant data on final examination results or similar indicators for achievements, but there are hardly any data on the knowledge that pupils possess when they start school. Final examination results will then have to be used as an approximation for the difference.

The approach followed here could be labelled the “user-value” approach to quality. The change in quality is measured by the value the user attaches to the improved

[2] The effect of class size on pupils achievements have been subject to many studies, however with varying outcomes.

product, whatever were the extra costs to produce it. Increasing the resources for education will only yield extra quality if it can be shown that the effectiveness in transferring knowledge is increased.

An alternative approach – which we could label the "resource-cost" approach – would be to assume that it is the society that consumes education and that determines by means of the political system how much tax money is spent on education and in which way. It is then assumed that an increase in resources will increase the quality of education. Quality is therefore measured by the extra costs that are made to produce, irrespective of the actual increase in effectiveness of transferring knowledge. An input method follows this reasoning. Using this approach would make it impossible to actually evaluate the effect government policy had on the quality of education.

3.3 Indicators for quality-adjusted output

In practice it is not possible to measure transfer of knowledge directly and we will have to look for indicators that give a reasonable approximation.

The first suggestion is the simple use of pupil numbers or, preferably, numbers of pupil-hours. Using this will assume that there are no changes in the quality of teaching.

An indicator that will be affected by the quality of teaching is the number of pupils or students that graduate. It should be remembered that such an indicator is an approximation for output and not output itself: a school produces teaching, not diploma's. A school prepares pupils for examinations: the better they do that, the more pupils will pass. That's why the number of diploma's or graduates could be a better indicator of the amount of knowledge transferred than the number of pupils.

There are however some drawbacks to the use of diploma's as output indicator:

- Teaching given to pupils that do not graduate does not count as output;
- There are large differences in diploma's between schools and over time;
- There is a time lag between quality improvements and a possible increase in the number of graduates (the number of graduates in a certain year reflects the quality of the teaching of a number of years before that year);
- The time that pupils take to reach their graduation should be taken into account as well: output will decrease if pupils need more time.

Some of these drawbacks could be mitigated by looking at the number of pupils that successfully complete their present year of their course. Large parts of Dutch education (at least primary and secondary education) is organised in school years. For each year there is a minimum level of education that the pupil should have attained to be allowed to move up to the next year. Whether or not the pupil moves up is determined by his or her results during the year. There is no central examination system each year (only for the final graduation): schools can themselves decide which pupils move up. The number of pupils that move up each

year is an alternative output indicator that is affected by the quality of the teaching. Of course, there are other factors that influence the moving up ratios as well, for example changing the standards.

If such an indicator would be used, one would make the assumption that a pupil that has moved up has obtained all the knowledge that was required for that year, while a pupil that does not move up is assumed to have obtained none of the required knowledge. The big advantage of such a method is that there is no time lag problem as with the use of numbers of graduates: the moving up ratios reflect the quality of the teaching in that year.

For secondary education quite detailed information is available on the number of pupils that move up each year and the number that will have to do the year again. For primary education such information is also available. However, some types of education, in particular higher education, are not organised in this way.

Another alternative that follows that same kind of logic, is to look at the “expected” number of years that the current pupils need to obtain their graduation. The expected study duration is calculated through a model of the flow of students through the school system. For some types of education such calculations have already been made (see further on). However, for university education such calculations are complicated due to variations in the allowed study duration (see later).

Data on expected study duration’s can be used to adjust numbers of pupils using the following formula:

$$\text{adjusted \# pupils} = \text{\# pupils} * \left(\frac{\text{nominal study duration}}{\text{expected study duration}}\right)$$

If for example a course takes normally four years, but the average pupil takes five years to complete it, then each year on average only 4/5 = 80% of the knowledge that should have been transferred, is actually transferred. Therefore, the number of pupils should be adjusted with that factor. This adjustment factor is in fact an approximation for the yearly moving up ratio. This method is complicated at times where nominal study durations change, as has happened in higher education.

If only the number of graduates is known, and no information is available on moving up ratios or study durations, the following interpretation may help. Suppose the number of pupils is distributed equally over the respective school years, e.g. in a four-year course each year will have a quarter of the total number of pupils. Calculate the graduation ratio as the number of graduates divided by the number of pupils in the graduation year. Suppose subsequently that the moving up ratios for each year are equal to this graduation ratio. Under these assumptions the change in the number of graduates is equal to the change in the number of pupils that move up to their next year.

Another possible source of quality indicator are final examination scores. For secondary education, for example, the final examination is centrally organised: it would therefore be possible to analyse the trend in the final examination results. It is

however doubtful whether such a trend will exist. Final examination results seem better suited for comparison among schools than for a comparison in time.

In section 3 for each type of education the various alternatives will be analysed empirically. The aim for each type of education is to find the indicator that will give the best approximation of the amount of knowledge transferred to the pupils in a given year.

4. Results per type of education

For each type of education the available data will now be analysed to find the best output indicator possible.

The main data source are the Education Statistics from Statistics Netherlands. Data on numbers of pupils and graduates, as well as on moving up ratios are drawn from the Education Statistics. In a few cases, indicated where applicable, data were used from the Ministry of Education.

At some points it was necessary to complete the information. In the following tables, the figures printed in italics are estimates often based on extrapolations.

Pupil numbers for a certain year are determined on a reference date. For most types of schools, this is 1 October. Only for university education the reference date is 1 December. The number of pupils in, for example, calendar year 1997 is defined as the number of pupils at the reference date of the year. These data refer in fact to the school year 1997/1998. The data on graduates and moving up ratios in 1997 however refer in fact to school year 1996/1997.

Moving up ratios include the results of the final year of education, i.e. the final examination scores. Pupils that flow into the next year of a lower level of secondary education are also counted as moving up.

Ideally, the information on school years should be recalculated to calendar years. An initial calculation of the effect of this on the outcomes showed that for an individual year the volume growth of total education could change with 0.2 or 0.3 percentage points. The overall picture does not change however.

Furthermore, such a recalculation would make it difficult to trace back the used numbers in the Education Statistics. Therefore, for the moment this recalculation is not carried out. In the end, when implementing the methodology in the national accounts, it is recommendable to formulate all series in calendar years.

All volume indices presented below have reference year 1995 (1995=100).

4.1 Primary Education

For primary education there is information about:
-the total number of pupils,
-the composition of the "pupil stock",
-the percentage of pupils that move up each year,
-the scores of the "level-test" (so-called CITO-test).

In the following the advantages and disadvantages of these different sources of information will be discussed.

Number of pupils

The number of pupils in primary education in the nineties developed as follows:

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils primary education	1392	1408	1415	1427	1451	1477	1502	1520	1534
Number of participants to primary education for adults	115	121	134	145	139	125	118	110	116
Total, with adult education counting 10%	1404	1420	1428	1442	1465	1490	1514	1531	1546
Volume index pupils primary education	94,2	95,3	95,9	96,8	98,3	100,0	101,6	102,8	103,8

Primary education for adults is destined at teaching basic and social skills to Dutch and immigrant adults. Important parts of this are the courses "Dutch as second language". A rough calculation showed that the number of hours of teaching received per pupil is about 10% of the number of hours that children in primary education receive. Therefore, this factor is used to add the number of pupils in primary education to that in adult education.

The thus resulting volume index shows an average increase of 1.2 % per year in this period. As stated in the introduction the use of the number of pupils does not allow to observe quality changes. If pupil numbers determine the output of primary education, this output will be influenced to a large extent by demographic factors. Demographic factors are very important indeed: if there are more pupils, there will have to be more teaching, and vice versa.

Composition of the pupil stock

In a volume index that uses only pupil numbers, changes in the composition of the pupil stock, for example an increase of immigrant children, are not taken into account. If the starting level of knowledge of the pupils decreases, the schools will have to make a larger effort to maintain the final level. By distinguishing between different types of pupils, changes in the composition of the pupil stock can be included. This is possible since schools receive more resources for pupils that are behind in development.

Pupils whose parents are Dutch and have a lower level of education are called 1.25-pupils. If the parents of a pupil are foreigners that have a lower level of education, the pupil is called a 1.9-pupil. In the following table the composition of the pupil stock is shown:

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of 1.0-pupils	-	766	782	801	846	896	949	1042	1069
Number of 1.25-pupils	-	480	468	452	424	396	363	285	267
Number of 1.9-pupils	-	156	162	170	176	181	184	189	194
Volume index using composition	-	95,4	96,2	97,1	98,5	100,0	101,4	102,2	103,1

The total number of pupils in the above table differs slightly from the total given in the first table of this paragraph since a few thousand so-called 1.4- and 1.7-pupils have been left out. The numbers of pupils per type are weighted together using cost factors. These cost factors reflect the average relative amounts of extra resources granted per pupil of a certain type. A rough estimation of the weighting factors based on information of the ministry of Education resulted in the following factors: 1.09 for a 1.25-pupil and 1.42 for a 1.9-pupil. The calculated cost factors are based on global data of the year 1999 that are provided by the Ministry of Education. In the table, it is assumed that the cost factors do not significantly change in time, so that the cost factors of 1999 have been applied to the years 1991-1998. According to the ministry of Education this assumption is not entirely correct. Netherlands Statistics does not have the data to calculate the cost factors more accurately. To the weighted total number of pupils again 10% of the number of pupils in adult education is added and the resulting volume index is shown above. The index differs slightly from the one based on the number of pupils. Nevertheless, the refinement could be of increasing importance in the future. However, because of the uncertainty in the cost factors, for the time being, the weighted index will not be used for the calculation of the overall index for education.

Pupils that move up each year

It appears that only 11% of the pupils (with a weight of 1.0) in the primary education need 9 years instead of the nominal 8 years to finish primary school. Practically no pupils need more than 9 years. This results in a moving up ratio of 0,986 per year. For 1.25 and 1.9-pupils the moving up ratios per year are respectively 0.979 and 0.967. Since these factors are almost constant over the years and very close to one, a correction of the numbers of pupils with these factors does not have a significant effect.

CITO-test

The CITO-test is a national test that a large proportion of the Dutch children make in the last year of primary education. The aim of the test is to get an indication for the level of secondary education that a pupil could attain. The average score of all pupils over the years 1995-2000 does not change. There are no CITO-scores available that are specified per type of pupil. As a consequence, it appeared not to be useful to apply the CITO-scores as an indicator for quality changes. Since 2 years also introduction tests are organised in the 6th and 7th school year. In the future it may be possible to compare the results of the introduction tests to those of the final test, and thus draw some conclusions about the “amount of transferred knowledge” in the last years of primary school.

4.2 Special Education

Special education is primary and first stage secondary education for children with learning or behavioural difficulties and handicapped children.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number pupils special education	108	109	111	114	116	119	120	121	123
Volume index pupils special education	90,8	91,6	93,3	95,8	97,5	100,0	100,8	101,7	103,4

The number of pupils in special education increased on average with 1.6% per year. Obviously, for special education concepts like graduates, moving up ratios or study duration have no meaning as indicator for performance.

4.3 Secondary Education

4.3.1 First general years

In the first two or three years of secondary education pupils follow a general program before they decide at which level of secondary education they will continue. Therefore, the first years cannot be attributed to any of the different levels that we will encounter in the next sections. For these years, data are available on pupil numbers and moving up ratios.

The number of pupils in the first general years is low around 1995 but is in the end practically unchanged compared to 1990. However, pupils move much faster through the years: the percentage of pupils that had to repeat a year is almost halved. The number of pupils that move up to the next year is therefore slightly increasing. It does not seem likely that an improvement of the performance of pupils of this magnitude is caused by lowering of the standards.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils first general years	382	378	380	383	376	362	360	366	379
Volume index pupils first general years	105,5	104,4	105,0	105,8	103,9	100,0	99,4	101,1	104,7
Percentage pupils not moving up to next year	*7*	6,5	6,5	6,0	4,5	4,0	3,5	3,5	*3,5*
Number of pupils moving up	355	353	355	360	359	348	347	352	365
Volume index pupils first general years moving up	102,2	101,7	102,2	103,6	103,3	100,0	100,0	101,6	105,2

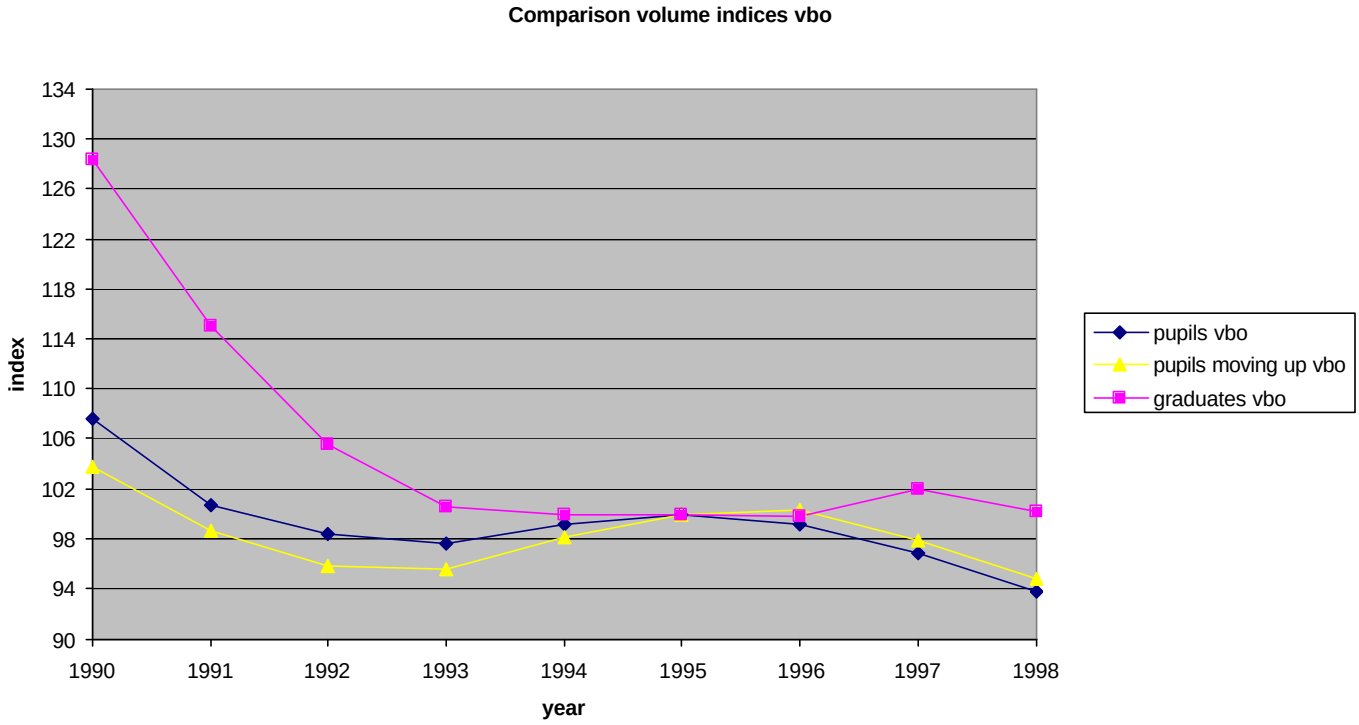
4.3.2 Pre-vocational Education (vbo)

Pre-vocational education (vbo) is secondary education comprising four years that prepares for further vocational education. The first two years of vbo are in the first general years described in section 3.3.1. This section comprises the last two years of vbo. We have data on number of pupils, graduates and moving up ratios (which are in this case an estimate based on data from the Ministry of Education; they might not be totally comparable to the moving up ratios used for other types of education).

The number of graduates show a big decrease in the first few years. The number of pupils decrease slightly with a little upturn around 1995. The schools have

nevertheless managed to reduce the percentage of pupils not moving up by 50%. One would expect that this reduction would also influence the number of graduates, possibly with a time-lag. An indication for this effect could possibly be the fact that the number of graduates in the last few years is quite stable or even slightly increasing, while the number of pupils continues falling (see also the following graph).

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils vbo	140	131	128	127	129	130	129	126	122
Volume index pupils vbo	107,7	100,8	98,5	97,7	99,2	100,0	99,2	96,9	93,8
Percentage pupils not moving up to next year	*9*	*7,5*	*8,0*	*7,5*	*6,5*	*5,5*	*4,5*	*4,5*	*4,5*
Number of pupils moving up	127	121	118	117	121	123	123	120	117
Volume index pupils vbo moving up	103,7	98,6	95,9	95,6	98,2	100,0	100,3	97,9	94,8
Number of graduates	71	64	59	56	56	56	56	57	56
Volume index graduates vbo	128,4	115,1	105,6	100,5	100,0	100,0	99,8	102,0	100,2

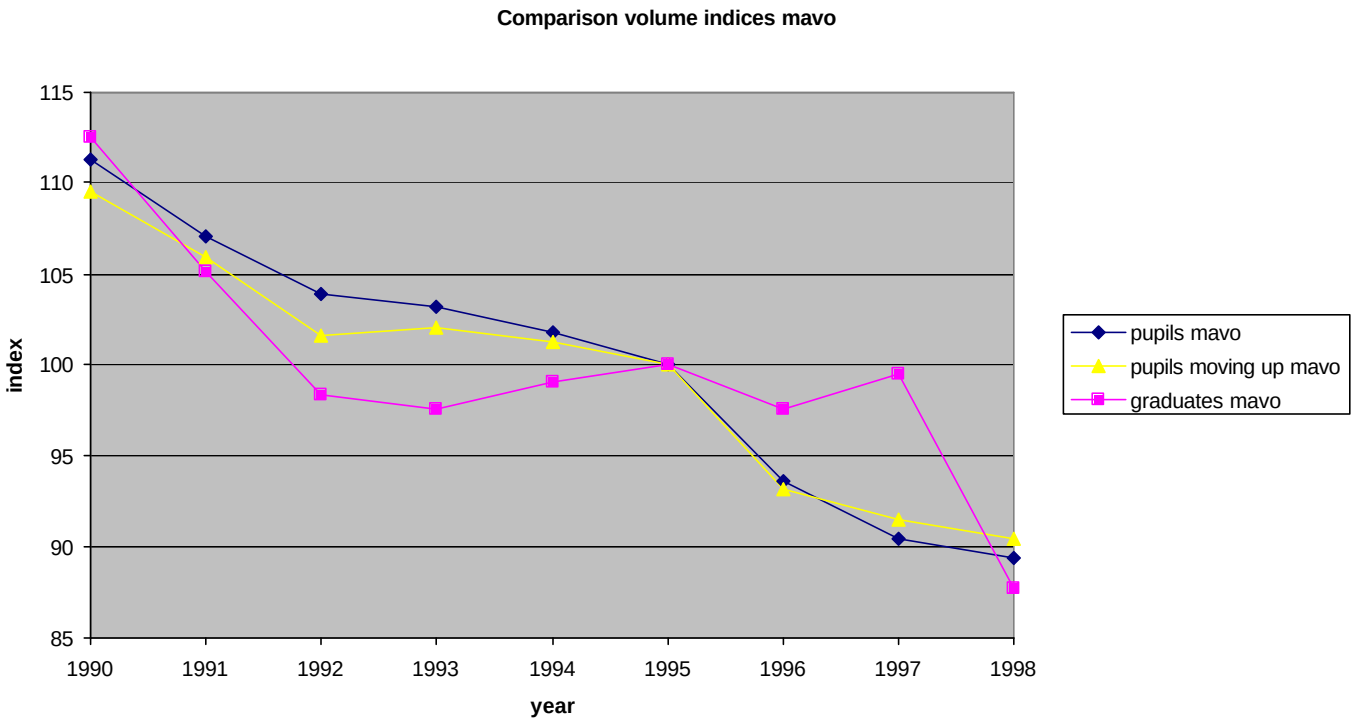


4.3.3 Lower General Secondary Education (mavo)

Mavo is the lower level of general secondary education, comprising four years. The first two years are included in section 3.3.1. This section only includes the last two years of mavo, plus part-time mavo, which is mostly adult education. There are no data on the number of hours of teaching received by the part-time pupils. It is therefore assumed that part-time pupils receive 50% of the amount of teaching per year that full-time pupils receive. The number of graduates consists of graduates from both full-time and part-time courses, both counting for full.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils full-time mavo	131	127	123	121	120	118	111	102	100
Number of pupils part-time mavo	53	49	48	50	48	47	43	52	53
Total, with part-time pupils counting 50%	158	152	147	146	144	142	133	128	127
Volume index pupils mavo	111,3	107,1	103,9	103,2	101,8	100,0	93,6	90,5	89,4
Percentage pupils not moving up to next year	*9*	8,5	9,5	8,5	8,0	7,5	8,0	6,5	*6,5*
Number of pupils moving up	143	139	133	134	132	131	122	120	118
Volume index pupils mavo moving up	109,5	105,9	101,6	102,1	101,2	100,0	93,1	91,4	90,4
Number of graduates	61	57	54	53	54	54	53	54	48
Volume index graduates mavo	112,5	105,1	98,3	97,6	99,1	100,0	97,6	99,4	87,7

Mavo also shows a decrease of the number of pupils and graduates. The percentage of pupils not moving up is also decreasing but not as strongly as the previous two school types. The difference between numbers of pupils and numbers of pupils moving up is therefore not very large. The number of graduates drops spectacularly in 1991 and 1992, after which it is reasonably stable until 1997. In 1998 there is again a considerable fall. Seen over the whole period, the decreases in the various indices are not too far apart.

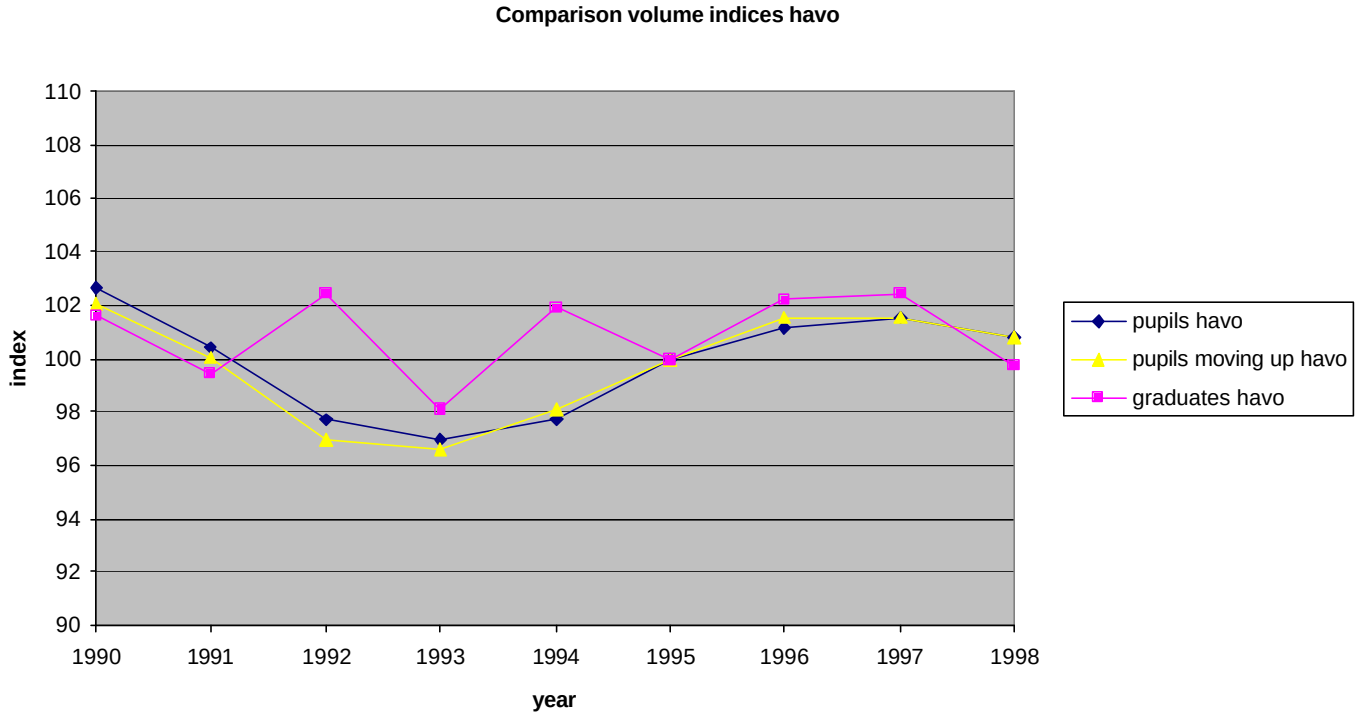


4.3.4 Higher General Secondary Education (havo)

Havo is the higher level of general secondary education, comprising five years. The first two years are included in section 3.3.1. This section only includes the last three years of havo, plus part-time havo, which is mostly adult education. There are no data on the number of hours of teaching received by the part-time pupils. It is therefore assumed that part-time pupils receive 50% of the amount of teaching per year that full-time pupils receive. The number of graduates consists of graduates from both full-time and part-time courses, both counting for full.

The number of pupils in havo is in 1998 at about the same level as in 1990, due to increases in particular in 1995 and 1996. The high percentage of pupils that do not move up is striking. Moreover, it does not decrease as it does for other school types. The variation in the number of graduates is minimal.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils full-time havo	125	123	120	119	120	124	126	127	127
Number of pupils part-time havo	*19*	*17*	16	16	16	14	13	12	10
Total, with part-time pupils counting 50%	135	132	128	127	128	131	133	133	132
Volume index pupils havo	102,7	100,4	97,7	96,9	97,7	100,0	101,1	101,5	100,8
Percentage pupils not moving up to next year	*12,5*	12,3	12,7	12,3	11,7	12,0	11,7	12,0	*12,0*
Number of pupils moving up	118	115	112	111	113	115	117	117	116
Volume index pupils havo moving up	102,1	100,0	97,0	96,6	98,1	100,0	101,5	101,5	100,8
Number of graduates	37	36	38	36	37	37	37	38	37
Volume index graduates havo	101,6	99,5	102,5	98,1	101,9	100,0	102,2	102,5	99,7

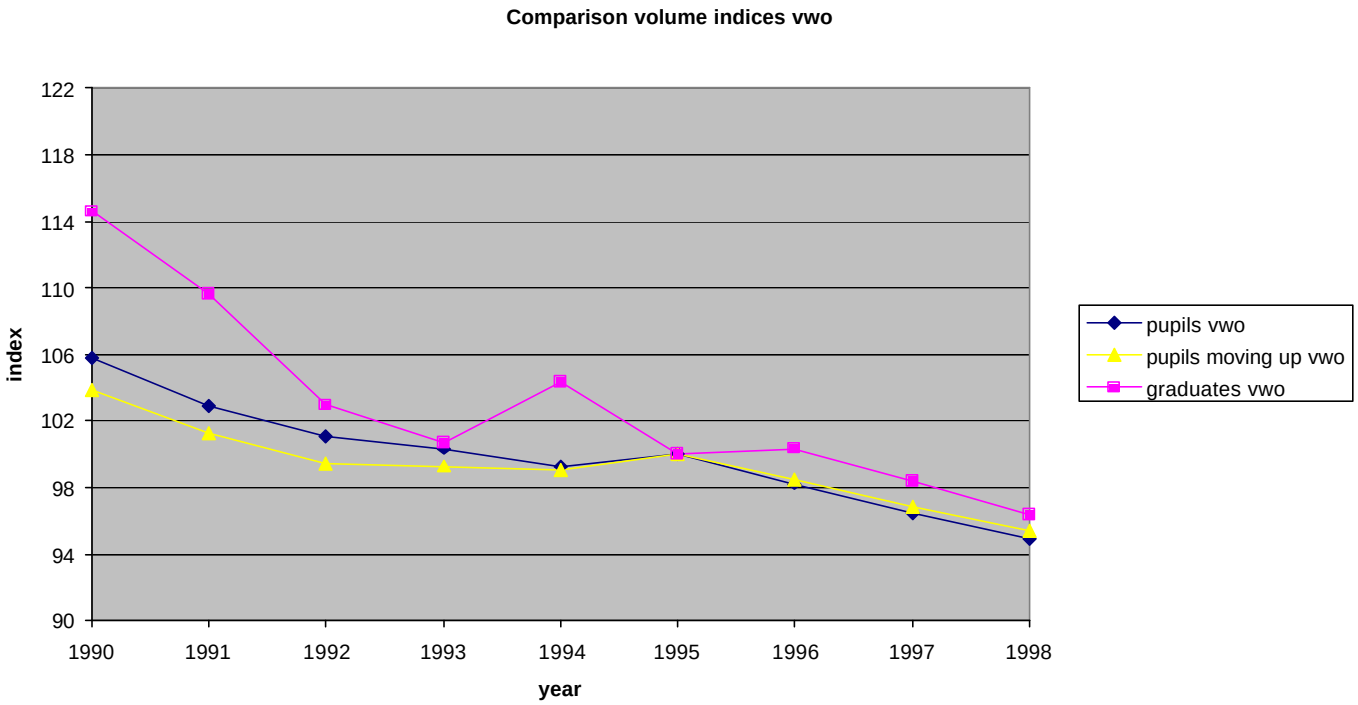


4.3.5 Pre-university Education (vwo)

Vwo is the highest level of general secondary education, comprising six years, that prepares for university education. The first three years are included in section 3.3.1. This section only includes the last three years of vwo, plus part-time vwo, which is mostly adult education. There are no data on the number of hours of teaching received by the part-time pupils. It is therefore assumed that part-time pupils receive 50% of the amount of teaching per year that full-time pupils receive. The number of graduates consists of graduates from both full-time and part-time courses, both counting for full.

The number of graduates drops considerably in 1991 and 1992, after which it remains more or less stable. The number of pupils falls continuously (in contrast with the number of pupils in havo!). Vwo does succeed in reducing the percentage of pupils that do not move up, so that the fall in the number of pupils that move up is less strong.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils full-time vwo	139	135	133	133	132	134	132	130	129
Number of pupils part-time vwo	*15*	*15*	14	12	11	9	8	7	5
Total, with part-time pupils counting 50%	147	143	140	139	138	139	136	134	132
Volume index pupils vwo	105,8	102,9	101,1	100,4	99,3	100,0	98,2	96,4	94,9
Percentage pupils not moving up to next year	*8*	7,8	7,8	7,3	6,5	6,3	6,0	5,8	*5,8*
Number of pupils moving up	135	131	129	129	129	130	128	126	124
Volume index pupils vwo moving up	103,8	101,2	99,5	99,3	99,0	100,0	98,5	96,9	95,4
Number of graduates	35	33	31	30	32	30	30	30	29
Volume index graduates vwo	114,6	109,6	103,0	100,7	104,3	100,0	100,3	98,3	96,4



4.3.6 Secondary Education, Total

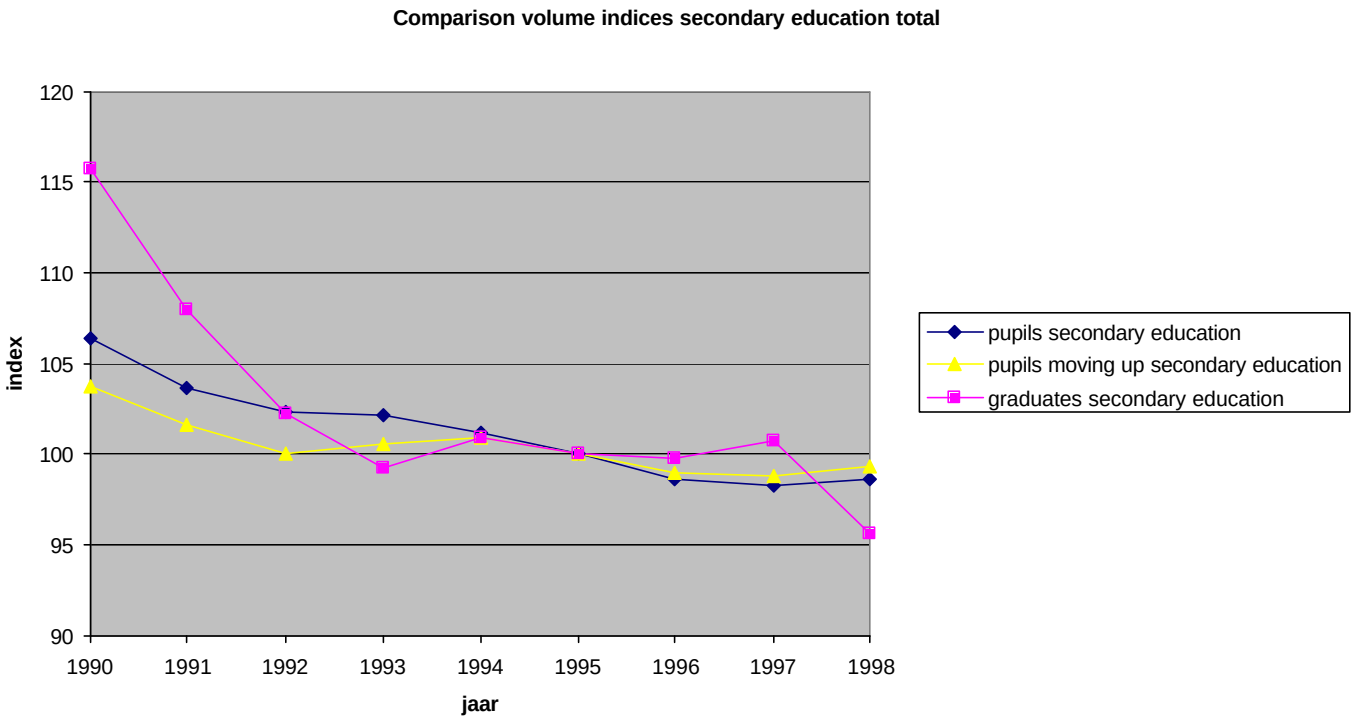
The next table and graph summarises the previous data for secondary education as a whole (without weighting the different school types).

The graph illustrates the drawback of using the number of graduates as indicator of output: using this indicator would show a decline of the output of secondary education in 1991 and 1992 of in total 12%. This will be caused mainly by developments that took place before these years. In the years 1991 and 1992 the number of pupils indeed falls, but a 12% decrease in two years time in the output (= transferred knowledge) does not seem realistic.

Moreover we have seen that pupils move much faster through the system: the moving up ratios have improved considerably for most school types. It does not seem realistic to assume that these improvements can be explained fully by lower standards. Also because there is one school type (havo) where there is no improvement. This corresponds to the known fact that the performance of this school type is the most problematic of all school types, and that few improvements have been achieved. This would be the school type most susceptible to lowering of the standards.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils full-time secondary education	916	895	885	883	876	867	858	852	856
Number of pupils part-time secondary education	88	81	78	78	74	71	64	70	68
Total, with part-time pupils counting 50%	960	936	924	922	913	903	890	887	890
Volume index pupils secondary education	106,4	103,7	102,4	102,2	101,2	100,0	98,6	98,3	98,6
Percentage pupils not moving up to next year	8,5	8,1	8,3	7,7	6,5	6,2	5,9	5,8	5,6
Number of pupils moving up	878	860	847	851	854	846	837	836	841
Volume index pupils secondary education moving up	103,8	101,6	100,1	100,6	100,9	100,0	98,9	98,8	99,3
Number of graduates	205	191	181	175	178	177	176	178	169
Volume index graduates secondary education	115,8	107,9	102,3	99,2	100,9	100,0	99,8	100,8	95,6

The improvements in moving up ratios are furthermore improvements that have been achieved in the respective years, i.e. there is no time lag problem. All in all, it seems that the index based on numbers of pupils moving up gives the most reasonable result.



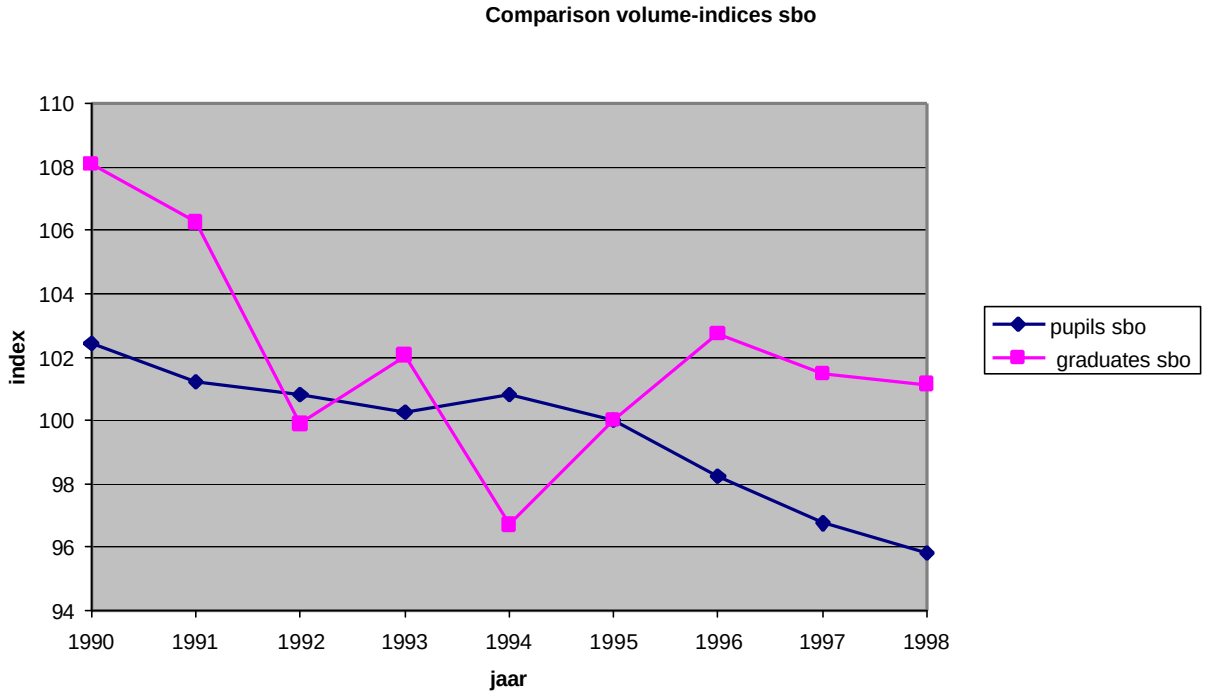
4.4 Senior Vocational Education (sbo)

Senior vocational education (sbo) is a very practice oriented type of education. It can be followed after having followed pre-vocational training or mavo. It is difficult to define exactly the number of hours of teaching received by the pupils because much of the knowledge is transferred during practical ‘stages’ or apprenticeships. Moreover, many types of this education can be followed in part-time. For simplicity, it is assumed that part-time pupils receive 50% of the hours that full-time pupils receive.

There are unfortunately no data on moving up ratios for this type of education. It is in fact very difficult to define such ratios. There are however data on numbers of graduates. For graduates, no distinction is made between full-time and part-time pupils.

In this case, the volume indices based on pupils and graduates are reasonably comparable: seen over the whole period is the decrease in the numbers of pupils and graduates practically the same (about 0.8% per year). Apparently, there have hardly been any improvements or deteriorations in performance. The number of graduates shows bigger variations than the number of pupils.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of pupils full-time sbo	288	284	283	285	290	289	285	*280*	275
Number of pupils part-time sbo	181	180	179	171	165	161	156	*155*	158
Total, with part-time pupils counting 50%	379	374	371	371	373	370	363	358	354
Volume index pupils sbo	102,4	101,2	100,8	100,3	100,8	100,0	98,2	96,8	95,8
Number of graduates	95	93	88	90	85	88	90	89	89
Volume index graduates sbo	108,1	106,3	99,9	102,0	96,7	100,0	102,7	101,5	101,1



4.5 Vocational colleges (hbo)

The vocational colleges (hbo) form the highest form of vocational education. The nominal study length is four years. There are data on student numbers and graduates.

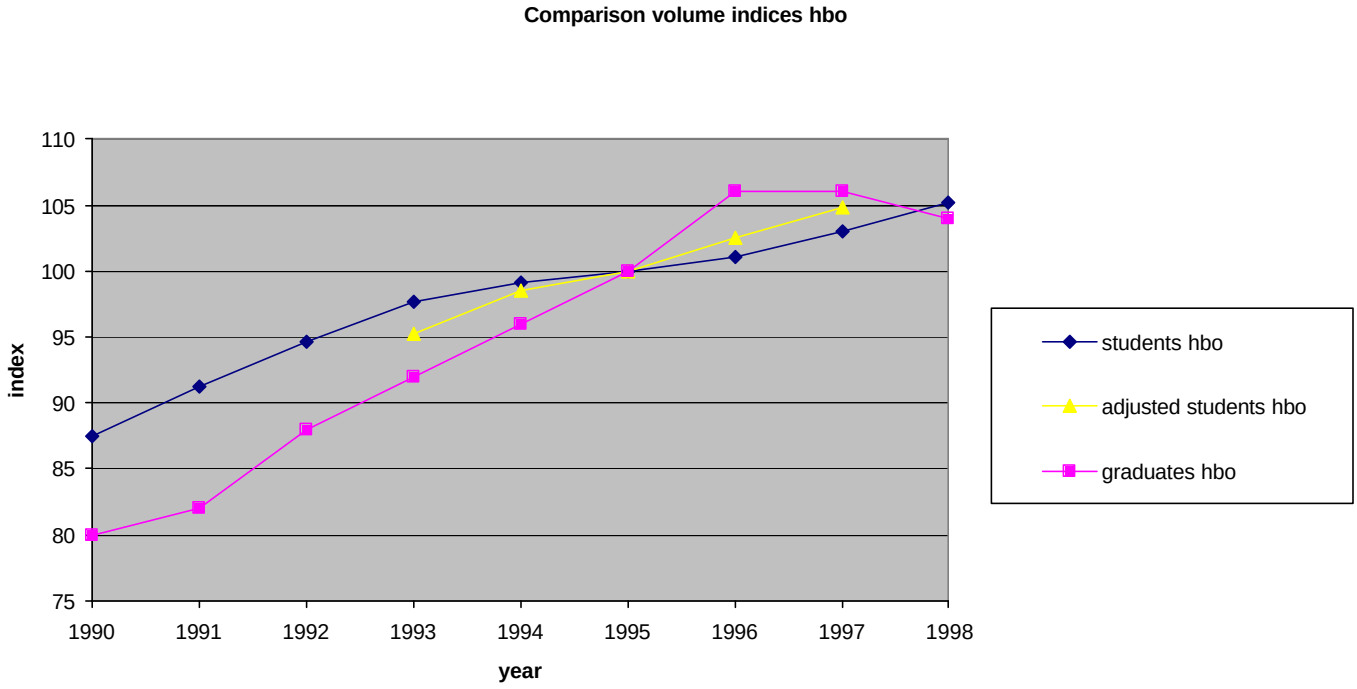
Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of students full-time hbo	194	205	214	222	228	231	233	237	241
Number of students part-time hbo	53	50	49	48	44	42	43	45	48
Total, with part-time students counting 50%	221	230	239	246	250	252	255	260	265
Volume index students hbo	87,5	91,3	94,6	97,6	99,2	100,0	101,0	103,0	105,2
Number of graduates	40	41	44	46	48	50	53	53	52
Volume index graduates hbo	80,0	82,0	88,0	92,0	96,0	100,0	106,0	106,0	104,0

In the vocational colleges there is a clear increase in the number of students, but an even bigger increase in the number of graduates. This indicates an improvement of the performance.

The Ministry of Education calculates for the vocational colleges a series of the expected study duration of the student population in a certain year. This series however only goes back to 1993. It shows a clear decrease of the average study duration, which again points at efficiency gains.

If the number of students is adjusted for this decrease in study duration we find a stronger increase of the output, but still not as strong as the increase in the number of graduates, as is shown in the graph.

	1993	1994	1995	1996	1997
Expected study duration in hbo	4,59	4,51	4,48	4,41	4,40
4/expected study duration	0,87	0,89	0,89	0,91	0,91
Adjusted number of students	214	222	225	231	236
Volume index adjusted number of students hbo	95,3	98,5	100,0	102,6	104,8



4.6 University education (wo)

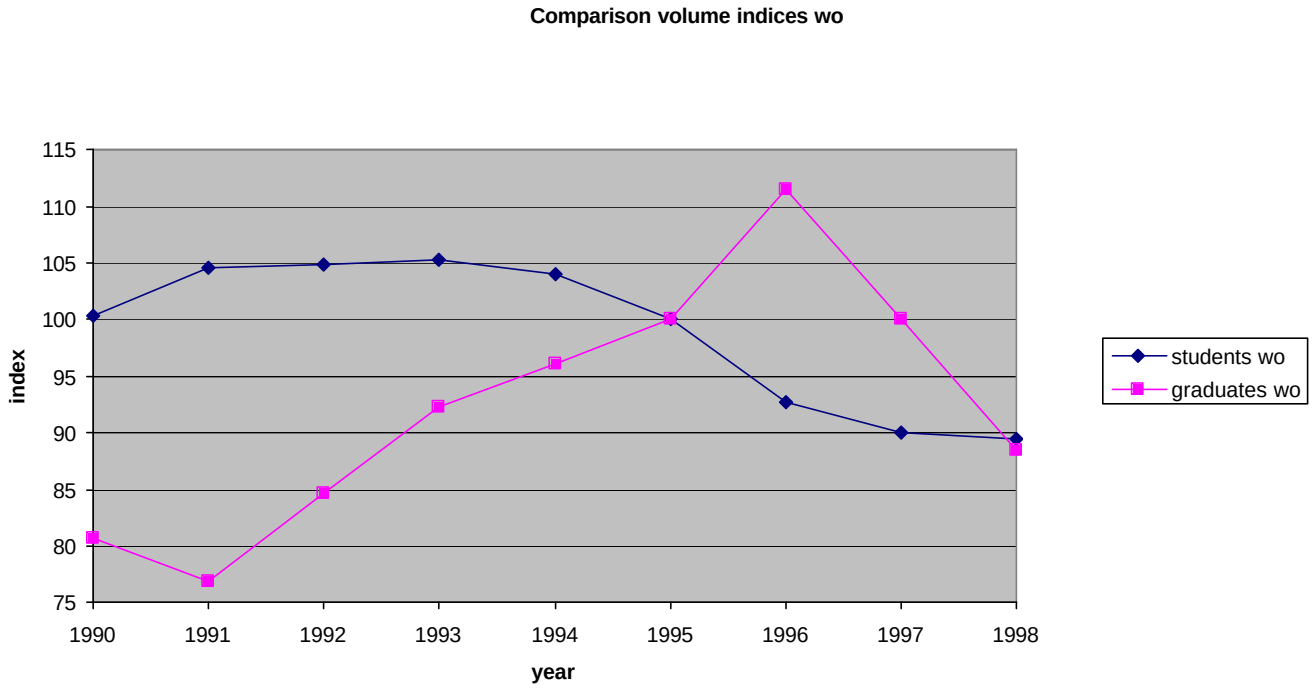
On the universities, the number of students drops considerably whereas the number of graduates increases (except for the last two years). In principle, this could be interpreted as an improvement of performance. However, it should be noted that in this period rules for study grants have changed: students had to study faster in order not to loose their grants. On the one hand, the total number of registered students decreased because the study duration per student decreased. On the other hand, students that got grants according to the old and the new rules graduated at the same time, causing for example a peak in the number of graduates in 1996.

The series of number of graduates varies a lot compared to the series of the number of students. An explanation is that the effect of demographic changes is stronger for the number of graduates than for the total number of students. In addition, the large relative variations are partly caused by the small population of graduates. A small absolute change might look large in relative terms. This effect can be mitigated somewhat by taking a moving average.

For university education it would in principle also be possible to calculate expected study durations, as was done for the vocational colleges. However, such a calculation is hampered by the fact that , as stated above, the nominal study duration has changed. This change was not the same for each discipline. For example, nowadays students in technical physics get a grant for 5 years whereas language students get a grant for only 4 years. For each discipline an expected study duration should thus be calculated. At the moment only realised study durations per group of disciplines (so-called HOOP group) can be calculated for students that have

finished. Expected study durations are calculated per HOOP-group by the Ministry of Education, however realised and expected study durations differ significantly. At the moment it is not possible to improve the volume index for university education by the use of expected study durations.

Reference date 1 Oct., x1000	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of students full-time wo	164	172	173	174	172	166	153	148	147
Number of students part-time wo	15	14	13	12	12	10	11	12	12
Total, with part-time students counting 50%	172	179	180	180	178	171	159	154	153
Volume index students wo	100,3	104,7	105,0	105,3	104,1	100,0	92,7	90,1	89,5
Number of graduates	21	20	22	24	25	26	29	26	23
Volume index graduates wo	80,8	76,9	84,6	92,3	96,2	100,0	111,5	100,0	88,5



5. Cost shares

The next table gives the government expenses on the various types of education. Expenses that cannot be attributed to a certain type of education, such as the expenses for general administration (e.g. the Ministry) are not included, so that the total expenses do not correspond to the expenses that are published in the Education Statistics or in the government budget. Since the expenses per type of education are used as weights in the construction of the overall volume index, it is most of all the shares of each type of education in the total that is important than the absolute numbers.

Some assumptions had to be made, in particular with respect to the costs for the various types of secondary education. The last years showed many mergers of schools which make it hard to allocate the costs over the various school types. Statistics Netherlands publishes for that reason only the expenses for secondary education, vocational education and adult education as a whole.

In data from the Ministry, however, some more indications were found, in particular on costs per pupil. All data did not totally match, but a distribution was nevertheless made.

For university education, the expenses for research had to be separated. Also expenses student’s season public transport tickets and study grants had to be separated.

The share of each type of education in total expenses in year t-1 is the weighting factor for the volume index of that type of education in the overall volume index for year t (i.e. the volume change from year t-1 to year t).

If the volume index of a school type is based on numbers of pupils, than this weighting is equivalent to weight each pupil with the expenses per pupil. If the volume index is based on another unit of output, such as the number of graduates, each unit will be weighted by the expenses per unit, e.g. the expenses per graduate.

Total government expenses in billions of guilders	1990	1991	1992	1993	1994	1995	1996	1997
Primary education	*6,0*	*6,2*	*6,6*	*6,6*	*7,0*	*7,3*	*7,5*	*7,6*
Special education	*1,3*	*1,4*	*1,5*	*1,6*	*1,7*	*1,7*	*1,7*	*1,8*
First common years of secondary education	*2,5*	*2,7*	*3,0*	*3,0*	*3,2*	*3,3*	*3,3*	*3,5*
Pre-vocational education	*1,3*	*1,3*	*1,3*	*1,4*	*1,4*	*1,4*	*1,5*	*1,5*
Lower general secondary education	*0,9*	*1,0*	*1,1*	*1,0*	*1,1*	*1,2*	*1,1*	*1,1*
Higher general secondary education	*0,9*	*0,9*	*1,0*	*1,0*	*1,1*	*1,2*	*1,2*	*1,3*
Pre-university education	*1,1*	*1,1*	*1,2*	*1,2*	*1,3*	*1,3*	*1,3*	*1,4*
Senior vocational education	*2,2*	*2,3*	*2,2*	*2,4*	*2,4*	*2,5*	*2,7*	*2,8*
Vocational colleges	*3,4*	*3,5*	*3,7*	*3,9*	*4,2*	*4,2*	*4,4*	*4,6*
University education (i.e. excl. research)	*2,6*	*2,7*	*2,9*	*2,8*	*2,9*	*3,1*	*3,1*	*3,1*
Total	*22,2*	*23,0*	*24,4*	*24,9*	*26,1*	*27,1*	*27,8*	*28,5*

Total government expenses per pupil in 1000 guilders	1990	1991	1992	1993	1994	1995	1996	1997
Primary education	*4,3*	*4,4*	*4,6*	*4,6*	*4,7*	*4,9*	*4,9*	*5,0*
Special education	*12,4*	*12,8*	*13,4*	*13,8*	*14,2*	*14,2*	*14,1*	*14,7*
First common years of secondary education	*6,6*	*7,1*	*7,8*	*7,8*	*8,5*	*9,0*	*9,2*	*9,4*
Pre-vocational education	*9,0*	*9,7*	*9,9*	*10,9*	*10,7*	*10,7*	*11,4*	*11,7*
Lower general secondary education	*6,0*	*6,4*	*7,2*	*7,1*	*7,8*	*8,3*	*8,4*	*8,7*
Higher general secondary education	*6,6*	*7,1*	*7,8*	*7,8*	*8,5*	*9,0*	*9,2*	*9,4*
Pre-university education	*7,3*	*7,7*	*8,5*	*8,5*	*9,2*	*9,7*	*9,9*	*10,2*
Senior vocational education	*5,9*	*6,0*	*6,0*	*6,4*	*6,3*	*6,7*	*7,3*	*7,7*
Vocational colleges	*15,5*	*15,3*	*15,5*	*16,0*	*16,7*	*16,7*	*17,3*	*17,7*
University education (i.e. excl.research)	*15,1*	*15,1*	*16,1*	*15,4*	*16,1*	*18,2*	*19,5*	*20,1*

6. Overall volume indices

The following volume indices for education as a whole have been analysed:

- Index of the number of pupils and students without weighting
- Index of the number of pupils and students with weighting with expenses per pupil/student
- Index of a combination of numbers of pupils and graduates ("combination index 1")
- Index of a combination of numbers of pupils and the moving average of graduates ("combination index 2")
- Index of a combination of numbers of pupils, pupils moving up and graduates ("combination index 3")
- Current volume index according to the input method. This is composed of a part before the recent revision of the national accounts and a part after revision. Before revision it concerns the volume index of the output of the branch "subsidised education". This is including research at universities. After revision the volume index of the total supply of the product group "subsidised education" is taken. This does not include research. Strictly speaking, the indices before and after revision are not totally comparable, but the difference will be minimal.

The exact composition of the combination indices is as follows:

	Combination index 1	Combination index 2	Combination index 3
Primary education	Pupils	Pupils	Pupils
Special education	Pupils	Pupils	Pupils
First common years of secondary education	Pupils	Pupils	Pupils moving up
Pre-vocational education	Graduates	(graduates t-1 + graduates t)/2	Pupils moving up
Lower general secondary education	Graduates	(graduates t-1 + graduates t)/2	Pupils moving up
Higher general secondary education	Graduates	(graduates t-1 + graduates t)/2	Pupils moving up
Pre-university education	Graduates	(graduates t-1 + graduates t)/2	Pupils moving up
Senior vocational education	Graduates	(graduates t-1 + graduates t)/2	Pupils
Vocational colleges	Graduates	(graduates t-1 + graduates t)/2	(graduates t-1 + graduates t)/2
University education (i.e. excl.research)	Graduates	(graduates t-1 + graduates t)/2	(graduates t-1 + graduates t)/2

Here are the results:

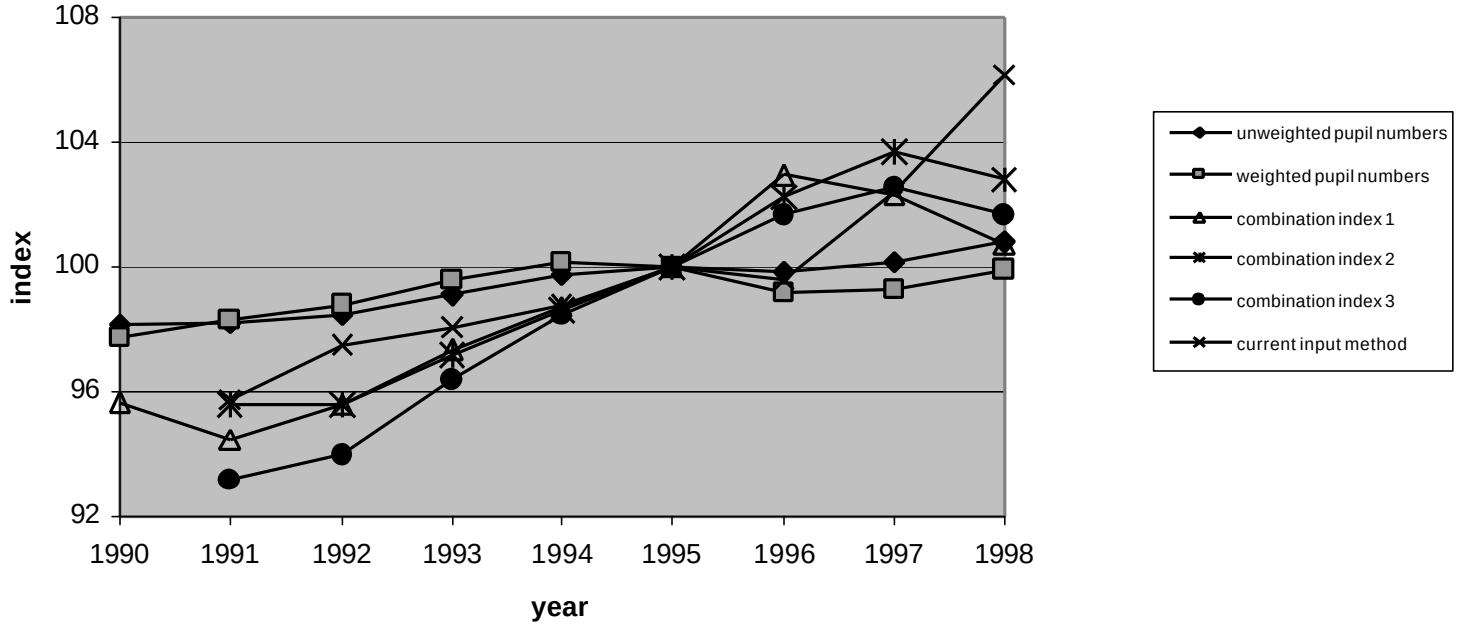
Volume indices, 1995=100	1990	1991	1992	1993	1994	1995	1996	1997	1998
Unweighted pupil numbers	98,1	98,3	98,5	99,1	99,8	100,0	99,9	100,2	100,8
Weighted pupil numbers	97,8	98,3	98,8	99,6	100,1	100	99,2	99,3	99,9
Combination index 1	95,7	94,5	95,6	97,4	98,7	100	102,9	102,3	100,7
Combination index 2		95,6	95,6	97,2	98,6	100	102,2	103,7	102,8
Combination index 3		93,2	94,0	96,4	98,5	100	101,7	102,5	101,7
Current input method		95,8	97,5	98,0	98,8	100,0	99,6	102,4	106,2

For completeness here also the yearly changes:

Yearly changes	1990	1991	1992	1993	1994	1995	1996	1997	1998
Unweighted pupil numbers		100,1	100,2	100,6	100,7	100,2	99,9	100,3	100,7
Weighted pupil numbers		100,6	100,4	100,8	100,5	99,9	99,2	100,1	100,7
Combination index 1		98,8	101,1	101,9	101,3	101,3	102,9	99,4	98,4
Combination index 2			100,0	101,7	101,4	101,4	102,2	101,4	99,2
Combination index 3			100,9	102,6	102,1	101,6	101,7	100,9	99,2
Current input method			101,8	100,5	100,8	101,2	99,6	102,8	103,7

The next graph also shows these indices.

Comparison volume indices total education



From these data we can draw the following conclusions:

- In general, the differences between the yearly changes of the various indices are not too large. Seen over the whole period there are however considerable differences.
- The indices of pupil numbers have a clearly different trend than the combination indices. The current index on the basis of the input method is comparable with the combination indices until 1996 but increases fastly in 1997 and 1998.
- The indices of numbers of pupils show hardly any variation. The effect of weighting with expenses per pupil on the overall indices is very limited.
- The effect of taking the moving average of the number of graduates is also limited (compare combination indices 1 and 2). As expected, the index becomes a bit more stable. The peak in university graduations in 1996, for example, is flattened out.
- The combination indices 1 and 2, based to a large extent on numbers of graduates, show first a decrease, but grow then steadily until 1997 and 1998, in which years they decline again.
- Combination index 3, based to a large extent on numbers of pupils moving up, follows the trend of combination indices 1 and 2, but begins and ends a bit lower.
- The current index based on the input method shows a large deviation from the other indices in the years 1997 and 1998. This increase is due to extra resources allocated to education, in particular meant to reduce the class size (indeed many new teachers were recruited) and to increase the use of computers in class rooms. The effect of such investments will only be shown – if at all – after a few years in the numbers of graduates or pupils moving up (but never in the numbers of pupils).

7. Effect on labour productivity

The national accounts contain the following data on labour input in the branch "subsidised education".

X 1000 labour years	1990	1991	1992	1993	1994	1995	1996	1997	1998
Volume of labour before revision	238	237	238	238	238	239			
Volume of labour after revision						274,9	280,8	285,1	286
Yearly changes		99,6	100,4	100,0	100,0	100,4	102,1	101,5	100,3
Volume index	99,6	99,2	99,6	99,6	99,6	100	102,1	103,7	104,0

The labour input in education remained practically constant from 1990 to 1995. In the later years there is however a significant increase. The data on labour input were considerably revised upwards (15%) during the revision. It is therefore unsure to what extent the yearly changes are comparable before and after the revision.

For further comparison of the various indices, the effect on labour productivity is calculated by dividing the output volume indices by the above labour input index.

Labour productivity indices, 1995=100	1990	1991	1992	1993	1994	1995	1996	1997	1998
Unweighted pupil numbers	98,6	99,1	98,9	99,5	100,2	100,0	97,8	96,6	96,9
Weighted pupil numbers	98,2	99,2	99,2	100,0	100,5	100,0	97,1	95,7	96,1
Combination index 1	96,1	95,3	96,0	97,8	99,1	100,0	100,8	98,6	96,8
Combination index 2		96,4	96,0	97,6	99,0	100,0	100,1	99,9	98,8
Combination index 3		94,0	94,4	96,8	98,9	100,0	99,5	98,9	97,8
Current input method		96,6	97,9	98,5	99,2	100,0	97,5	98,7	102,1

They are also shown in the next graph

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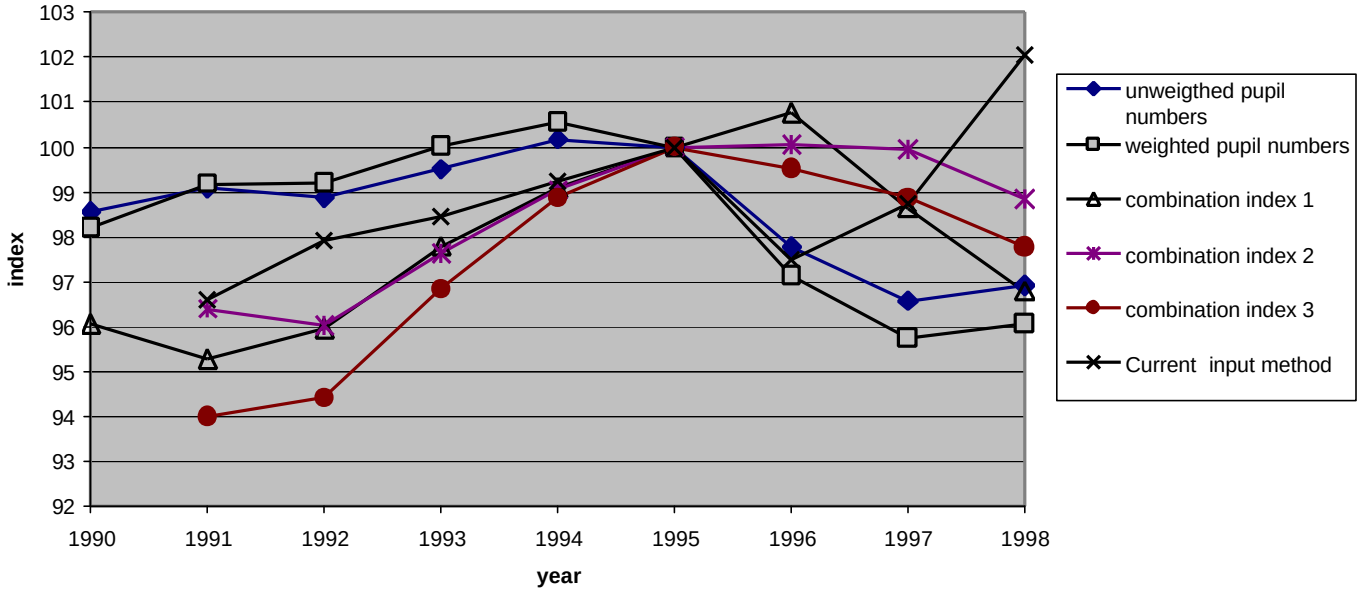
Effects on labour productivity changes



Using an index based on pupil numbers will lead to a decrease of labour productivity since 1995, which is a direct consequence of the increase in labour input with a constant population of pupils. The other indices are grossly comparable, except for the present input method in 1997 and 1998. This shows a large increase in labour productivity simply because the volume of labour has increased. This is not a meaningful result.

8. Effect on GDP growth

The next table gives a tentative estimate of the effect that the various indices have on the GDP (market prices) growth figure. This is calculated by deflating the government consumption of subsidised education (which contributes directly to GDP).

GDP growth figure	1996	1997	1998
Unweighted pupil numbers	103,0	103,7	103,5
Weighted pupil numbers	103,0	103,7	103,5
Combination index 1	103,1	103,6	103,5
Combination index 2	103,1	103,7	103,5
Combination index 3	103,1	103,7	103,5
Current figure	103,0	103,8	103,7

For 1996, growth is 0.1 percentage point higher according to combination indices 1, 2 and 3. For 1997 and 1998 the new indices have a lowering effect because the input method gives a strong growth for these years. For 1998 the effect is even 0.2 percentage point which can be called significant.

9. Conclusions and suggestions for future research

Which index gives the best representation of the trend in the output of education?

It will certainly not be the current index on the basis of an input method: the assumed relation between inputs and outputs has not been shown to exist or at least not in the same year.

It will also not be an index based on pupil numbers alone. In this index none of the various performance improvements we have encountered is taken into account.

The indices using indicators such as graduates and pupils moving up do show these performance improvements. On the basis of the time lag argument, the index using pupils moving up (combination index 3) seems preferable. According to this index, the average yearly output volume change is 1.2 % over the years 1991-1998, and the labour productivity change is 0.5 %.

Obviously, such indices remain rude descriptions of the developments in the educational system. There are debatable assumptions (such as on the relationship between the moving up ratios and the quality of the teaching) and many aspects of education are ignored. Nevertheless, the three combination indices that are developed in this paper in any case give better descriptions of educational developments than the present input method.

In the future, it might be possible to improve the volume indicators for primary education and university education. For primary education, results of CITO tests of pupils in the last two years of primary school might give the opportunity to observe differences in knowledge of pupils between the beginning and the end of a school year. In addition, a more transparent system for the classification and funding of different types of pupils might allow to monitor variations in the population of the pupils stock. Once for university education study durations have not been changed for several years, it will be possible to calculate more accurate values for the expected study durations.