

CPB Memorandum

CPB Netherlands Bureau for Economic Policy Analysis



Sector : Growth, structure and knowledge economics
Unit/Project : Edu
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Number : 194
Date : March 17, 20088

Raising teacher supply:

An assessment of three options for increasing wages

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Summary

A shortage of teachers in primary and secondary schools in the Netherlands is expected in the near future as a large part of the current workforce will retire. Recently, the Dutch government has decided to increase wages of teachers. This paper qualitatively assesses the impact of three options for increasing teaching wages on teacher supply in the medium term: increasing wages at the start of the career, increasing wages at mid career or increasing wages at the end of the career.

The first option, spending the whole additional budget on raising wages at the start of the career, is likely to lead to the largest increase in the supply of teachers. The main advantage of allocating the whole additional budget to the starting salaries of teachers is that a large share of the budget can be used for the 'new supply' of teachers. The current number of teachers in this group is relatively small and the wage level at the start of the career is low. As a consequence, there is budget for a relatively large increase of wages (more than for the two other options). In addition, the wage elasticity of teacher supply seems relatively large at the start of the career. However, the main effect will come from new enrolment in teacher studies and it takes a least four years before these new students can start in a teaching job. In addition, the wage elasticity of enrolment for teacher studies is unknown. Another disadvantage of this option is that the current level of teaching wages at the start of the career seems quite competitive as it equals the average level of starting wages in the market sector. At mid career teachers salaries are not competitive. Raising wages at the start of the career also has the disadvantage of making the age-wage profile less steep. This wage profile would stimulate enrolment in teacher studies and working in education at the start of the career but would not stimulate a long working career in education. Raising wages at the start of the career targets at only one source of new supply and is therefore more risky than the other options.

The main advantage of the second option, raising teaching wages at mid career, is that it focuses on many different sources of teachers supply including the reservoir of young teachers. In addition, this option makes the age-wage profiles steeper, which increases the career opportunities for young teachers and makes it easier to keep them in a teaching job. Moreover, the relative wages of teachers at mid career are lower than at the start or the end of the career, which is another advantage of this option. However, the potential wage increase and the wage elasticity of teacher supply are probably smaller than in the case of the first option.

For the third option, raising wages at the end of the career, the wage increase and wage elasticity of teacher supply will be even smaller than for the second option. We expect that raising wages at the end of the career is not very effective. However, policy measures that make working as a teacher more attractive compared to not working might be very effective for teachers at the end of their career. The reservoir of potential teachers is large at the end of the career and the wage elasticity might be large for this type of measures.

Choosing between these options depends on the preferences of the decision maker. If the only preference is to attract as many teachers as possible then the first option is probably the best to choose. An important risk is that this option may induce short term teaching careers. The option to raise starting wages seems the best *temporary* one, however it is *unbalanced*. If the decision maker also values career opportunities, work incentives and a balanced age composition of the teacher work force then the second option becomes more attractive. This option seems also less risky than the first option. From this, it seems that raising wages at mid career is the best *structural solution* for the supply of teachers. Finally, measures that make (early) retirement less attractive compared to working might be effective in increasing the supply of teachers.

1 Introduction¹

The supply of teachers in the Netherlands will decline considerably in the near future as a large part of the current workforce of teachers will retire soon and needs to be replaced. Likely the reservoir of non-teachers is too small to replace them. Therefore a shortage of teachers is threatening the Netherlands. In economics shortages are reduced by higher prices. Therefore an increase of teaching wages seems to be an obvious instrument to neutralize the foreseen shortage, an instrument recently advised by the 'Commissie Rinnooy Kan'.^{2,3}

This paper assesses how a rise in teaching wages can neutralize the foreseen shortages in teachers in primary and secondary education at the lowest public expenditures. The assessment is structured as follows. Firstly, we illustrate the change from the current to the future teacher market due to shifts in the demand curve and the supply curve. It turns out that higher teaching wages do not affect teacher demand. Therefore, the focus of the analysis is on the impact of higher teaching wages on teacher supply. The teacher market is not homogenous but segmented. Therefore the same teaching wage increase can have different impacts on shortages between the segments. Important segments are the female and male teacher market.

We start to define decision points on the path to teacher supply and how persons currently choose on these points. Next, we analyse the teaching wages compared to occupations in the market sector during a teacher's career. It gives indications at which age higher relative teaching wages may have the largest impact on teacher supply.

Up till now we have assumed that higher teaching wages increase teacher supply. The question arises what the shape of the teacher supply curve is in practice. Therefore, we summarize evidence for the size of the impact of higher teaching wages on teacher supply at the decision points on the path to teacher supply found in international research.

Finally, we qualitatively assess the effects on teacher supply of three options for raising teaching wages: raising starting wages, raising salaries at mid career or raising salaries at the end of the career. We are primarily interested in the effects on the reduction of teacher shortage for approximately the next ten years.

The paper assumes quality elements of education as constant. Therefore obvious instruments to neutralize teacher shortages are not discussed, such as increasing class sizes, lowering entry barriers to the teacher market for less qualified persons or dropping the age of compulsory education.

¹ A.E. Kuypers (CPB) carried out the computations with the database of the Loonstructuuronderzoek 2002 and gave helpful advice on the relevance of the figures mentioned in section 3.

² OCW, Advies van de Commissie Leraren, 2007, Leerkracht!, September

³ The topic of the impact of teaching wages on teacher supply in order to reduce quantitative teacher shortages was put by CPB on its research agenda end 2006.

2 Future changes on the teacher market

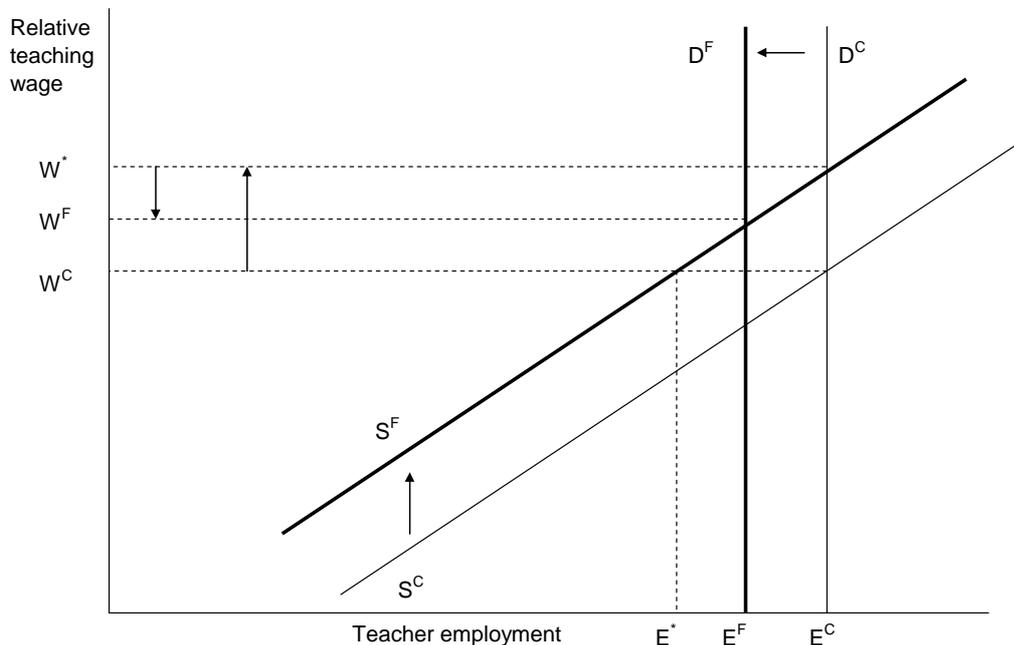
Aim

Which are the determinants of the foreseen teacher shortage? Higher teaching wages are only effective if they influence these determinants. Therefore the question arises which causes are influenced by teaching wages? These are the questions discussed in this section.

Teacher supply drops

Figure 2.1 illustrates the reasons for the future teacher shortage. Current teacher demand is the vertical line D^C through the present level of teacher employment E^C . The vertical shape reveals that teacher demand does not depend on the teaching wage. Teacher demand only depends on the number of pupils and of class size (= the number of pupils per teacher). The line S^C shows the current relation between the teaching wage and the supply of teachers. The line shows that teacher supply increases if the relative teaching wage increases. Currently, there are no significant teacher shortages.⁴ Therefore W^C can be considered as the current equilibrium relative teaching wage.

Figure 2.1 Current and future teacher market



⁴ OCW, 2007, Nota werken in het onderwijs 2008, p. 83, tabel TB.1.3 shows that the number of vacancies in the course 2006/06 equals 630 teachers in primary education and 430 teachers in secondary education in FTEs. These numbers correspond with about ½ % vacancies in teacher employment in primary and in secondary education. Hence, the number of vacancies is small today if we take into account that there are always vacancies due to teachers who change jobs between schools.

The future expected teacher shortage at current teaching wages is the result of the expected net effect of less teacher supply and less teacher demand. Teacher supply will diminish due to the ageing of the teacher workforce. Table 2.1 shows that in 2006 18% of the teachers in primary education are older than 55 years and 25% of the teachers in secondary education. Hence, more than 20% of the teachers will exit the teacher market and become pensioner within 10 years. This will lead to an upward shift of the supply curve from S^C to S^F . The new equilibrium teaching wage rises from W^C to W^* .

Table 2.1 Distribution teacher employment (in FTEs) across age classes

| | Primary education | | Secondary education | |
|--------------------|-------------------|------|---------------------|------|
| | 1994 | 2006 | 1994 | 2006 |
| Age class in years | % | | | |
| Smaller than 25 | 3 | 5 | 1 | 3 |
| 25 – 34 | 24 | 24 | 13 | 17 |
| 35 – 44 | 41 | 19 | 35 | 20 |
| 45 – 54 | 27 | 34 | 40 | 35 |
| 55 – 65 | 5 | 18 | 11 | 25 |
| Total | 100 | 100 | 100 | 100 |

BSO, 2007, Jaarboek Onderwijsarbeidsmarkt in cijfers, Original data CASO, 1994 -2000 processed by OCW, 2001-2006 processed by ITS

Teacher demand falls less

Teacher demand will also decline due to a decline in the number of pupils related to the age composition of the population. Class size is a policy instrument. We assume that policy makers keep class size constant. The drop in teacher demand leads to a shift of the demand curve to the left, from D^C to D^F . Therefore the age composition of the population contributes to a reduction of the future teacher shortage, and as a consequence the equilibrium teaching wage falls from W^* to W^F . In total the net effect is that the future equilibrium teaching wage is higher than the current relative teaching wage ($W^F > W^C$ in figure 2.1). At current teaching wages W^C there will be a teacher shortage of E^*E^F .

Conclusion

Higher teaching wages can only reduce the teacher shortage through their impact on teacher supply. Therefore the following sections focus on the determinants of teacher supply only.

3 Decision points where teaching wages affect supply

3.1 Aim

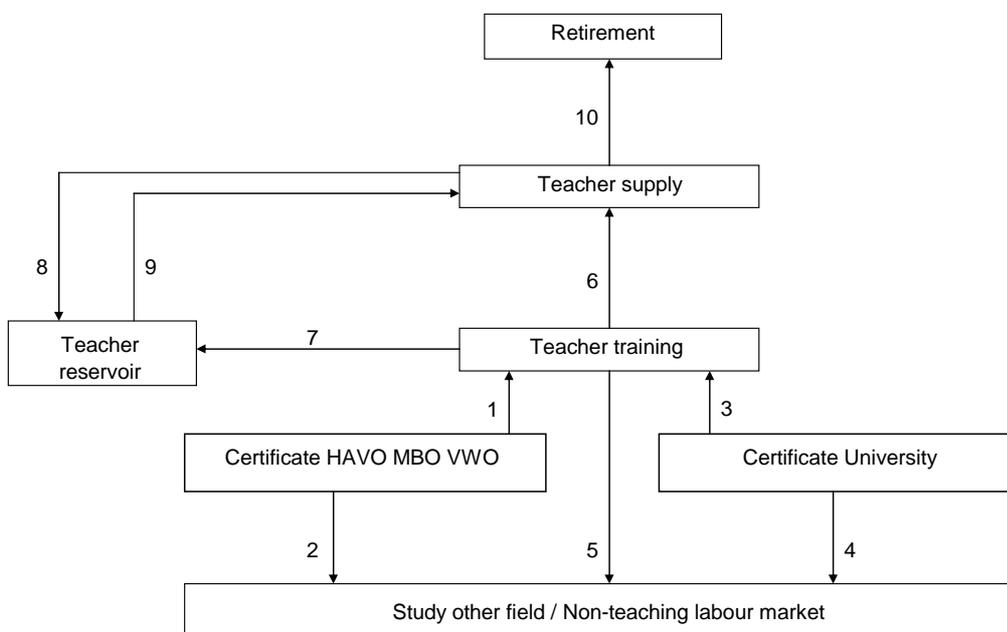
The aim of this section is to follow a teacher during her or his career from entry to PABO and NLO to their exit of the teacher market and present their number, their current probabilities to enter or stay in teaching and their wage levels.

3.2 Teacher supply

We distinguish decision points where persons take decisions which determine teacher supply. The boxes in figure 3.1 are the decision points. Each box is a position where people can be. Arrows from each box show the options a person in the box has to move to other positions. We assume that a rise in teaching wages leads to a shift in the choice persons make between the available options at each decision point. Next we mention the number of persons involved at each decision point and the actual probabilities that they opt to enter or stay in teaching. The latter are of importance because higher teaching wages lead to an increase of the probabilities.

We start to discuss the flowchart with the box filled with new holders of a teaching certificate. From this decision point we follow the teacher career.

Figure 3.1 Teacher supply



Decision HAVO, MBO-4 and VWO graduates to enrol teacher studies or not

Potential teachers are the pupils who have just successfully passed their HAVO, VWO or MBO-4 examinations. They have the qualifications to enrol teacher studies at HBO. From this reservoir of 164 thousand pupils in 2004 (see table 3.1) the entrants to teacher studies are drawn.

They have the following options. They can choose to enrol PABO for a 4 year course to learn for teacher at primary education or to enrol NLO to learn for teacher at secondary education, 2nd degree (arrow 1) or to continue their study in a field outside teaching or enter the non-teaching labour market (arrow 2). The number of pupils who choose for teacher studies is mentioned in table 3.1.⁵ In total 15.1 thousand students enrolled for the first time in 2006. Finally, the table shows the probabilities that pupils with a secondary school certificate enter teacher studies (arrow 1). The probability that a HAVO graduate enters teacher studies is 20%, which is much larger than the probabilities of about 5% of VWO and MBO-4 graduates.

Table 3.1 Inflow teacher studies at HBO, 2004 (arrow 1)

| | |
|--|---------|
| Number of graduates ^a | |
| Total graduates | 164,300 |
| of which from | |
| HAVO | 36,700 |
| VWO | 27,400 |
| MBO-4 | 100,200 |
| Inflow teacher studies in number | 15,100 |
| of which | |
| PABO ^b | 8,550 |
| NLO ^b | 6,550 |
| Probability to enter teacher studies of graduates ^c | in % |
| HAVO | 20 |
| VWO | 5 |
| MBO-4 | 6 |

^a Statistics Netherlands, 2007, Jaarboek Onderwijs in cijfers 2007, p. 183 (MBO-4) and p.185 (HAVO, VWO).

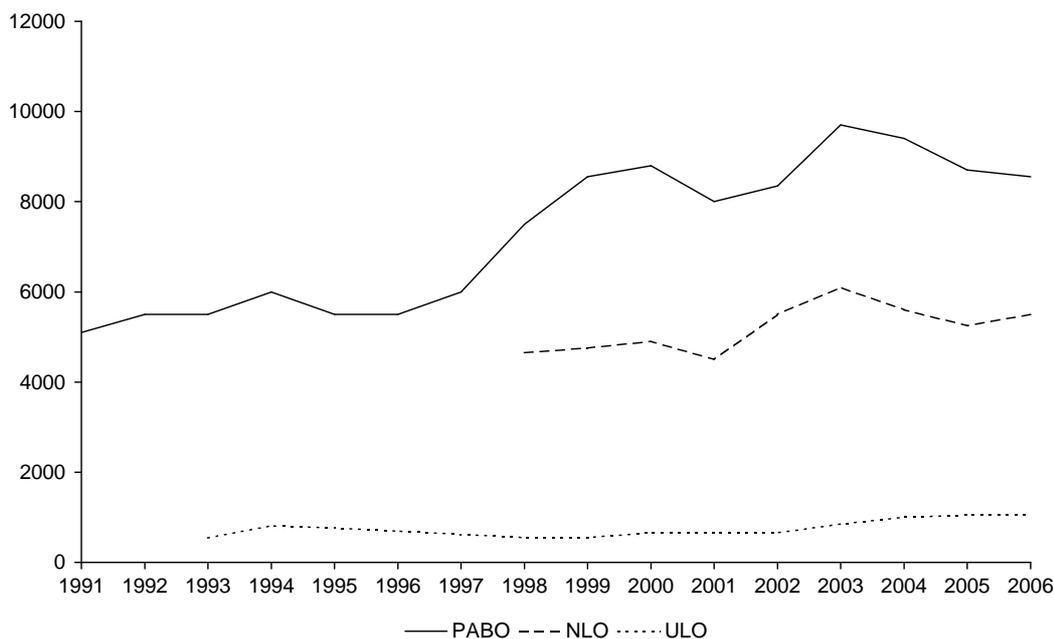
^b OCW, Kerncijfers 2002-2006, p. 31, figures 2006. Statistics Netherlands, CBS, Onderwijsjaarboek 2007, tabel 3.1.1.3, p. 180 mentions slightly different figures.

^c Derived from the distribution of the inflow Hogere Pedagogische Opleidingen with preparatory training HAVO, VWO and MBO-4 in 2006 from HBO-Raad, 2007, Het HBO ontcijferd 2007.

Figure 3.2 shows the development of the inflow into teacher studies at HBO. The flow to PABO has grown since 1991, while the flow to NLO has been rather constant since 1998.

⁵ It concerns the number of 1st year students who have not enrolled a HBO course before. Another definition which is often used measures the number of students who have already followed a HBO-course before. Apparently this gives a much higher number. This latter definition is used by the HBO-raad in 'Het HBO ontcijferd 2007 (data downloadable from www.hbo.nl). For a discussion on this issue see OCW, 2007, Nota werken in het onderwijs 2008, Bijlage B4.

Figure 3.2 Inflow teacher studies (arrow 1 and arrow 3)



Source arrow 1: inflow PABO and secondary education HBO level. OCW, Nota werken in het onderwijs 2008, p. 86 and OCW, Kerncijfers 2002-2006, p.31 and fig. 2.21. Source arrow 3: inflow teacher studies at universities (ULO): sources: 1993-1997: VSNU, 2003, Onderzoeksvisitatie en onderzoeksbeoordelingen van de Universitaire Lerarenopleidingen, Bijlage 4; 1998 - 2006: OCW, Nota werken in het onderwijs 2008, p.86.

Decision university graduates to enrol teacher studies or not

University graduates have the option to follow ULO (Universitaire Leraren Opleiding): a course of 1 year to acquire a 1st degree certificate to teach at second education (arrow 3) or enter the labour market or to study for a PhD (arrow 4).

Table 3.2 shows that about thousand of the almost 26 thousand university graduates (doctoral or master exams) enrol teacher studies, resulting in a probability of 3.5 %. The other graduates do not follow teacher studies (arrow 4).

ULO-enrolment is unevenly distributed across the fields of study related to the outlook of future occupation. For instance, students of languages have fewer options to work as non-teacher than doctors. Therefore 27% of the graduates in languages follow teacher studies a share which is much higher than the average of 3½%. The table also learns that a relative large share of students of history enrol ULO.

Figure 3.2 also presents the development of ULO-enrolment. The figure reveals a rather strong trend growth since 1993: from about 600 students in 1993 to about 1000 students in 2006.

Table 3.2 Inflow teacher studies at university , 2004/05(arrow 3)

| | |
|--|--------|
| Number of university graduates ^a | 25,900 |
| Inflow ULO ^b | 1,050 |
| | % |
| Probability to enter teacher studies of graduates ^c | 3½ |
| Of which subjects ^{d, e} | |
| Languages | 27 |
| Physics | 14 |
| Biology | 11 |
| History | 23 |
| Economics | 3 |

^a Source number of university graduates Statistics Netherlands, 2007, Jaarboek Onderwijs in cijfers 2007, p. 237, data refer to 2004/05.

^b Source inflow: OCW, 2007, Nota werken in het onderwijs 2008, p. 86 (ULO series), data refer to 2005. Note that SBO, Jaarboek Onderwijsarbeidsmarkt mentions another number, namely 506 in 2004.

^c Computed as inflow teacher studies / number of university graduates * 100.

^d Data refer to cause 2002/03. Inflow teacher studies / number of graduates * 100. Source inflow teacher studies by subject VSNU, 2003, Onderzoeksvisiteatie en onderzoeksbeoordelingen van de Universitaire Lerarenopleidingen, Bijlage 4. Source number of graduates by field of study: Statistics Netherlands, 2007, Jaarboek onderwijs 2007, p. 237.

^e ROA, WO-Monitor 2004 en 2005, table 2.3 (p. 13) mentions lower figures. The percentage of university graduates in 2005 with a continuing course teacher education is 2% for all graduates, of which 10% for graduates in languages and culture is by far the largest group. However, it little disturbs the ranking.

Table 3.3 Probabilities to drop out teacher studies

| | |
|---|----|
| | % |
| HBO students: PABO and NLO ^a | 25 |
| ULO ^b | 45 |

^a Dropout without certificate after 8 years of cohort entering teacher studies in 1995. Source: Statistics Netherlands, 2007, Jaarboek Onderwijs in cijfers 2007, PABO p. 218, NLO p.220

^b Source: OCW, Nota werken in het onderwijs 2008, p. 86, computed as 1 – Table TB.4.2 2006/ Table TB.4.1 in 2005. The reason is that the ULO course takes 1 year.

Supply diminished by decision to drop out

A number of students drop out of teacher studies (arrow 5). Table 3.3 shows that 25% of the entrants of the cohort which entered teacher studies at PABO and NLO in 1995 dropped out. Therefore about three-quarter of the entrants were successful.

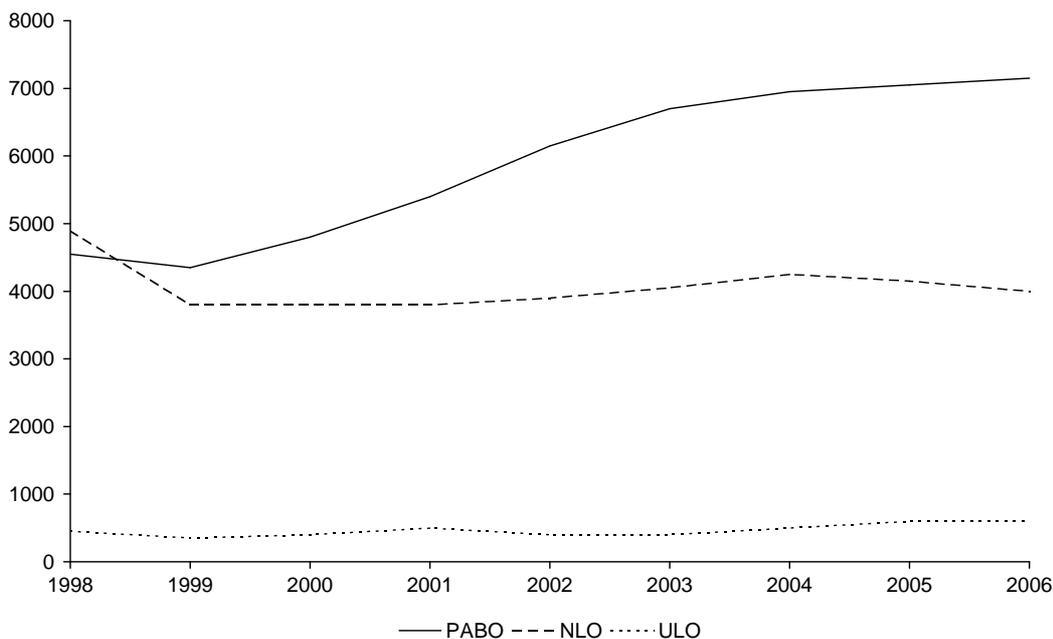
There are indications that the dropout probabilities in table 3.3 underestimate current dropout due to the following reasons. Firstly, recently, first year PABO students are tested on their abilities in mathematics and Dutch language. About 70% of the students of the cohort 2006 passed both tests, and a number of them still exited the PABO after a year of study. If the tests are carried out after enrolment, and a large share of the students do not pass the tests, this

may lead to more dropout than the 25% mentioned in table 3.3.⁶ Secondly, the trend of dropout is increasing in particular of NLO, 2nd degree. In 2000, 31% of these students dropped out after their first year of study and this figure increased to 38% in 2004.⁷ Thirdly, also dropout of ULO increased considerably: from 18% in 1998 to 45% in 2006. Thus while the enrolment has increased, the number of certificates was almost constant during 1998 – 2006 at about 500 certificates per year.⁸

Decision graduates in teacher studies to enter the teacher market or not

The persons who have just acquired their teacher certificate (arrows 1 and 3 minus arrow 5) move to a next step in their career. In 2006 7150 PABO students graduated, 4000 NLO students graduated and 600 ULO students graduated. In total almost 12 thousand graduates. Figure 3.3 shows the development of the number of graduates with certificates of PABO, NLO and ULO. The figure shows an increasing trend in PABO-certificates and rather constant number of NLO and ULO certificates.

Figure 3.3 Number of graduates in teacher studies (arrow 6 and arrow 7)



Source: OCW, 2007, Nota werken in het onderwijs 2008, p. 86. The information on the number of graduates is ambiguous. ROA, 2007, HBO Monitor 2006, Statistisch Supplement, table 2.1 mentions a number of 8126 PABO graduates instead of 7150 in the source of the figure.

⁶ Source: SBO, Uitstroom eerstejaars studenten pabo cohort 2006 nader verklaard, 16/10/2007.

⁷ Source: SBO, Jaarboek Onderwijsarbeidsmarkt in cijfers.

⁸ A different source: VSNU, '1 Cijfer HO bestand 2004', table 1.7 mentions figures for 1998-2003 which are slightly different but also show a strong rising trend in dropout of ULO in this period.

Table 3.4 Probabilities to become teacher after graduation (average cohorts 2004 and 2005)^a

| | Teacher occupation | To reservoir | | Total |
|-----------------------------|--------------------|-------------------|------------------------|-------|
| | | Non-teaching work | Further study or other | |
| Certificate teacher studies | % | | | |
| PABO | 81 | 5 | 14 | 100 |
| NLO | 70 | 17 | 13 | 100 |

^a After half a year after graduation. Source OCW, 2006, *Nota werken in het onderwijs 2007*, p. 34.

The graduates have two options to move to a new position. They can opt for teacher as first occupation (arrow 6) else to do something else and flow into the teacher reservoir (arrow 7), which contains the non-teachers who are qualified to teach.

Table 3.4 shows that the probability to become a teacher at primary education after graduation at the PABO is high: 81% of the graduates have entered teaching half a year after graduation. The preferences or alternatives of PABO-graduates to work elsewhere are low, as only 5% found work elsewhere in the economy. The remainder (14%) continues their study. Another data source – SEO (2007)⁹ – gives an even higher estimate: 92% of the graduated PABO students of the course 2004/05 have become teacher in January 2007.

NLO-graduates enter teaching with a lower probability than PABO-graduates. Still by far the majority (70%) have entered teaching half a year after graduation. As a complement they have a larger probability to find work as non-teacher (17% instead of 5%). SEO (2007)¹⁰ shows a range with higher probabilities than 70%, namely between 79 % (teachers in exact subjects) and 95% (teachers Dutch) of the graduates of the course 2004/05 work as teacher in January 2007.

OCW has not published the destination of the ULO-graduates. SEO (2007)¹¹ estimates that on average ULO-graduates of the course 2004/05 have a probability to work in education in January 2007 of 17%. Fields of study closely related to subjects of secondary education have much higher probabilities however. For example, graduates in languages have a probability to work in education of about 60%, graduates in theoretical mathematics score 69%, in chemistry 77%, in history 38% and economists 5%. These probabilities overestimate the probability to become teacher in secondary education, as the education sector also includes teachers at HBO and universities and university graduates have access to these sectors of education.¹²

⁹ SEO (2007) *Studie en werk 2007*, Statistische bijlage: hbo-tabellen, table 7, p.7.

¹⁰ SEO (2007) *Studie en werk 2007*, Statistische bijlage: hbo-tabellen, table 7, p.7.

¹¹ SEO (2007) *Studie en werk 2007*, Statistische bijlage: wo-tabellen, table 7, p. 7.

¹² There is another estimate of the probability to enter teaching after ULO. SBO, *Jaarboek onderwijsarbeidsmarkt 2005* mentions a probability of 82%. However, the figure refers to long ago: namely 2001. Its basic source is ROA *Onderwijsmonitor*.

Decisions to move to or enter from the reservoir

Teacher supply is diminished by decisions of current teachers to exit teaching in order to move to a non-teaching job or inactivity, for instance to care for children. If they do this, they move to the teacher reservoir, which contains all potential teachers who do not actually teach (arrow 8 in figure 3.1). By contrast, teacher supply increases if potential teachers enter or re-enter from the reservoir (arrow 9).

Unfortunately there are no statistics available on the amount of persons in the reservoir. The size of this reservoir is of importance as it determines the additional number of teachers if we know the increase in probability to stay or enter teaching after the teaching wage increase facilitated by the reserved additional teacher budget

There are some statistics available on the size of the flows of persons between teacher supply and the reservoir. However, these figures are not reliable¹³ or do not fit the criteria in this paper.¹⁴

Retirement

Arrow 10 in figure 3.1 shows the exit of teaching due to pension or early retirement regulations. The flow to the pension fund is exogenous and determined by the age composition of the teachers. Exit from the teacher market to early retirement regulations is endogenous as it depends on the difference between the net teaching wage and the net allowances of the BAPO (Bevordering Arbeidsparticipatie Ouderen) regulation which stimulates shorter workweeks of teachers from the age of 52. The flow to the BAPO is large. At the age of 60 more than 60% of the teachers use the BAPO regulation.

Total teacher supply

In total, there are 215 thousand teachers in FTE in 2006. Table 3.5 shows their distribution across three stages of the teacher career. It reveals that if the additional teacher budget would be spent on the starter group of teachers, 35 thousand would benefit, and that 100 thousand would benefit if the same budget would be spent on teachers in the mid career.

¹³ It concerns BZK, 2007, Personeels- en mobiliteitsonderzoek Overheidspersoneel 2006, figures on exit p.51 and origin p. 40. The source is not reliable for teachers in primary and secondary education due to the small sample of enquiries.

¹⁴ It concerns figures from the pension fund ABP cited by SBO, Jaarboek onderwijzarbeidsmarkt. This source also mentions exit by death.

Table 3.5 Distribution of teacher employment FTE between the stages in the teacher career

| | Total | Start-career Less than 30 years | Mid career 30-49 years | End career Older than 50 years |
|-------------------------------------|-------|------------------------------------|---------------------------|-----------------------------------|
| | % | | | |
| Primary education ^a | 100 | 17 | 48 | 35 |
| Secondary education ^{a, b} | 100 | 11 | 46 | 43 |
| Total education ^c | 100 | 15 | 47 | 38 |
| | *1000 | | | |
| Teacher employment ^d | 215 | 35 | 100 | 80 |

^a BSO, 2007, Jaarboek Onderwijsarbeidsmarkt in cijfers, Original data CASO, 1994 -2000 processed by OCW, 2001-2006 processed by ITS. The age classes 25-34 respectively 45 - 54 are equally divided between below 30 and above 30, respectively below 50 and above 50 years.

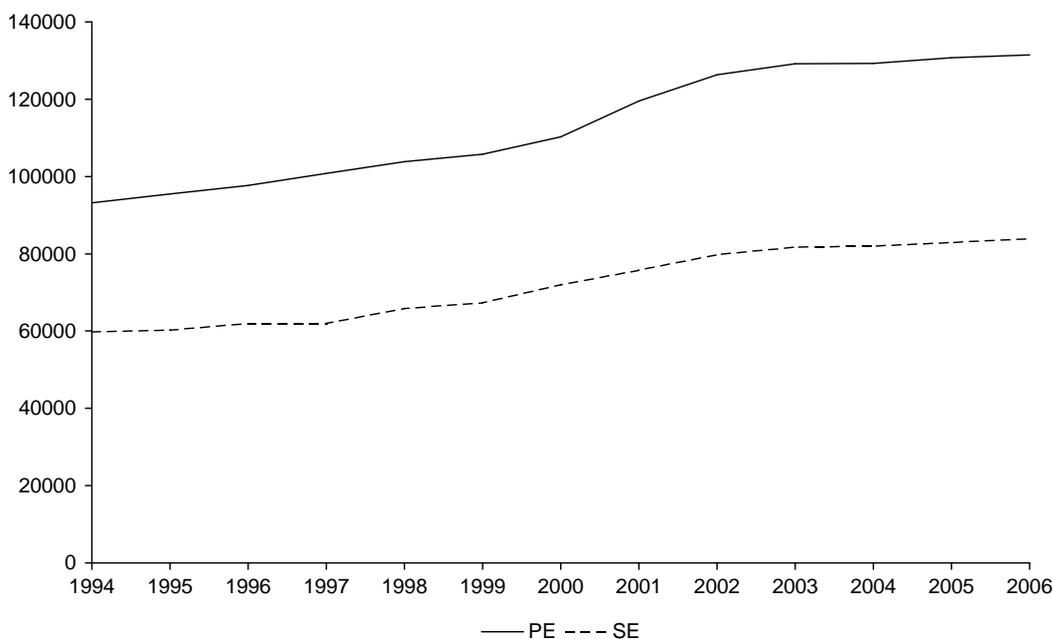
^b OCW, Nota werken in het onderwijs 2008, table TB.1.2b, p. 83 also gives the age distribution of the teachers in secondary education which mentions splits at the ages of 30 and 50. This gives almost the same distribution.

^c Computed as 0.6 * primary education + 0.4 * secondary education.

^d Computed as the share of the distribution times teacher employment 215.

Figure 3.4 shows the development in teacher employment during 1994-2006. Teacher employment has risen with 40% during that period in primary as well as secondary education. In 1994, 93 thousand people worked employment in primary education and in 2006 employment has risen to 131 thousand workers. In secondary education FTE-employment rose from 60 thousand in 1994 to 84 thousand in 2006.

Figure 3.4 Employment in primary education and secondary education (FTE)

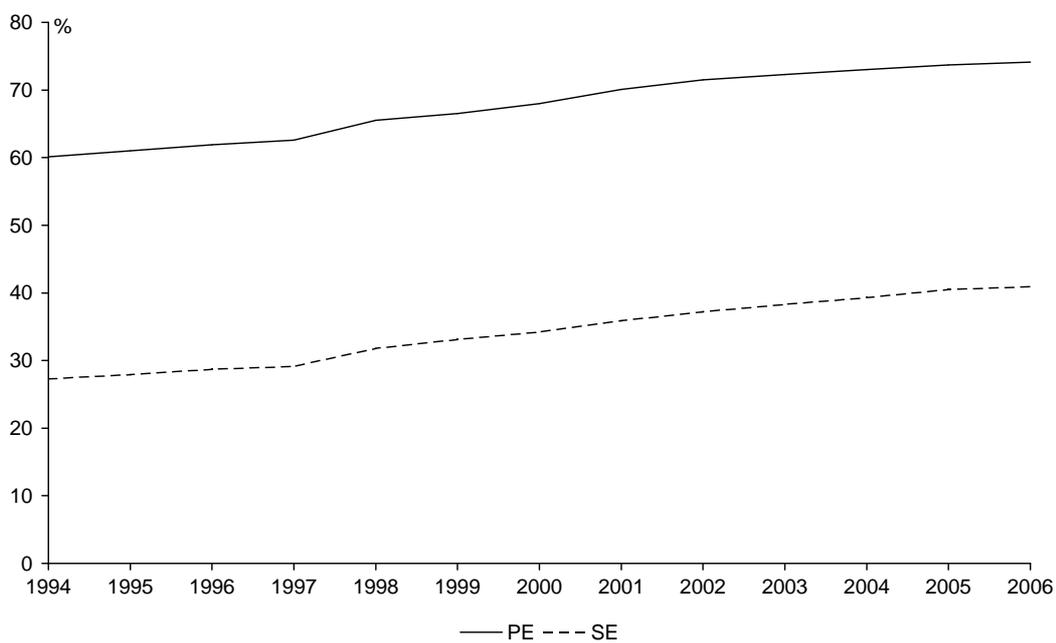


Source: Statistics Netherlands, Onderwijsjaarboek 2007, PE: p. 153 and SE: p. 167 and p. 273, and earlier editions. Downloadable from SBO, 2007, Jaarboek Onderwijsarbeidsmarkt in cijfers 2007, Cijfers en trends.

Share female teachers is rising

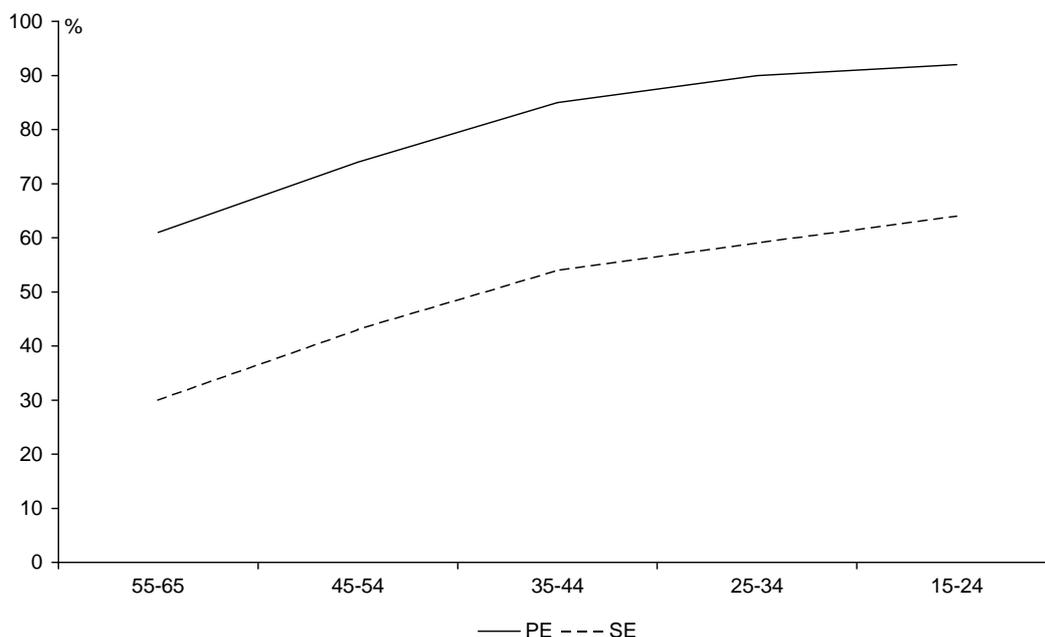
The teacher market as a whole is changing because the female share in teaching in primary and secondary education will probably increase. Figure 3.5 shows the increase during 1994-2006. In 1994 the female share was already high in primary education with 60% of the teachers and this share has risen to 74% in 2006. Male teachers still dominate in secondary education. However, the female share rose strongly from 27% in 1994 to 41% in 2006. The trend was smooth, as young vintages of teachers with very high female shares gradually substitute old vintages with high male shares.

Figure 3.5 Share of female teachers in teacher employment (in FTE)



Source: SBO, 2007, De onderwijsarbeidsmarkt in cijfers. The data originate from CASO (1994-2000 processed by OCW, 2001-2006 processed by ITS)

Figure 3.6 Share of female teachers in by age class, 2005



Source: BZK, 2007, Personeels- en mobiliteitsonderzoek overheidspersoneel 2006, p.53

Figure 3.6 illustrates the large differences in female shares in between age classes. The youngest class of teachers in primary schools is almost completely female: 92% of these teachers are women in 2005. The oldest generation contains 61% women. The majority of the youngest class of teachers in secondary schools is already female: 64% is female in 2005. The oldest class contains 30% women. The figure can be interpreted as outlook for the female share. The oldest teachers exit earlier in the future than younger ones. Thus within 10 years the class of the 55-65 year of age is not employed, and this will lead to a rise in the female share in teachers.

The feminization of teaching is of importance for the impact of higher teaching wages on teacher supply, because the next sections show that female teachers have higher relative teaching wages than male teachers and the wage elasticity of teacher supply are lower for women than for men. Women have more preferences to care for their children or produce unpaid in the household. There is evidence for the USA that women decide to enter the teacher market complementary with the decision to enter the labour market at all, because it is much easier to re-enter the teaching market after voluntary inactivity than the non-teaching labour market.¹⁵ It leads to temporary exit of the labour market and more preferences for part time work than men. Table 3.6 shows that two-third of female teachers work part time in primary as well as secondary education, whereas a fifth of male teachers work part time.

¹⁵ See Dolton and Makepeace, 1993.

Table 3.6 Distribution part time and full time teachers by gender, 2006

| | Primary education | | Secondary education | |
|--|-------------------|------|---------------------|------|
| | Female | Male | Female | Male |
| | % | | | |
| Part time: less than 32 hours per week | 66 | 15 | 64 | 20 |
| Full time: more than 32 hours per week | 34 | 85 | 37 | 80 |
| Total | 100 | 100 | 100 | 100 |

Source: BZK, 2007, Personeels- en mobiliteitsonderzoek onderwijspersoneel 2006, p. 57.

3.3 Teaching wage levels

The level of the teaching wages also determines the teaching wage increase which can be paid from the reserved additional teacher budget. Table 3.7 mentions the hourly gross wages of male and female teachers together in 2002 based on data from the 'Loonstructuuronderzoek 2002'. The table reveals that the hourly wages increase during the whole career.¹⁶ The trends are reliable, although there is some error as the data are based on samples. We estimate yearly gross wages with a number of hours of 52 weeks with workweeks of 36 hour. Then the annual wages of teachers in the start of their career (below 30 years of age) are about 30 thousand euros, of teachers in their mid career (between 30 and 50 years) about 40 thousand euros and of teachers in their end career (older than 50 years) 50 thousand euros. For all teachers this gives an average annual wage of about 40 thousand euros. These figures are computed with 60% share of the teachers in primary education and not-weighted averages of the age classes.

Table 3.7 Hourly gross wages full time teachers by age class, 2002^a

| | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-65 |
|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | euros | | | | | | | | |
| Primary education | 15.1 | 15.9 | 17.1 | 19.3 | 21.0 | 24.3 | 23.1 | 25.9 | NA |
| Secondary education | 15.1 | 16.0 | 17.7 | 19.4 | 22.5 | 23.8 | 25.3 | 27.8 | 29.4 |

^a Male and female teachers together, derived from LSO 2002.

3.4 Conclusions

Current teacher employment amounts 215 thousand persons, 35 thousand are in their start-career, 100 thousand in their mid career and 80 thousand in the end of their career. The share of female teachers in the total number of teachers is increasing. They work mainly in part time.

¹⁶ The continuous rise of hourly teaching wages during the career is also found by SEO 2006a, p.93 for data of 2004.

From a reservoir of 164 thousand pupils with a secondary education certificate, 15 thousand start to study teacher studies. About a quarter drops out. Of the 26 thousand university graduates almost a thousand start a 1-year course teacher training 1st degree. Almost half drops out. Of the graduates in teacher studies (almost 12 thousand in 2006) about 80% chooses for teacher as first job. There are no reliable statistics on the number of persons in the teacher reservoir. Teachers in the start of their career (to 30 years of age) earn about 30 thousand euros per year, in their mid career (between 30 and 50 years of age) about 40 thousand euros and in the end of their career (older than 50) about 50 thousand euros.

4 Relative teaching wages in the Netherlands

Aim

How competitive are the teaching wages? And how does this competitiveness change during the teacher career? This section answers these questions for 2002 with data of the 'Loonstructuuronderzoek (LSO)' produced by Statistics Netherlands. Next the question arises to which extent are our findings robust? We answer this question by comparing our findings with findings from other research.

Relative teaching wage during a teacher's career with HBO education in 2002

Figures 4.1 and 4.2 show the development of relative teaching wages during the teachers' career in primary and in secondary education in 2002. The vertical axes show the percentage deviation of gross hourly teaching wages from the gross hourly wages of employees in the market sector, both groups of people with a HBO certificate.¹⁷ Thus if the relative teaching wage is negative, teacher earn less per hour than employees in the market sector with a HBO certificate. The stage in the career is measured as the age of a teacher. The career is shown on the horizontal axes in the range between 25 years and 60 years of age.

We distinguish relative teaching wages for women and for men separately. Moreover we make a distinction between full time and part time work. The reason is twofold. Firstly, female teachers are usually part timers and male teachers are usually full timers. Secondly, it facilitates tests on robustness of the results as other research also makes this distinction.

The figures reveal that the relative teaching wages depend on the age of teachers. They show U-shapes. During at least a part of the career teachers they earn less per hour than employees in the market sector. These are the periods where the curves are below the horizontal lines through 0. The teaching wage of young teachers differs little from the wage paid by the market sector. Generally the relative teaching wage is lowest at around 35 years of age of women and around 45 years of age of men. If teachers become older, their wages catch up.

¹⁷ More precisely, the vertical axis is 100 times the natural logarithm of the ratio of the teaching wage and the wage in the market sector for each year of age of a teacher. See annex B for the regression results and definitions.

Figure 4.1 Relative teaching wage in %, female (left) and male (right), full time

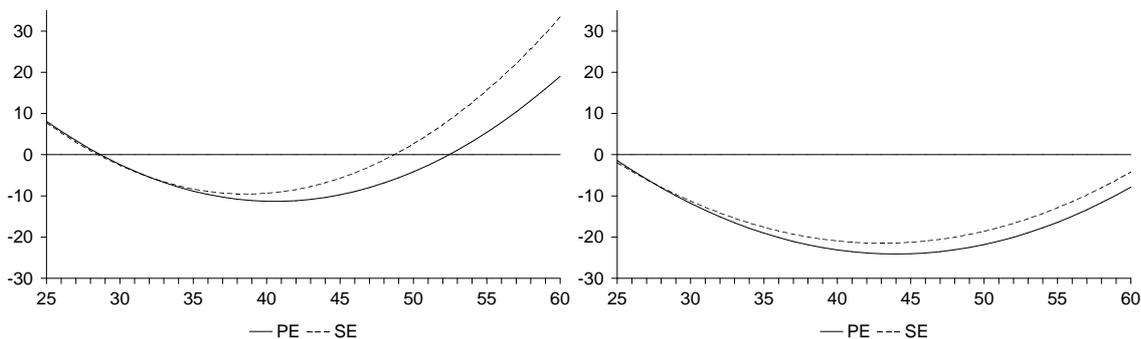
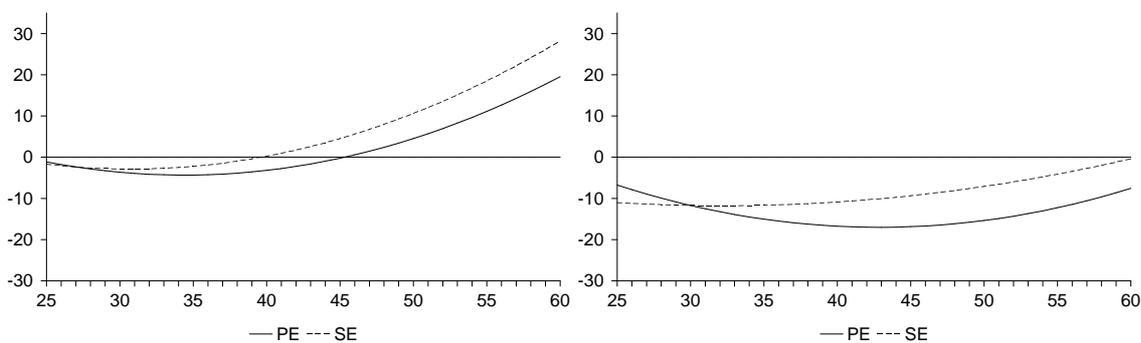


Figure 4.2 Relative teaching wage in %, female (left) and male (right), part time



The figures are derived from annex B, table B.2 for the range of AGE = 25 to AGE = 60. In the main text we discuss the relative teaching wages as percentage difference from the market sector. In fact this is an approximation as the regression analysis was carried out in logarithms and then percentage hold by approximation. For more technical account see annex B.

The figures show that the relative teaching wages of women are much higher than of men. Female teachers earn more per hour than female employees in the market sector if they are older than about 50 years. Also female full time teachers earn more per hour than female employees in the market sector if they are 25 years old and the earnings are about equal if they work part time. In contrast, male teachers earn less per hour than male employees in the market sector during their whole career. Full timers between the age of 40 and 45 years earn about 20% per hour less than in the market sector. Only if male teachers are young or about 60 the market sector hardly pays more. The difference between the female and male relative teaching wages is largely due to the difference of the career profiles in the market sector. Figures 4.1 and 4.2 show that in the whole economy the hourly wages of female employees are lower than of male employees. The wage profile of female teachers does not differ much from the wage profile of female employees in the whole economy. The wage profile of female and male teachers does not differ much either. The relative teaching wage profile is less favourable for male teachers.

The relative teaching wages in secondary education are about equal to the relative teaching wages in primary education till about the age of 40. From the age of about 40 teachers in secondary education earn more per hour.

First test on robustness: relative teaching wages during career, 2004

SEO (2006) also investigated the relative teaching wages but with other data and another method of the relative teaching wages. The data are drawn from the 'Enquête Werkgelegenheid en Lonen' (EWL) and the 'Enquête Beroepsbevolking' (EBB) also provided by Statistics Netherlands. The EWL data concern 2004. The method of estimation differs from the one applied above. Similar with our method is that the relative hourly gross wages are explained by occupation and many control variables.

Table 4.1 Relative teaching wages of HBO educated, 2004 and other method

| | Women | | | | Men | | | |
|------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| | 25 years | 35 years | 45 years | 55 years | 25 years | 35 years | 45 years | 55 years |
| | % | | | | | | | |
| Full time | | | | | | | | |
| Teacher PE | - 4 | - 14 | - 11 | 8 | - 7 | - 23 | - 27 | - 21 |
| Teacher SE | - 8 | - 12 | - 5 | 15 | - 11 | - 21 | - 23 | - 16 |
| Part time | | | | | | | | |
| Teacher PE | - 7 | - 16 | - 13 | 5 | - 9 | - 24 | - 28 | - 22 |
| Teacher SE | - 11 | - 14 | - 7 | 13 | - 13 | - 23 | - 24 | - 17 |

Source: SEO, 2006, Exploratie van beloningsverschillen in het onderwijs 2001-2004, table 2.1 and table 2.2, columns 'PO', 'VO' and 'Markt', rows 'Hoger opgeleid'

Table 4.1 shows SEO's findings. There is much agreement with figures 4.1 and 4.2. Firstly, the relative teaching wages show a U shape. Secondly, the relative teaching wages are lowest at the age of 35 for women and at the age of 45 for men. Finally, relative teaching wages are higher for women than for men. A difference is that the relative teaching wages are lower in table 4.1 than in figures 4.1 and 4.2.

Second test on robustness: starting wages

SEO annually enquires graduates with a HBO certificate or university certificate on their labour market position in order of Elsevier. SEO explained the net monthly wages measured in January 2007 by the industries where the enquired persons work, the length of their workweek and a large number of personal characteristics. The wages are starting wages because the enquired persons are from the cohort of graduates of the course 2004/05.

Table 4.2 Starting net monthly wages in industries compared to wages in business services, 2007^{a, b}

| | Level of education employee | |
|--|-----------------------------|------------|
| | HBO | University |
| | % | |
| Education | 7 | - 2 |
| Public government | 7 | 5 |
| Manufacturing | 3 | 5 |
| Health | 3 | 3 |
| Agriculture, Utilities, Construction, Transport ^c | 1 | 2 |
| Professional services | 0 | 0 |
| Trade | - 1 | - 3 |
| Restaurants, hotels | - 2 | - 8 |
| Culture, sport | - 8 | - 6 |

^a Source: SEO, 2007, Studie & werk 2007, Main report, figures 3.1 and 3.2

^b A large number of control variables are applied such as age, gender, region, level of occupation and length workweek, the test scores at the examination.

^c Not-weighted average of these industries.

Table 4.2 shows the percentage difference between the net monthly wages in a number of industries compared to the net monthly wage in business services after control of the length of the workweek and personal characteristics for HBO graduates. It follows that the starting wage for HBO graduates in the industry 'education' is highest among the industries. This conclusion roughly agrees with the findings in figures 4.1 and 4.2.

Third test on robustness: Relative teaching wages in 1995 and 1997

CPB (2000)¹⁸ investigated relative teaching wages in 1995 and 1997 with data of the 'Loonstructuuronderzoek' of those two years. The findings were that in 1995 the hourly wages of teachers (2nd degree) with a HBO education on secondary schools were 3,5% higher than the hourly wages of employees with a HBO education in the rest of the economy. The estimate holds for the whole career under the assumption of similar wage profiles of teachers and non-teachers (apart from a constant multiplier for all years of age). This is a specification which is similar we used for 2002 and shown in table B.1 in annex B of this publication. In 1997 the advantage of these teachers has declined to 0.3% higher teaching wages compared to the wages of other employees.

Also this publication sheds light on the relative teaching wage during the career if the wage profiles for teachers with a HBO education on secondary schools may differ between teachers and non-teachers. It appears that the relative teaching wages in 1997 are positive for teachers (male and female) between 25 and 30 years, negative (-7%) for teachers between 30 and 45 years and positive again for teachers older than 45 years. For part time female teachers the relative teaching wages are more favourable than for all teachers together. Their relative wages

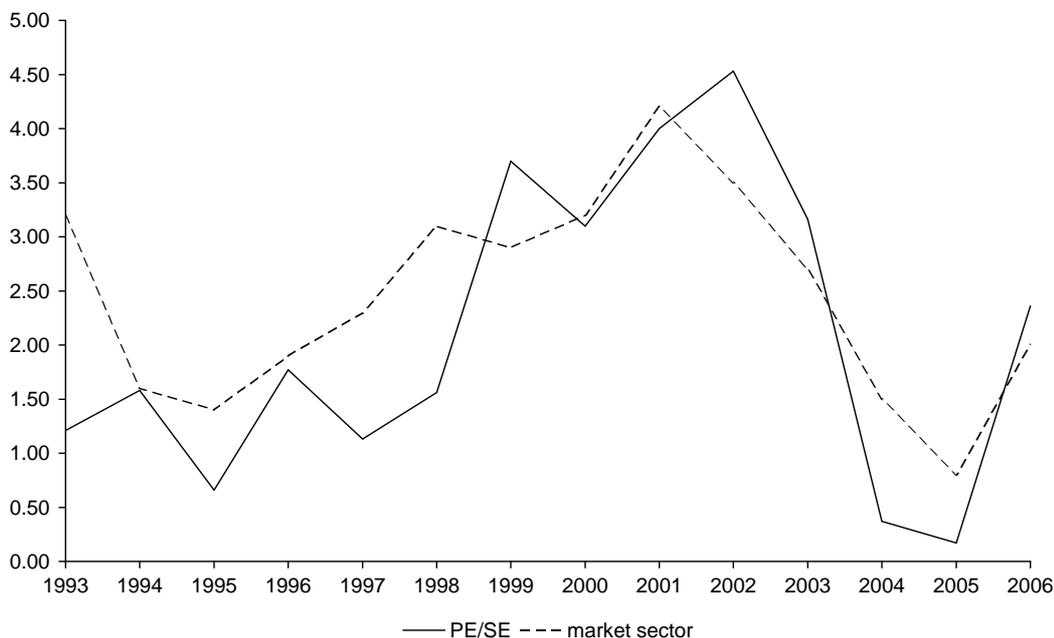
¹⁸ We use p. 41 tabel 5.1 and p. 48 grafiek 5.2 and p. 54 grafiek 5.5 of CPB (2000).

are only slightly negative (−2%) between 30 and 35 years. Therefore the male relative teaching wages are lower than the female relative teaching wages during the career. These findings largely agree with our findings in figures 4.1 and 4.2.

Development relative teaching contract wage 1993-2006

Finally we investigate if the relative teaching wage has changed in the course of time. Figure 4.3 shows the annual changes of the ‘contract wages’ earned in primary and secondary education and in the market sector during 1993-2006. The difference between both lines is the development of the relative teaching wage.

Figure 4.3 Change contract wages in primary and secondary education and market sector (%)



Definition: Source: Contract wage education: 1993-1998: (Education excepted higher education) BZK, 2001, Trendnota arbeidszaken overheid 2002, p. 114; 1993-1998: PO/VO BZK, 2005, Trendnota arbeidszaken overheid 2006, p. 90; 2002-2006: PO/VO BZK, 2007, Trendnota arbeidszaken overheid 2008, p. 96. Source: Contract wage market sector: CPB, 2007, CEP 2007, Bijlage A6.

The figure reveals that during 1993-2006 the relative teaching wage little dropped. The contract wage of teachers rose on average with 2.1% per year and the wages in the market sector rose with 2.5%. Thus the relative teaching wage dropped on average with 0.4% per year. The decline in relative teaching wages was concentrated in the period 1995–1999. Since 2000 the relative teaching wages did not change as the average annual teaching contract wage growth of 2.5% was equal to the wage growth of the market sector. This finding agrees with the decrease of the relative teaching wage of 3.5% in 1995 to 0.3% in 1997 found in CPB (2000). The figure also indicates that the findings found for 2002 will roughly hold in 2006 as well.

Relative teaching wages of persons with a university degree

The majority of teachers have a HBO education. It holds for all teachers in primary schools and the teachers with the qualification 2nd degree in secondary schools. However, there are also teachers with a university education who teach in secondary schools with a so-called 1st degree qualification. They teach the highest classes of HAVO and VWO.

Table 4.3 Relative hourly gross teaching wages at secondary education, female and male together, 2002^a

| Subjects | Education teacher | |
|------------------|-------------------|------------|
| | HBO | University |
| | % | |
| Languages | - 5 | - 26 |
| Science subjects | - 5 | - 17 |
| Economics | - 3 | - 17 |
| Agriculture | - 11 | - 21 |
| Social subjects | - 5 | - 23 |

^a After control for a large number of variables. See annex C, table C.1 for account.

There is robust evidence that their relative teaching wages are lower of teachers with university education than of teachers with a HBO education.

Firstly, in secondary schools in 2002, the relative teaching wages of teachers with a university education are lower than the relative teaching wages of teachers with a HBO education for all subjects. For instance teachers of languages with a university education earn 28% less than employees with a university education in the market, whereas teachers in languages with a HBO certificate earn 5% less than employees with a HBO education in the market sector. See annex C for account.

Table 4.4 Relative teaching wages secondary schools, 45 year of age

| | Education teacher | |
|-----------------|-------------------|------------|
| | HBO | University |
| | % | |
| Female teachers | - 5 | - 26 |
| Male teachers | - 24 | - 33 |

Source: SEO, 2006a, Exploratie van beloningsverschillen in het onderwijs 2001-2004, table 2.1 and table 2.2, Columns 'VO' and 'Markt'; rows 'Hoger opgeleid' and 'Wetenschappelijk'.

The second argument is provided by SEO (2006a) and mentioned in table 4.4. The table shows the relative teaching wages in secondary schools of teachers with a HBO respectively university education. It turns out that the relative teaching wages are much lower for teachers with a university education than for teachers with a HBO education.

The third argument for this proposition is that the starting salaries of teachers with a 1st degree are 2% lower than the wages in business services for employees with a university education, whereas the teachers with a HBO education earn 7% more than employees in the rest of the economy with a HBO education.

Fourthly, CPB (2000, table 5.1 and grafiek 5.2) provides strong evidence of lower relative teaching wages of teachers with university education compared to teachers with HBO education during the teacher career in 1995 and 1997.

Conclusions

We find robust evidence that the relative hourly wage of teachers with a HBO education shows a U-shape during the teacher career. The relative teaching wages are lowest for teachers about 40 years old. At that age the relative teaching wages are negative. The relative teaching wages of young and old teachers are higher.

The relative teaching wages of women are much higher than those of men with HBO education. At the end of their career female teachers earn more per hour than in the market sector and there are indications that they earn more at the start of their career as well. Male teachers earn less than in the market sector during their whole career. At the age of about 40 male teachers earn at least 20% less per hour than employees in the market sector. The main reason for the higher relative teaching wages of women compared to men is that the wage profile of female employees in the market sector is lower than the wage profile of male employees in the market sector.

The number of teachers with a university certificate is smaller than the number with a HBO education. The relative teaching wages of teachers with a university education are much lower than the relative teaching wages of teachers with a HBO certificate.

5 Empirical evidence on impact teaching wages on supply

A large literature studies the effects of wage changes on the supply of teachers. Dolton (2006) summarizes the main results in a review of 46 key studies. In this section we draw conclusions from this survey.

The studies reviewed by Dolton (2006) focus on different countries, mainly the US and the UK, and different periods. In addition, there is variation in the type of supply decision that is investigated. Some studies focus on the decision to enter teaching and some on the decision to exit from teaching. Moreover, there is variation in the level of education, mainly primary or secondary education, and in the econometric specification that has been used and the coefficients that are reported. This variation between the studies makes it difficult to give a quantitative summary of the estimated effects of wages on teacher supply. However, several qualitative conclusions can be drawn.

Wages matter for teacher supply

All studies find that higher wages have a positive effect on the decision to enter or to stay in teaching.

Relative wages are important

Higher wages in non-teaching jobs have a negative effect on the decision to enter or to stay in teaching.

Both starting wages and growth of wages during the teaching career matter

Studies that include both starting wages as the growth of wages during the career find positive effects of both wage components on the decisions to enter or stay in teaching.

The decisions of male teachers are more sensitive to wage changes than the decisions of female teachers

The estimated wage elasticities for teaching decisions are higher for men than for women. This is remarkable because in general wage elasticities of labour supply are smaller for men.

It is not clear whether the effect of wage changes differs between the types of decisions and the timing of the wage changes during the teaching career

Wage elasticities have been estimated for entry and exit decisions. There is some variation in the size of the elasticities but there seems to be no systematic association with the type of decision or the timing of the decision.

The growth of wages matters for all supply decisions: choosing a teacher education, enrolment in teaching and duration of the teaching career

Studies show that the growth of wages during the teaching career has an effect on both the decision to enrol in teaching as on the decision to stay in teaching.

6 Assessing three options to increase teacher supply

Which way of spending the additional budget for increasing teacher salaries is the most effective in attracting new teachers and reducing the predicted shortages of teachers? This is the central question in this study. In this section we address this question by assessing the effects of three options for raising teacher salaries: raising starting wages, raising salaries at mid career or raising salaries at the end of the career. We are primarily interested in the effects on the reduction of teacher shortage for the medium term, approximately the next ten years. We use the main results from the previous sections for a qualitative exploration of the effects of increasing teacher salaries at these three stages of the career. A quantitative assessment would require a detailed model of teacher supply over the life cycle. Within the context of this project such a model is not feasible. To improve our insight in the qualitative assessment of the three options we formulated a simple model for the effects of spending the additional budget on teacher supply (see appendix A). This model is only used a tool for the qualitative assessment of the advantages and disadvantages of the three options for raising teaching wages.

6.1 Determinants

An increase of the wages of teachers will attract new teachers but will also raise the wages of the current teachers. Hence, the additional budget will be divided between ‘the old teachers’ and ‘the newly attracted teachers’. The effect of an increase of the wages of teachers on the new teacher supply for the medium term depends on the following components:

- The speed of adjustment;
- The current wage level;
- The number of teachers currently working whose wages will also be increased;
- The wage elasticity of the supply of teachers;
- The relative teaching wage level;
- The reservoir of potential teachers.

The first component refers to the time that is needed before the new supply of teachers will start working in education. For instance, an increase of starting salaries may attract more students in teacher studies. However, it takes several years before these students will finish their studies and start to work in education. An increase of teaching wages at a certain stage in the career will also raise the wages of the current teachers. The second and third component determine which part of the additional budget will flow to the current teachers and will not be used for attracting new teachers. If a large part of the budget flows to the current teachers there remains less budget for increasing wages for the new teachers. In addition to the wage increase, the last

three components determine the number of newly attracted teachers or the number of teachers that will not exit from teaching. A higher wage elasticity increases the probability that a person will enroll or stay in teaching when wages increase. The effect of an increase in teaching wages also depends on the relative wage level of teachers. Hence, an increase of teaching wages will be more effective if the relative wages of teachers are lower. The last component, the reservoir of potential teachers, is also important because the number of additional teachers will be larger if the pool of potential new teachers is larger.

Assessing 3 options for spending additional budget on teacher salaries

The previous sections provide information on the components that determine the effect of an increase of teacher salaries on the number of new teachers. We use this information to explore the possible effects of three options for increasing teaching wages: higher starting wages, higher wages at mid career or higher wages at the end of the career. We assume that the wages in the market sector are constant. Therefore higher teaching wages imply higher relative teaching wages. Table 6.1 characterizes the main components that determine the effects of the three possible wage increases.

Table 6.1 Determinants by stage in career

| | | Total | Start | Mid career | End career |
|------------------------|--------------|-------|---------------|---------------|---------------------|
| | | | 20 – 29 years | 30 – 49 years | Older than 50 years |
| Determinants | | | | | |
| Speed of adjustment | | | Slow | Fast | Fast |
| Teacher employment | * 1000 FTE | 215 | 35 | 100 | 80 |
| Teaching wage | * 1000 euros | 40 | 30 | 40 | 50 |
| Teacher reservoir | * 1000 FTE | | Medium | Large | Medium/Large |
| Wage elasticity | No dimension | | High | Medium | Low |
| Relative teaching wage | No dimension | 0.9 | 1.0 | 0.8 | 1.0 |

The effect of raising wages for a certain group of teachers depends on the size of the wage increase, the wage elasticity of teacher supply, the reservoir of potential teachers and the relative wage level.

The size of the wage increase, which can be realised with a certain option for allocating the additional budget, depends on the teachers employment and the level of wages at that stage of the career. If the wage increase is targeted at a stage of the career with a large employment and high wages a large share of the budget will flow to the current teachers and there will be less resources for raising wages. It should be noted that the final effect of a certain wage increase depends on interactions between all separate determinants (see appendix A). If one of the components is zero or very small the final effect is likely to be small. Below we discuss the advantages and disadvantages of these three options.

Higher starting wages for teachers (= teachers younger than 30)

Higher starting wages may stimulate entry to teacher studies and may encourage teachers who just finished their studies to enter the teacher market. The advantage of allocating the whole additional budget to the starting salaries of teachers is that a large share of the budget can be used for the 'new supply' of teachers. The current number of teachers in this group is relatively small and the wage level at the start of the career is low. As a consequence, there is budget for a relatively large increase of wages (more than for the two other options). A second advantage is that the wage elasticity is probably larger at the start of the career than at later stages of the career. However, it should be noted that the wage elasticity of enrolment in teachers studies is unknown.

From these two components it seems likely that a wage increase will result in more additional supply at the start of the career than in the two other options. A third advantage is that the reservoir of new teachers is large because there is large potential of students for enrolling in teacher studies. These three advantages will probably lead to a relatively large additional supply of teachers (compared to the other two options).

However, this option also has some disadvantages. First, the speed of adjustment is low because it takes at least 4 years before students that enrolled in teacher studies will enter the teacher market. For the short run the reservoir of new teachers is small because about 80% of the graduates in teacher studies choose teaching as first job at current teaching wages. Hence, it takes a few years before this option will generate a significant increase in the supply of teachers. As it takes a few years before the supply of teachers will adjust it is probably not optimal to spend the whole yearly additional budget for increasing wages immediately in the first year. This will probably lead to 'overshooting' and an inter temporal allocation of the budget, in which more resources are spent after a few years, will be more efficient. A second disadvantage is that increasing starting wages will make the age-wage profile for teachers less steep. Hence, reducing the increase of wages during the career. From the economic literature it is well known that a steeper age-wage profile increases incentives to supply effort and reduces exit of teaching. Thus this option probably leads to a high exit rate of teaching at a relatively young age. A third disadvantage of this option is that there might be capacity problems in teachers studies in accommodating a large increase in enrolment. In addition, a strong increase of enrolment in teacher studies will induce shortages in other segments of the labour market. These shortages will lead to wage increases in other jobs which mitigates the effects on the supply of teachers.

Higher mid career teaching wages (=teachers between 30 and 50)

If the whole additional budget would be allocated to teachers at mid career the wage increase would be smaller than in the previous option because the teacher work force at mid career is relatively large and the wage level at mid career is higher than at the start of the career. Hence,

there would remain less resources to be spend on new supply. It seems likely that the wage elasticity is smaller at mid career than at the start of the career. The lower wage increase and lower wage elasticity can be considered as disadvantages of this option compared to the previous option. An advantage of this option is that the reservoir of new teachers is large and consists of many groups. It includes the reservoir of the previous option (young teachers), the reservoir of potential teachers in non teaching jobs, current teachers who consider to exit from teaching and teachers that might extend their weekly working hours. Hence, this option has the advantage that it may have an impact on different sources of teacher supply. A second advantage of this option compared to both other options is that currently the level of teaching wages at mid career are not competitive to the level of wages in the market sector as the teaching wages are considerably lower. A teaching wage increase makes this wage more competitive. A third advantage of this option is that it would yield a steeper age-wage profile, which creates more career opportunities for young teachers and might lower their exit rate from teaching during mid career. Compared to the previous option this type of age-wage profile is expected to generate longer teaching careers and will make it easier to tie mid career teachers to the education sector. A fourth advantage of raising wages at mid career is that the adjustment process is probably more smooth than with the previous option as the wage increase is smaller and is targeted at more sources of additional supply.

Higher end career teaching wages

We consider two policy options at the end of the career: increasing wages at the end of the career or policy measures that make (early) retirement less attractive. Increasing wages at the end of the career will probably not yield a large increase in teacher supply. The wage increase will be small because of the high wage level at the end of the career and the relative large teacher work force at the end of the career. In addition, the wage elasticity is probably small. Although the reservoir of potential teachers is large we expect that a relatively small increase of teaching wages at the end of the career will hardly attract new teachers.

At the end of the career supply decisions depend on a comparison between earnings as a teacher and earnings while not working. Policy measures that make (early) retirement less attractive and working more attractive can therefore be effective in increasing the supply of teachers. A first advantage of this type of measures is that the reservoir is large because it includes all teachers that will retire in the next years. In fact, the main reason for the expected shortages of teachers in the near future is the large share of teachers that will retire in the next years. Hence, these measures are targeted directly at the cause of the teacher supply problems. A second advantage of these measures is that the impact on teacher supply might be quite large. Studies in other economic sectors suggest that these types of policy measures might be very effective (CPB, 2003; Euwals et al., 20005). Currently the so-called BAPO regulation (Bevordering Arbeidsparticipatie Ouderen) makes it more attractive for teachers to reduce their teaching

hours. Abolishment of this measure may be effective for increasing the supply of teachers if other measures are introduced to reduce absenteeism.¹⁹

Other considerations

Different impacts of higher teaching wages on women and men

Empirical studies have found that the wage elasticity of teacher supply is larger for men than for women. In particular men respond to a better career profile. In addition, the relative teaching wages are higher for women than for men. This gender difference in relative teaching wages is largest at the mid career. Therefore, an increase of wages will probably have a larger effect on male teachers than on female teachers. In order to attract as many teachers as possible it might be more efficient to use the additional resources not only for increasing wages but also for improving working conditions. The latter might have a larger effect on the supply of female teachers than an increase of wages. Female teachers mainly work part time. Also female teachers often opt for temporary inactivity to care for their children. In these cases the alternative for working as a teacher will be household production. The value of household production is probably high, and in this case the relative teaching wage is low. The alternative is to increase relative teaching wages by reducing the value of household production. This can be achieved by spending the additional teacher budget on secondary working conditions, such as subsidizing child care. It may also increase the supply of weekly teaching hours.

Supply of teachers with an academic degree

The arguments above mainly hold for teachers in primary education and secondary education 2nd degree. The share of teachers with an academic degree (1st degree) in total teacher employment will rise more due to a teaching wage increase than of the other teachers. The first reason is that the response is faster from entry to teacher studies and graduation, because these courses take 1 year instead of 4 years. Secondly, the reservoir is relatively large. A third reason is that the teaching wage are not competitive as relative wages of teachers with an academic degree are quite low, even for those at the start of the career. It is likely that an increase of

¹⁹ The BAPO regulation allows teachers older than 52 to reduce their working hours by 10 % at the cost of a 3.5 % salary reduction. At age 56 they can reduce their working hours by another 10 % at the same costs. This measure was introduced to lower the high absenteeism among older teachers. A recent study shows that teachers that participate in the BAPO regulation in 2005 on average had a lower absenteeism in 2004 than teachers that do not participate in the BAPO regulation (Vrieling, 2007). Hence, the BAPO attracts especially teachers with a low absenteeism. A recent study that focuses on the causal effect of the BAPO (Leuven, 2005) shows that this measure reduced hours worked at age 53 with 4 percent point and at age 56 with another 4 percent point . The policy measure decreased absenteeism with on average 1.1 percent points.

wages will then be more effective for individuals at the margin between teaching and working in competing jobs.

Conclusions: which option is most effective?

In sum, we made a qualitative assessment of three options. Each option has advantages and disadvantages. The first option, spending the whole additional budget on raising wages at the start of the career, is likely to lead to the largest increase in the supply of teachers because of the relatively large wage increase and relatively large wage elasticity. However, the main effect will come from new enrolment in teacher studies and it takes a least four years before these new students can start in a teaching job. In addition, the enrolment elasticity for teacher studies is unknown. Raising wages at the start of the career also has the disadvantage of making the age-wage profile less steep. This wage profile would stimulate enrolment in teacher studies and working in education at the start of the career but would not stimulate a long working career in education. Raising wages at the start of the career targets at only one source of new supply and is therefore more risky than the other options. The main advantage of the second option, raising teaching wages at mid career, is that it focuses on many different sources of teachers supply including the reservoir of young teachers. In addition, this option makes the age-wage profiles steeper, which increases the career opportunities for young teachers and makes it easier to keep them in a teaching job. Moreover, the relative wages of teachers at mid career are lower than at the start or the end of the career. This option makes the teaching wages more competitive and this is another advantage. However, the wage increase and the wage elasticity are probably smaller than in the case of the first option. For the third option, raising wages at the end of the career, the wage increase and wage elasticity will be even smaller than for the second option. We expect that raising wages at the end of the career is not very effective. However, policy measures that make working as a teacher more attractive compared to not working might be effective for teachers at the end of the career. The reservoir of potential teachers is large at the end of the career and the impact on teacher supply might be large for this type of measures.

Choosing between these options depends on the preferences of the decision maker. If the only preference is to attract as many teachers as possible then the first option is probably the best to choose. However, there is more risk involved. This option seems to be the best *temporary* one, however it is *unbalanced*. If the decision maker also values career opportunities, work incentives and a balanced age composition of the teacher work force then the second option becomes more attractive. This option seems also less risky than the first option. From this, it seems that raising wages at mid career is the best *structural solution* for the supply of teachers. Finally, measures that make (early) retirement less attractive compared to working might be very effective in increasing the supply of teachers.

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Annexes

A Analysis of teacher supply from higher budget

Aim

This annex clarifies the reasoning applied in section 6. It explains how the current wage level, the number of current teachers, the wage elasticity of teacher supply, the relative wage level and the reservoir of potential teachers determine the number of new teachers and the percentage wage growth of current teachers given the reserved additional teacher budget. In other words, it explains how this budget is divided by additional and current teachers.

Additional teachers

Assume that the probability that a person chooses for the teacher occupation increases if the percentage relative teaching wage increases. The relative teaching wage is the ratio of the level of the teaching wage to the value of reference activities. We assume that the value of the reference activities is fixed. Therefore a percentage rise of the relative teaching wage is equal to the percentage rise in teaching wages. The size of the impact of a percentage teaching wage increase on the increase of the probability to choose for teaching depends on the ratio of the constant wage elasticity of teacher supply and the relative teaching wage today. This implies that the impact of a percentage wage increase on the increase of the probability is larger the lower the current relative teaching wage. These propositions can be written as follows:

$$\Delta p = \alpha / w^* [\Delta w/w] \quad (\text{A.1})$$

where Δ denotes the difference of a variable between two successive years, p denotes the probability to choose for teaching, w the teaching wage level (thus $\Delta w/w$ is the percentage wage rise), α denotes the wage elasticity of supply of teachers and w^* the current relative teaching wage. The additional teachers due to a rise in teaching wage is equal to the increase in the probability to choose for the teacher occupation times the teacher reservoir, denoted R : $\Delta T = \Delta p R$. Substitution of (A.1) gives

$$\Delta T = R \alpha / w^* [\Delta w /w] \quad (\text{A.2})$$

where T denotes the current number of teachers and ΔT the additional teachers.

The budget constraint

Assume that the teacher budget increases with ΔB euros. The budget is shared by current and additional teachers. The new wages are $w + \Delta w$. Current and additional teachers earn these wages. Thus the additional wage sum paid to current teachers equals $\Delta w T$ and the wage sum paid to new teachers equals $(w + \Delta w) \Delta T$. The whole extra teacher budget is spent, thus in equilibrium holds the constraint:

$$\Delta B = \Delta w T + (w + \Delta w) \Delta T \quad (\text{A.3})$$

Equilibrium

The additional teachers and the percentage wage increase of current teachers under the constraint that the whole additional teacher budget is spent follow from (A.2) and (A.3).

Substitution gives

$$(R \alpha / w^*)^{-1} (\Delta T)^2 + [1 + T (R \alpha / w^*)^{-1}] \Delta T - \Delta B / w = 0 \quad (\text{A.4})$$

and

$$R \alpha / w^* [\Delta w/w]^2 + (T + R \alpha / w^*) [\Delta w/w] - \Delta B / w = 0 \quad (\text{A.5})$$

There are two solutions for the number of new teachers ΔT and for the percentage teaching wage increase $[\Delta w/w]$ because equations A.5 and A.6 are quadratic in ΔT and $[\Delta w/w]$.

However, only one solution is positive and therefore economically relevant. These are (A.6) and (A.7):

$$\Delta T = -\frac{1}{2} (\beta + T) + \frac{1}{2} \beta X^{1/2} \quad (\text{A.6})$$

where

$$X = (1 + T / \beta)^2 + (4 / \beta) * (\Delta B / w) \quad (\text{A.6a})$$

and

$$\Delta w/w = -\frac{1}{2} \beta^{-1} (\beta + T) + \frac{1}{2} \beta^{-1} Y^{1/2} \quad (\text{A.7})$$

where

$$Y = (\beta + T)^2 + 4 \beta (\Delta B / w) \quad (\text{A.7a})$$

and

$$\beta = R \alpha / w^* \quad (\text{A.8})$$

Equation A.6 gives the additional number of teachers from the additional teacher budget. The exogenous variables are the increase in the teacher budget ΔB , the current teaching wage w and the current number of teachers T . The parameter β is endogenous and depends on the exogenous variables current teacher reservoir R , the wage elasticity of wages α and the current relative teaching wages w^* . Equation A.7 shows that the percentage teaching wage increase depends on the same endogenous variables but in another combination.

Note that the share of the additional teacher budget paid to the new teachers is the ratio $(w + \Delta w) \Delta T / \Delta B$. The remainder is paid to current teachers

Signs changes of teacher employment and teaching wages due to exogenous shocks

In which directions do the additional number of teachers respond and the percentage wage increase respond to increases of the exogenous variables? In order to give an answer we should know the derivatives. Table A.1 mentions them in the second column.

| Table A.1 Derivatives: signs impacts of increases in exogenous variables | | |
|---|--|------------------------|
| Sign impact on additional number of teachers | | Sign derivative |
| $\partial [\Delta T] / \partial \Delta B$ | $\beta X^{-1/2} / w$ | > 0 |
| $\partial [\Delta T] / \partial \beta$ | $\frac{1}{2} X^{1/2} - \frac{1}{2} - \frac{1}{2} \beta^{-1} X^{-1/2} [(1+T/\beta) T \beta^{-1} + 2 \Delta B / w]$ | > 0 |
| $\partial [\Delta T] / \partial T$ | $\frac{1}{2} [(1+T/\beta) X^{-1/2} - 1]$ | < 0 |
| $\partial [\Delta T] / \partial w$ | $- \Delta B / w^2 * X^{-1/2}$ | < 0 |
| Sign impact on percentage teaching wage change | | |
| $\partial [\Delta w/w] / \partial \Delta B$ | $Y^{-1/2} / w$ | > 0 |
| $\partial [\Delta w/w] / \partial \beta$ | $\frac{1}{2} \beta^{-1} Y^{-1/2} (\beta + T + 2 \Delta B / w) - \frac{1}{2} (1 + T/\beta) T \beta^{-2} - \frac{1}{2} \beta^{-2} Y^{1/2}$ | < 0 |
| $\partial [\Delta w/w] / \partial T$ | $\frac{1}{2} \beta [(\beta + T) Y^{-1/2} - 1]$ | < 0 |
| $\partial [\Delta w/w] / \partial w$ | $- \Delta B / w^2 * Y^{-1/2}$ | < 0 |

The additional number of teachers respectively the percentage wage increase if the sign of the derivative is positive. The third column of table A.1 shows these signs. The signs follow from the following restrictions. We only investigate the impact of higher teaching budgets, thus $\Delta B > 0$. The wage level and the number of current teachers are positive: $w > 0$ and $T > 0$. The parameter $\beta > 0$, because the teacher reservoir, the wage elasticity and the relative teaching wage are all positive numbers: $R > 0$, $\alpha > 0$ and $w^* > 0$. Therefore $X > 0$ and $Y > 0$. For the derivatives of T we also use $X > (1 + T/\beta)^2$ and $Y > (T + \beta)^2$ following from (6a) respectively (7a). It is difficult to derive unambiguous signs of the derivatives of β . Simulations learn that the derivative for the additional number of teachers is positive and for the percentage wage increase negative.

From the third column follows that a higher additional teacher budget leads to more additional teachers as well as a higher percentage wage increase of current teachers. A higher β (thus a higher reservoir, a higher wage elasticity or a lower current relative teaching wage) leads to

more additional teachers and a lower percentage wage increase. Finally, a higher number of current teachers and a higher current wage level lead to less additional teachers and a lower percentage wage increase.

No quantitative predictions

The annex analyses stylised facts and we regard the qualitative analysis in section 6 as reliable as the derivatives hold in wide ranges of the parameters. However, we do not present quantitative predictions as we regard them as unreliable due to the following reasons. Firstly, the model does not describe the consequences for teacher supply over the life cycle. Secondly, the sizes of the parameters show large ranges of uncertainty.

B Relative teaching wages with HBO education

Similar career profiles of teachers and employees in the market sector with HBO

The gross hourly wages of employees (WAGE) in natural logarithms for each employee i is explained by a number of determinants as follows:

$$\ln(\text{WAGE}(i)) = \text{constant} + \sum \mu_m \text{AGE}(i,m) + \alpha_1 \text{PE}(i) + \alpha_2 \text{SE}(i) + \alpha_3 \text{OE}(i) + \beta_1 \text{HAVO/VWO}(i) + \beta_2 \text{UNI}(i) + u(i)$$

The specification assumes that all employees have the same hourly wage profile during their career. The stage in the career is measured with age. We distinguish 9 age classes starting with ages between 20 - 24 years. Each following class contains an additional 5 years of career and we denote the age classes m $\text{AGE}(m)$, $m = 2, 9$ as dummy. Thus if employee i is in the age class m , $\text{AGE}(i,m) = 1$, otherwise $\text{AGE}(i,m) = 0$. We expect an age profile with increasing estimators as the age class increases, thus we expect for the estimators that $\mu_{m+1} > \mu_m > 0$.

There are 3 types of teachers: teachers in primary education (PE), in secondary education (SE) and a rest group, mainly consisting of educationalists (OE). Each type is denoted by a dummy, which equals 1 if the person is a teacher of the agreeing type. The reference group consists of employees in the market sector, which is therefore not included with a dummy. The specification implies that for all ages a teacher of type i ($i = 1,3$) earns $100 * \alpha_i$ percent more per hour than an employee in the market sector. Therefore the estimators of α_i show the relative teaching wages. If teachers earn less per hour than employees in the market sector, the estimated signs of α_i , $i = 1,3$ are negative.

We control for the level of education of the employees. Therefore we distinguish three levels of education, namely HAVO, MBO and VWO (HAVO/VWO), HBO and university level (UNI). We take HBO as reference level of education. Both other levels of education are denoted as dummy. We expect that the estimator of the dummy is negative for workers with a HAVO, MBO or VWO certificate ($\beta_1 < 0$) because that level of education is lower than HBO level. Similarly we expect a positive impact for workers with an academic degree ($\beta_2 > 0$).

The equation has been estimated with ordinary least squares regression where $u(i)$ is the error for employee i . We carried out a regression for female and male employees separately.

| Table B.1 Estimates impact determinants on hourly gross wage in higher occupations ^{b, d} | | | |
|---|----------|--------------------|------------------|
| Estimators * 100 | | Women ^a | Men ^a |
| Age class versus 20 - 24 years | | | |
| 25 - 29 years | AGE (i) | 9.0 ** | 18.3 ** |
| 30 - 34 years | | 21.5 ** | 37.3 ** |
| 35 - 39 years | | 30.9 ** | 53.6 ** |
| 40 - 44 years | | 32.0 ** | 59.8 ** |
| 45 - 49 years | | 34.7 ** | 64.7 ** |
| 50 - 54 years | | 37.5 ** | 68.9 ** |
| 55 - 59 years | | 42.4 ** | 74.7 ** |
| 60 - 65 years | | 41.8 ** | 78.4 ** |
| Teachers versus market | | | |
| Primary education | PE | 0.1 | - 17.2 ** |
| Secondary education | SE | 5.0 ** | - 11.0 ** |
| Rest education personnel ^c | OE | 1.9 | - 11.4 ** |
| Level of education versus HBO | | | |
| HAVO, MBO, VWO | HAVO/VWO | - 15.1 ** | - 11.1 ** |
| University | UNI | 12.6 ** | 17.6 ** |
| Fit R-squared | | 0.292 | 0.299 |
| Number of observations (= persons) in regression | | 7513 | 7273 |

^a Asterisks denote impact, statistically significant from 0. *2 < t-value > 3, ** t-value > 3

^b Left out: Persons with wage lower than 5 and larger than 100 excluded, and persons with low levels of education. Estimator constant not listed

^c Mainly pedagogic workers and educationalists

^d There are also occupation classes Lower., Medium and Scientific which contain persons in education. We limit the analysis to higher occupations because teachers at primary and secondary education belong to higher occupations.

Table B.1 shows the results. The estimators are multiplied with 100 in order to enable interpretation as percentage effects of the determinants if the estimators are rather small.

The columns clearly reveal the different career profiles of female and male employees shown under the heading 'Age class versus 20-24 years'. The estimators increase indeed with age. The only exception is that female employees earn a top hourly gross wage between 55-59 years of age.

The relative teaching wages of women are positive as the estimators of α_i are positive for female employees. This implies that female teachers earn relatively more than female employees during the whole career. For instance, female teachers in secondary education earn 5% more per hour than female employees in the market sector at each year of age.

In contrast the relative teaching wages of male teachers is negative: they earn significant lower wages than male employees in the market sector during their career. The estimates point to 17% lower hourly earnings in primary education and 12% lower earnings in secondary education for each year of age.

Finally, the level of education has an impact on the hourly earnings. Employees with HAVO, MBO-4 or VWO certificate earn more than 10% less than workers with a HBO certificate and employees with a university graduation earn more than 10% more than workers with a HBO certificate. These results hold for male and female employees.

Different career profiles of teachers and employees in the market sector

The career profiles of the teaching wages and in the market sector may differ. In other words, the relative teaching wage may depend on the age of a teacher. Therefore we investigate to which extent the conclusions of the former section remain unchanged.

The gross hourly wages of employee i (denoted $WAGE(i)$) in natural logarithms are explained as follows:

$$\ln(WAGE(i)) = \text{constant} + \kappa_0 PE(i) + \lambda_0 SE(i) + \mu_1 AGE(i) + \kappa_1 PE(i) * AGE(i) + \lambda_1 SE(i) * AGE(i) + \mu_2 AGE(i)^2 + \kappa_2 PE(i) * AGE(i)^2 + \lambda_2 SE(i) * AGE(i)^2 + u(i)$$

where $AGE(i)$ denotes the year of age of employee i ($AGE = 20, 21, \dots, 64, 65$). $PE(i)$ is a dummy which is equal to 1 if the employee is teacher in primary education and $SE(i)$ is a dummy which is equal to 1 if the employee is teacher in secondary education. Employees in the market sector are the reference; and $u(i)$ is the error of employee i .

Table B.2 Estimation results

| | Women | | Men | | | | | |
|--|-----------|-----------|-----------|-----------|--------|--------|--------|--------|
| | Full time | Part time | Full time | Part time | | | | |
| Primary education | | | | | | | | |
| $\kappa_2 * 1000$ | 0.803 | (5.1) | 0.363 | (5.6) | 0.632 | (3.3) | 0.321 | (1.7) |
| κ_1 | -0.065 | (5.4) | -0.025 | (4.6) | -0.056 | (3.6) | -0.028 | (1.6) |
| κ_0 | 1.2078 | (5.5) | 0.386 | (3.5) | 0.979 | (3.2) | 0.419 | (1.0) |
| Secondary education | | | | | | | | |
| $\lambda_2 * 1000$ | 0.937 | (4.8) | 0.363 | (4.1) | 0.603 | (4.4) | 0.147 | (0.9) |
| λ_1 | -0.072 | (4.6) | -0.022 | (3.0) | -0.052 | (4.3) | -0.009 | (0.6) |
| λ_0 | 1.302 | (4.2) | 0.313 | (2.0) | 0.902 | (3.5) | 0.035 | (0.1) |
| Common to all employees, including market sector | | | | | | | | |
| $\mu_2 * 1000$ | -0.945 | (8.0) | -0.577 | (14.6) | -0.846 | (11.7) | -0.534 | (7.4) |
| μ_1 | 0.089 | (9.8) | 0.054 | (16.9) | 0.091 | (15.0) | 0.060 | (9.7) |
| constant | 1.015 | (6.0) | 1.751 | (27.8) | 0.989 | (8.1) | 1.627 | (12.6) |
| Fit R-squared | 0.47 | | 0.25 | | 0.37 | | 0.21 | |
| Number of observations | 875 | | 4693 | | 2478 | | 2298 | |

Between brackets: t-ratios.

We estimated this equation with ordinary least squares for female and male employees separately. Moreover we make a distinction in full time and part time jobs. We only include in the sample employees with a HBO-education. Thus we have left out the persons with a HAVO, MBO-4 or VWO certificate (linked to HAVO/VWO and UNI in table B.1) because these groups are rather small and may contain measurement errors. Moreover, the employees belonging to the OE group (see section before) have been deleted from the sample. Table B.2 presents the results of the regression results.

The regression equation can be rewritten to

$$\begin{aligned} \ln(\text{WAGE}(i)) = & \text{constant} + \\ & + \text{PE}(i) * [\kappa_0 + \kappa_1 \text{AGE}(i) + \kappa_2 \text{AGE}(i)^2] + \\ & + \text{SE}(i) * [\lambda_0 + \lambda_1 \text{AGE}(i) + \lambda_2 \text{AGE}(i)^2] + \\ & + \mu_1 \text{AGE}(i) + \mu_2 \text{AGE}(i)^2 + u(i). \end{aligned}$$

The estimators in table B.2 are presented in this sequence. The reason is that the expression linked to the PE-dummy, namely $[\kappa_0 + \kappa_1 \text{AGE}(i) + \kappa_2 \text{AGE}(i)^2]$, gives the wage profile during the lifetime of teachers in primary education compared to employees in the market sector. Similarly, the expression linked to the SE-dummy, namely $[\lambda_0 + \lambda_1 \text{AGE}(i) + \lambda_2 \text{AGE}(i)^2]$ gives the wage profile during the lifetime of teachers in secondary education compared to employees in the market sector. The figures 4.1 and 4.2 show both quadratic expressions for women working full time and part time and men working full time and part time.

Different career profiles of teachers and employees in the market sector with HBO

The quadratic function may lead to sharp rises at the ends of the range of AGE hardly filled with observations. In order to test for robustness we take an approach with age-classes instead of years of age. We distinguish three age classes: young (between 20 – 29 years), middle (between 30 – 49 years) and old (between 50 -64 years). In total this gives 9 categories. All persons in the sample are classified in one of the nine groups. Each group is a dummy, which equals 1 if a person belongs to a group. If an employee does not belong to a group the dummy equals 0. The reference person is a young person in the market sector. Therefore, the dummy of this group is omitted. This gives the following regression equation where all determinants are dummies:

$$\begin{aligned} \ln(i, \text{WAGE}) = & \alpha_1 \text{PE (YOUNG)} + \alpha_2 \text{PE (MIDDLE)} + \alpha_3 \text{PE (OLD)} + \\ & + \beta_1 \text{SE (YOUNG)} + \beta_2 \text{SE (MIDDLE)} + \beta_3 \text{SE (OLD)} + \\ & + \gamma_2 \text{MS (MIDDLE)} + \gamma_3 \text{MS (OLD)} + \\ & \text{constant (i)} \end{aligned}$$

In the equation PE (YOUNG) denotes young teachers in primary education. SE denote teachers in secondary education and MS employees in the market sector. The estimators of the coefficients are multiplied with 100 to give the percentage difference with the reference person.

The relative teaching wage in primary education (compared to the market sector) for young employees equals $\alpha_1 * 100$, the relative teaching wage of middle aged employees equals $(\alpha_2 - \gamma_2) * 100$ and of old employees $(\alpha_3 - \gamma_3) * 100$. The wage profiles of teachers in primary education and the market sector are similar if $\alpha_1 * 100 = (\alpha_2 - \gamma_2) * 100 = (\alpha_3 - \gamma_3) * 100$. The analogous formula holds for relative teaching wages in secondary education.

The regressions have been carried out with ordinary least squares for the same sample as in table B.2. Table B.3 shows the results. The table clearly reveals that the relative teaching wages are not constant during the career as a teacher.

Table B.3 Relative teaching wage by age class with employees with HBO certificate

| | Women | | | Men | | |
|----------------------------|-------|---------|---------|-------|---------|---------|
| | Young | Middle | Old | Young | Middle | Old |
| Full time | | | | | | |
| Estimated coefficient *100 | | | | | | |
| Teacher PE | 4.7 | 21.6 ** | 39.6 ** | - 6.6 | 22.1 ** | 40.7 ** |
| Teacher SE | 5.8 | 29.1 ** | 50.0 ** | - 5.5 | 27.7 ** | 46.3 ** |
| Market sector | 0 | 27.9 ** | 44.7 ** | 0 | 39.6 ** | 59.6 ** |
| Relative teaching wages | | | | | | |
| Teacher PE | 5 | - 6 | - 5 | - 7 | - 18 | - 19 |
| Teacher SE | 6 | 1 | 5 | - 6 | - 12 | - 13 |
| Part time | | | | | | |
| Estimated coefficient *100 | | | | | | |
| Teacher PE | 0.0 | 22.1 ** | 33.9 ** | - 7.2 | 27.7 ** | 35.9 ** |
| Teacher SE | - 1.7 | 25.7 ** | 41.3 ** | - 6.7 | 27.5 ** | 45.5 ** |
| Market sector | 0 | 21.5 ** | 24.7 ** | 0 | 34.9 ** | 48.3 ** |
| Relative teaching wage | | | | | | |
| Teacher PE | 0 | 1 | 9 | - 7 | - 7 | - 13 |
| Teacher SE | - 2 | 4 | 17 | - 7 | - 7 | - 3 |

* 2 <t-ratio < 3, ** t-ratio > 3.

C Relative teaching wages with university education

The hourly gross wages of employees (WAGE) in natural logarithms for each employee in age group m is explained by a number of determinants as follows:

$$\begin{aligned} & \ln(\text{WAGE}(m)) \\ &= \sum \mu_m \text{AGE}(m) + \sum \alpha_i \text{T}(i) + \beta_1 \text{LOW} + \beta_2 \text{HAVO/VWO} + \beta_3 \text{UNI} + \text{other dummies} + \\ & \text{constant} \end{aligned}$$

The AGE dummies have the same significance as in table A.1. Teachers in primary education are denoted TPE. Teachers in secondary education are denoted T(i) where teachers in the subjects languages (TL), science subjects (TS), economics (TE), agriculture (TA), social subjects (TO). Moreover there are employees with an university degree in education who do not teach. We distinguish pedagogic workers (TP), educationalists (TD) and the other employees in education with an university degree (TU). The levels of education are the same as in table A.1. Moreover the following dummies were added: gender (F/M), temporary or permanent contract (T/P) and part time or full time job (P/T).

The equation has been estimated with ordinary least squares regression for employees with a HBO education and with a university education, women and men together. The difference between women and men is covered with the F/M dummy.

Table C.1 Estimates impact determinants on hourly gross wage in higher occupations^{b, d}

| Estimators * 100 | | HBO education | University education |
|--|----------|---------------|----------------------|
| Age class versus 20 - 24 years | | | |
| 25 - 29 years | AGE (i) | 10.8 ** | 10.0 ** |
| 30 - 34 years | | 25.1 ** | 32.0 ** |
| 35 - 39 years | | 37.2 ** | 46.0 ** |
| 40 - 44 years | | 41.2 ** | 57.0 ** |
| 45 - 49 years | | 45.1 ** | 62.6 ** |
| 50 - 54 years | | 48.8 ** | 67.7 ** |
| 55 - 59 years | | 54.2 ** | 72.9 ** |
| 60 - 65 years | | 55.0 ** | 76.3 ** |
| Teachers versus market | | | |
| Primary education | TPE | - 5.9 ** | - |
| Secondary education | | | |
| Languages | TL | - 5.0 ** | - 25.5 * |
| Science subjects | TS | - 5.8 ** | - 17.4 ** |
| Economics | TE | - 3.3 | - 17.0 ** |
| Agriculture | TA | - 10.8 ** | - 21.0 ** |
| Social subjects | TO | - 4.9 ** | - 23.1 ** |
| Pedagogic | TP | - 5.5 * | - 14.1 ** |
| Educationalists | TD | - 3.8 | - 13.5 ** |
| Unspecified education | TU | - 8.7 ** | - 29.0 ** |
| Level of education versus HBO^c | | | |
| HAVO, MBO, VWO | HAVO/VWO | - 12.0 ** | - 19.3 ** |
| University | UNI | 14.8 ** | 18.4 ** |
| Other characteristics | | | |
| Gender (Female = 1) | F/M | - 15.7** | - 9.8 ** |
| Contract (Temporary = 1) | T/F | - 6.8** | - 8.8 ** |
| Part time = 1, Full time = 0 | P/T | - 4.1** | - 5.3 ** |
| | | 282.4 ** | 735.8 ** |
| Fit R-squared | | 0.367 | 0.406 |
| Number of observations (= persons) in regression | | 18044 | 7358 |

^a Asterisks denote impact, statistically significant from 0. *2 < t-value > 3, ** t-value > 3.

^b Left out: Persons with wage lower than 5 and larger than 100 excluded, and persons with low levels of education. Estimator constant not listed..

^c Left out mentioning the results for low educated employees.

Table C.1 shows the results. It appears that for all subjects the relative wages of teachers with a HBO education and university education are lower than in the market. Moreover it appears that for all subjects in secondary education the relative teaching wages of teachers with a university education is lower than on teachers with a HBO education.

D Data and definitions LSO in annexes B and C

The data are from the 'Loonstructuuronderzoek 2002' (LSO 2002) from Statistics Netherlands. This database contains data of employees between the ages of 15 – 64 years in the Netherlands of their wages and a number of personal characteristics. The computations have been carried out for teachers and employees in the market sector.

A teacher is defined as a person who is called a teacher in LSO 2002 and who also is classified as belonging to SBI-class 80: Class Education. We distinguish teachers in primary education, secondary education and a rest group. The latter group is separate in the regression with a similar career (table B.1) and is included in the teachers in secondary education in the regression with different careers (tables B.2 and B.3). Employees in the market sector are the rest group after deleting employees in the public sector including teachers. A person works full time with a workweek of 32 hours or more.

A person works part time with a workweek of less than 32 hours.

E Abbreviations

| | |
|------|---|
| BZK | Ministerie van Binnenlandse Zaken |
| CASO | Commissie Automatisering Salarisadministratie Onderwijs |
| FPU | Flexibel Pensioen en Uitkering |
| FTE | Full Time Equivalent |
| HBO | Hoger BeroepsOnderwijs |
| HAVO | Hoger Algemeen Vormend Onderwijs |
| ITS | Onderzoeksinstituut naar o.a. onderwijs (Nijmegen) |
| LSO | LoonStructuur Onderzoek |
| MBO | Middelbaar BeroepsOnderwijs |
| NLO | Nederlandse Leraren Opleidingen |
| OCW | Ministerie voor Onderwijs, Cultuur en Wetenschap |
| PABO | Pedagogische Academie voor het BasisOnderwijs |
| PE | Primary Education |
| ROA | Researchcentrum voor Onderwijs en Arbeidsmarkt |
| SBO | SectorBestuur Onderwijsarbeidsmarkt |
| SE | Secondary Education |
| SEO | Stichting Economisch Onderzoek |
| ULO | Universitaire Leraren Opleidingen |
| VSNU | Verenigde Samenwerkende Nederlandse Universiteiten |
| VWO | Vorbereidend Wetenschappelijk Onderwijs |
| WAO | Wet Arbeids Ongeschiktheidsverzekering |

F Explanation abbreviations

| | |
|------|--|
| BZK | Ministry of Home Affairs |
| CASO | Salary payment system education personnel |
| FTE | Employment computed to full time input |
| HAVO | Secondary general education, medium level |
| HBO | Higher vocational education |
| ITS | Research institute for (among others) education (Radboud University, Nijmegen) |
| LSO | Micro database with wages and personal characteristics (Statistics Netherlands) |
| MBO | Secondary vocational education |
| NLO | Teacher studies at HBO in behalf of secondary education |
| OCW | Ministry of Education |
| PABO | Teacher studies on behalf of primary education |
| PE | Primary education |
| ROA | Research institute for education and the labour market (University of Maastricht) |
| SBO | Expertise centre for educational staff set up by employer and employee organisations |
| SE | Secondary education |
| SEO | Research institute for (among others) education (University of Amsterdam) |
| ULO | Teacher studies, 1 st degree at universities |
| VSNU | Association of Dutch universities (employer organisation) |
| VWO | Secondary educational education, higher level |
| WAO | Law insurance employment disability |