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Netherlands, 1986 – 1998*

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## **The impact of education and mismatch on wages: The Netherlands, 1986 – 1998**

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### Abstract

In analysing the impact of education on wage differentials and wage growth, we use next to personal characteristics (e.g. education) also job characteristics (e.g. skills required) to explain wages. We estimate wage equations on individual data for the Netherlands, 1986 – 1998. It turns out those personal characteristics like education and experience explain only about 50 percent of the variation in wages. The other half is explained by variation in job characteristics.

Moreover, the increasing educational attainment, which is widely thought to enhance productivity growth, is countered both by an increasing level of skills required for each job and by overschooling. Thus a plausible explanation for the productivity slow-down since the mid-eighties is provided.

### Acknowledgements

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## 1. Introduction

There are various ways to explain why persons have different wages. Some approaches stress differences in personal characteristics as the main determinant – cf. the widely used Mincer (1974) earnings function, based on human capital theory. Other approaches emphasise differences in job characteristics – cf. Thurow's (1975) job competition theory. A synthesis is provided by the assignment or allocation theory, which recognises that, since individuals are characterised by abilities and jobs are characterised by complexity, there may be comparative advantages in assigning particular individuals to particular jobs, which will be exploited by an efficient labour market – cf. Hartog (1992) and Sattinger (1993). Also the segmented labour market theory and discrimination theories stress that both demand and supply characteristics should be taken into account when explaining wage differentials.

Looking at the various approaches, it seems reasonable to us that indeed wages are determined by both personal characteristics and job characteristics. But then several interesting questions arise. First, to what extent are wage differentials explained by personal characteristics, to what extent by job characteristics and to what extent do these characteristics interact? A second question concerns the implications for the observation of mismatch between persons and jobs. When persons are classified according to their skill level obtained, often measured by years of education or highest grade, and jobs are classified according to the skill level required, it is often observed that there is a mismatch between the educational attainment of a persons and the skills required on the job were he or she is working. We illustrate this for the Netherlands below.

Figures 1 and 2 show the composition of the workforce in the Netherlands for the period 1971 – 1995 with respect to educational attainment and required skill levels. Comparison of both figures indicates that the share of lower educated persons among the work force decreased strongly, whereas the share of jobs requiring only low skills hardly changed. At the opposite end of the range, the share of higher vocational and university educated persons increased relatively strong compared to the share of jobs requiring high skills. Figure 3 illustrates how, as one might expect, the average level of education did increase stronger over time than the average of

skills required. As a consequence the data show that for each level of education, the average level of skills required on jobs where persons with that education are working declined over time – this is elaborated extensively in Asselberghs cs. (1998).

Figure 1 Education of the workforce in the Netherlands, 1971 – 1995<sup>1</sup>

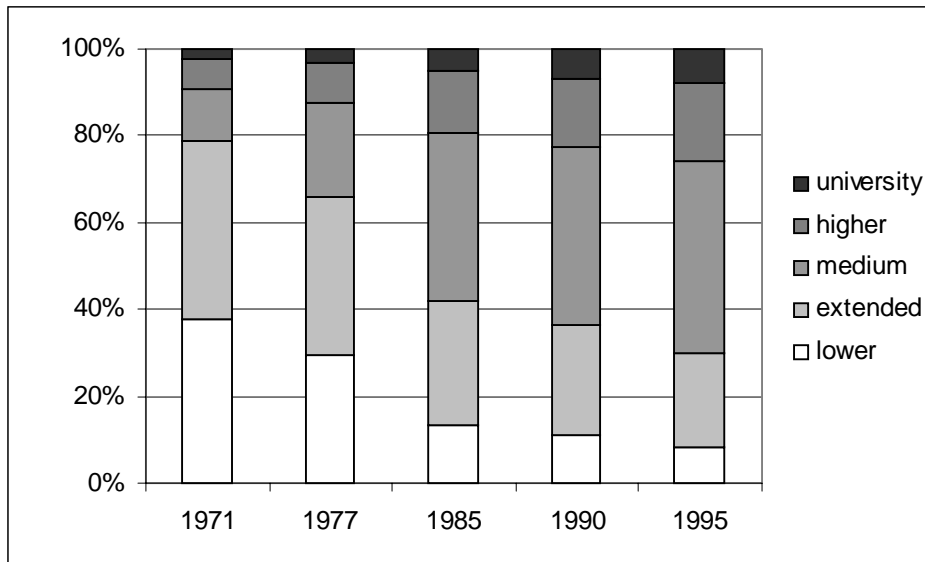
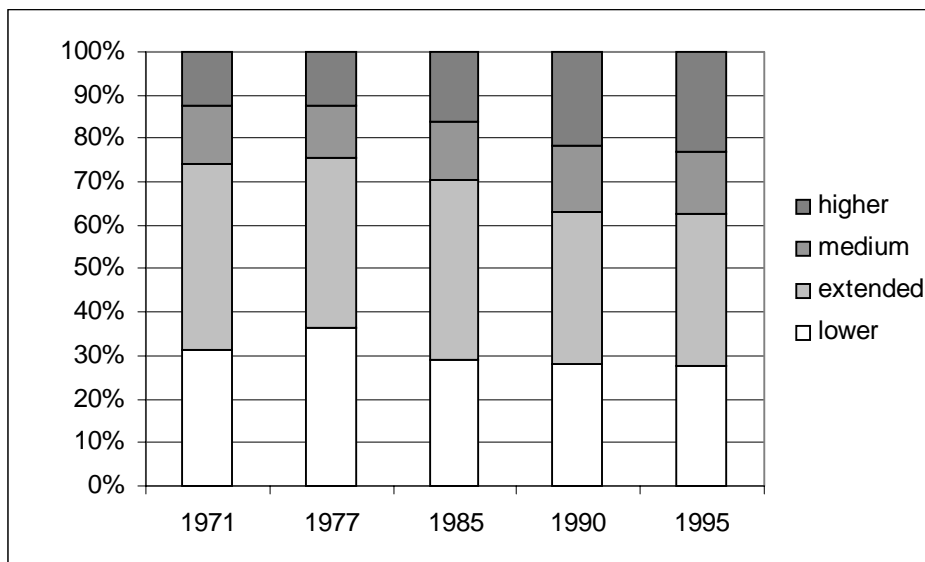


Figure 2 Skill level required of the workforce in the Netherlands, 1971 – 1995<sup>2</sup>



<sup>1</sup> Source: Asselberghs cs. (1998), Table 3.1.

<sup>2</sup> Source: Asselberghs cs. (1998), Table 2.1. The skill levels of the work force, ranging from 1 to 7, are explained in the data we use below.

Figure 3 Average education and skill level required of the workforce in the Netherlands, 1971 – 1995<sup>3</sup>

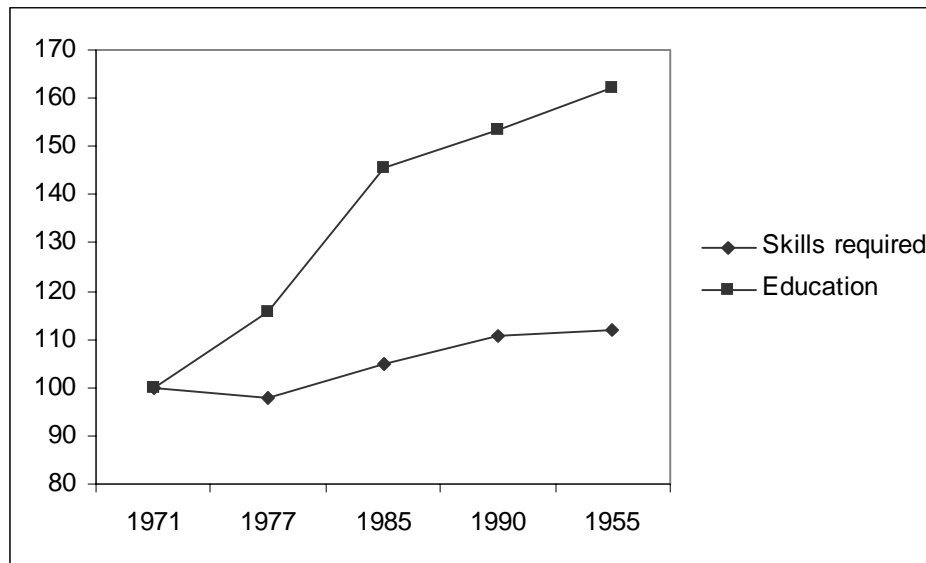


Table 1 presents a snapshot of this development for the year 1994. As one might expect, most persons with low and extended education are working on jobs with low and extended skills required, and most persons with high skills are working on jobs with high skills required. However, the association between educational level and skills required is not unique.

Table 1 Skill level required by educational level of the workforce in the Netherlands, 1994<sup>4</sup>

		Required skills			
		Low	Extended	Medium	High
Education	Low	13,9	2,5	1,0	0,6
	Extended	25,1	10,6	4,6	2,6
	Medium	9,7	8,0	4,2	3,7
	High	2,8	1,2	1,8	7,6

<sup>3</sup> Source: Asselberghs cs. (1998), Tables 2.1 and 3.1. The averages are calculated by weighing the various educational categories and the required skill levels on a scale 1 to 7.

<sup>4</sup> Source: data used – see section 3 below.

One might also wonder why for instance persons with a high education are working on a job requiring low skills only – this involves 20 percent of the high skilled work force in 1994. Does this indicate mismatch (overschooling) due to market imperfections, or are other explanations plausible? We shall elaborate various possible reasons below. Moreover, Table 1 illustrates that both personal characteristics (education) and job characteristics (skills required on a certain job) are important to determine the position of a worker and hence also his or her earnings.

The outline of our paper is as follows. Section 2 briefly describes the assignment approach, which shows how wages are determined by both personal characteristics and job characteristics. We emphasise there the impact of comparative advantage in skill-job combinations on the allocation between skills and jobs. Although we are somewhat more eclectic when interpreting our empirical results, this approach provides an interesting theoretical background for our analysis.

Section 3 presents the data for the Netherlands 1986 – 1998 which we use in our empirical analysis. We estimate wage equations from these data, where we distinguish between personal characteristics and job characteristics. Section 4 discusses the estimation results. It turns out that both personal characteristics and job characteristics are significant in explaining wages. Moreover the coefficients are stable over time. Section 5 shows how personal characteristics and job characteristics each influence the mean wage and the variation in the wage in a different way. Roughly speaking half of the variation in wages can be explained by changes in personal characteristics, while the other half is explained by changes in job characteristics. This observation also allows for some reflection on the interpretation of mismatch in section 6.

Section 7 then uses these estimation results to analyse the impact of education on productivity growth. We contrast our analysis with that of Pomp (1998) who estimates a Mincerian wage equation for the Netherlands and uses the results in an attempt to explain the observed productivity slow-down. However, Pomp finds that the observed increase in educational attainment leads to an overestimation of productivity growth. We show that this problem is solved once job characteristics also are included in the wage equation. Section 8 summarises these and other conclusions.

## 2. Assignment models and the fallacy of composition

The notion that wages are influenced by both personal characteristics and job characteristics can be found in the assignment literature – cf. Sattinger (1993) for a survey. The usual approach, which only takes personal characteristics into account, is based on human capital theory and is supply side oriented. That is, differences in earnings are explained by differences in human capital, based on either formal training or on-the-job training, and demand characteristics (jobs, occupations) are either redundant or subsumed in human capital (Mincer, 1974). The implicit assumptions are either perfect substitutability of labour by schooling levels or perfect allocation of individuals to jobs.<sup>5</sup>

An alternative view is presented in the segmented labour market theory. This theory is demand side oriented. Market imperfections prohibit groups of individuals (with common and disadvantageous characteristics) to collect the full return to their productive abilities. Therefore the labour market structure and job characteristics are prime determinants of individual's earnings. An extreme version of this theory is found in Thurow (1975), where earnings are solely determined by job characteristics.

Synthesising both approaches above, the assignment or allocation literature stresses the interaction between demand and supply. This theory recognises that, since individuals are characterised by abilities and jobs are characterised by complexity, there may be comparative advantages in assigning particular individuals to particular jobs, which will be exploited by an efficient labour market – cf. Hartog (1992) and Sattinger (1993). Therefore wages are determined by both personal characteristics and job characteristics.

One way to understand assignment models is to look at an example that illustrates the implications of comparative advantage when an individual is allocated to a certain job – cf. Hartog (1992, p. 107). Assume that three individuals with capability levels 1, 2 and 3, respectively, have to be allocated to three jobs. Table 2 presents the output each individual generates when allocated to that job.

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<sup>5</sup> Demand characteristics may be included in empirical estimations, but that is on an ad hoc basis, without theoretical motivation. A recent example is provided in Black, Trainor and Spencer (1999) who in a study on gender inequalities use a Mincerian earnings function, with education and experience as the only explanatory variables, in their theoretical analysis. Next they introduce a host of job related characteristics in their estimations, without any further motivation.

Table 2 *Productivities of individuals on jobs: an example*

		Job		
		1	2	3
Capability level	1	20	30	60
	2	40	60	80
	3	100	110	120

At first sight one might think that the individual with capability level 3 will be allocated to job 3, but looking at the comparative advantages shows that (s)he will be employed in job 1, whereas the individual with capability level 1 will end up in job 3. Thus the individual with the lowest capability ends up in the most productive job, and that with the highest productivity in the least productive job.

It should be clear that the latter is not a general statement, but holds for this example. However, one observes in general that the individual with the highest capability will be assigned to the job with the largest productivity dispersion. Therefore Roy (1951) already observed that the unequal variance between sector productivities plays at least as important a role in the allocation of individuals to jobs and hence earnings, as does the correlation between performances of each individual in various sectors – cf. also Hartog (1992, p. 108) and Sattinger (1993).<sup>6</sup>

The implication of these findings is, for instance, that sector earnings are not proportional to prices, since price changes induce non-random changes in the workforce of that sector, reflecting the comparative advantages of the workers. Therefore an aggregation bias in the sector earnings functions will occur, because of movements between sectors. Moreover changes in the aggregate wage rates do not reflect changes in the wage for workers with the given skill.<sup>7</sup> The above is a typical example of the fallacy of composition, which does not allow for extrapolating the relationship between an individual's earnings and his or her characteristics to get the distribution of earnings.

<sup>6</sup> Sattinger (1993, p. 839ff.) also shows how comparative advantage is relevant when earnings from a job are proportional to physical output at the job. This link can be severed when other factors of production cooperate in the process, and hence determine the scale of operation. In that case the opportunity cost of the cooperating factor must be subtracted from the value of output to yield the earnings. This might again lead to a different assignment of workers to jobs.

<sup>7</sup> Sattinger (1993, pp. 856-7) emphasises this, referring to Heckman and Sedlacek (1985).



Tinbergen (1951) analyses how, instead of comparative advantages, preferences may also guide the assignment. He assumes that workers have a higher preference for a better match between abilities and job requirements; this can be balanced by compensating wage differentials. Amongst others Tinbergen's approach implies that the earnings function should take job characteristics into account, next to personal characteristics. Moreover, as in the presence of comparative advantage effects, the specification should allow for an interaction between personal and job characteristics.

The above approaches provide several reasons, which indicate "... the earnings function is no longer a direct relationship arising from the contribution of worker characteristics to production. ... it is generated from the supply and demand decisions of workers and firms." [Sattinger, 1993, p. 868] And as a consequence the return to education varies with the job allocation of the worker. A related finding is that "A shift in the match between required and available characteristics is not necessary a sign of poor market performance ... the real test is whether the earnings functions show sufficient adjustment" (Hartog, 1992, p. 105).

Another implication of the assignment approach for the estimation of earnings functions is that there will be a selection bias in the estimation results, which in principle should be accounted for. However, as Sattinger (1993, p. 835) puts it: "Assignment models .... have not so far generated a set of easy identifiable questions which can be answered by accessible empirical procedures."<sup>8</sup>

Given the complications involved in estimating assignment models properly, we will follow an approach similar to that proposed by Hartog (1992, Ch. 7.5). There Hartog estimates a Mincerian type of earnings functions where he adds to the usual personal characteristics in stead of education attained, the education required for the job on which the individual is employed and the years of overeducation or undereducation, determined by education required and attained. He has advocated this approach more recently on various occasions – for instance in Hartog (2000). We will follow a similar approach below, where we will distinguish in the earnings function next to personal characteristics also job characteristics. Moreover, we will allow for interaction between both types of characteristics to test whether comparative advantage prevails.

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<sup>8</sup> This is illustrated by the interesting applications in van Ophem, Hartog and Vijverberg (1993) and Teulings (1995).

### 3. The data used<sup>9</sup>

We have used survey data obtained by the OSA for the years 1986 – 1998 (even years only).<sup>10</sup> These data are a representative sample of the workforce. They are partly panel data, but new individuals replace the dropouts to keep the sample representative.<sup>11</sup> Actually we eliminated those cases from the survey data for which either some observations were missing (in most cases) or some reported data seemed totally unreliable (in some cases only). However, although the size of the survey sample decreased between 1986 and 1998, the proportion of complete cases increased. Thus we were able to use about half of the survey for the latter period – this amounts to approximately 2000 cases for each year. We used these data to estimate wage equations with explanatory variables which can be attributed either to the personal characteristics of the worker, or the job (s)he performs.

Personal characteristics of the worker are first of course gender and age. However, since age correlates strongly with total experience, we only allow for an age dummy, which indicates whether the worker is younger than 20 years of age, or not. The motivation is that the youth minimum wage is highly increasing in age below 20 years. The second personal characteristic then is experience, which is distinguished in previous experience and current experience on the job. Moreover, in order to allow for decreasing returns to learning-on-the-job, total experience squared is added. The third personal characteristic is education received. Here we distinguish between educational level on the one hand and the type of educational instruction on the other. Finally we have included number of hours worked as a personal characteristic, although this is already on the borderline with job characteristics. The inclusion of this variable is motivated by the large incidence of part-time work in the Netherlands, which to a large extent is considered to be of a “voluntary” nature – this motivates us to include it as a personal characteristic.

The characteristics of the job occupied by the worker are first the size of the firm in which this job is located, measured by number of workers, and the sector, exposed or sheltered. Second the level of skills required on the job is indicated on the

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<sup>9</sup> We would like to thank the OSA (Organisatie Strategisch Arbeidsmarktonderzoek), in particular Dr. P. Allaart, for allowing us to use these data.

<sup>10</sup> We did not use the sample for 1990 because of severe definition problems.

<sup>11</sup> Cf. the descriptions in OSA (1987, ..., 1999). A more detailed description of the variables is given in the Annex and an overview of the data used is available from the authors.

one hand by whether this job has subordinated workers or not. On the other hand the skill level required by the job can be derived from the data: the lowest level is 1, the highest 7.<sup>12</sup>

The annex summarises information on these characteristics for each year, together with the natural log of the hourly net wage, which is the dependent variable.

The data show a steady increase in the proportion of women in the workforce (cf. the gender dummy) and a decrease in the number of hours worked (Mhours), which partly should be attributed to the increase in part-time work in which the majority of women is involved. Also the share of lower education decreases modestly over time, i.e. below level 3 (which is LBO/MAVO), which is compensated by an increase of the share above that level. Thus the average educational level of the workforce increases over time, cf. also Figure 1 above. The share of persons with higher skills required (levels 4-7) increases too, whereas that with lower skills required (levels 1-3) decreases – cf. also Figure 2 above.<sup>13</sup> The shares or means of the other variables show no clear development over time.

#### **4. The estimation results**

We used the data presented above to estimate the wage equation in a Mincerian form, albeit including job characteristics. Since the ordinary least squares estimation results suffer from heteroskedasticity,<sup>14</sup> we re-estimated the equations with weighted least squares. As the variable *man-hours* turned out to be the only variable with a significant correlation with the OLS-residuals, we used this as the weight variable –

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<sup>12</sup> The data are transformed with the so-called ARBI scale, which starts from the detailed occupational classification and divides occupations into 7 required skill levels, coded 1 to 7 from low to high (*Skill lev* in our notation). The classification uses the complexity of occupations as a criterion and takes into account, amongst others, the job content, the required knowledge and mental ability. Some more details are provided in Hartog (1992), pp.154-155 and Annex 5.2.

<sup>13</sup> The tendencies with respect to education and required skill levels as they can be observed from the sample data are not as clear as the tendencies presented in Figures 1 and 2 above. This is due to the nature of the sample.

<sup>14</sup> This was obvious from visual inspection of the estimated residuals and confirmed by White's general test.

cf. Greene (1997, p. 557).<sup>15</sup> The thus obtained estimation results no longer suffer from heteroskedasticity – as can be seen from White’s general test.

Table 3 shows that the estimated parameter values for most variables are remarkably constant over time – i.e. the parameter values lie within a relatively narrow range.<sup>16</sup> This might indicate that our estimation results do not suffer from a specification bias, although we did not estimate the job match simultaneously with our wage equation.<sup>17</sup>

The estimation results indicate that almost all variables attributed to personal characteristics are highly significant for all years. As might be expected, both being female and being young have a negative impact on hourly wages, as does working more hours. Both current and previous experiences have a positive impact, although with decreasing returns. The returns to education are positive too.

Most of the variables attributed to job characteristics are significant too for all years, except the sector. Having subordinates definitely pays a higher wage, whereas working in a larger firm also yields a bonus. Finally, when the job requires a higher level of skills this also yields a higher wage.

We also tested for interaction effects between personal and job characteristics – in particular between educational and functional levels. None of these effects turned out to be significant.<sup>18</sup> According to the assignment theory, the absence of interaction effects indicates that there is no comparative advantage. However, a more sophisticated estimation method might lead to different conclusions as is witnessed by Ophem, Hartog and Vijverberg (1993), following the Tinbergen approach, and by Teulings (1995), using the comparative advantage approach. Since the application of such estimation methods is beyond the scope of this analysis, we will indicate possible comparative advantages in a further elaboration of the present estimation results in the next section. First we take a closer look at the estimation results and compare them to other results for the Netherlands.

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<sup>15</sup> Using the Heteroskedasticity Consistent Covariant Matrix (HCCM) method in EViews resulted in quite similar results.

<sup>16</sup> This is consistent with the finding of most Dutch studies reported in OSA(1994) that returns to education have been stable over time – at least till the early nineties.

<sup>17</sup> Sattinger (1993, p. 868) argues that the influence of demand might cause the coefficients of the earnings functions to change over time, which indicates a specification bias.

<sup>18</sup> Only the interaction between educational level 3 and required skill levels 3–4 turned out to be significant – but only for 1994, it was insignificant level for the other years.

Table 3 The estimation results (dependent variable LN hourly wages)

Variables	OSA 86	OSA 88	OSA 92	OSA 94	OSA 96	OSA 98
Constant	2.401	2.221	2.664	2.405	2.438	2.687
Gender	-0.227	-0.106	-0.204	-0.145	-0.146	-0.197
Agedum	-0.423	-0.410	-0.465	-0.502	-0.367	-0.320
Pexp	0.024	0.024	0.020 <sup>19</sup>	0.033	0.032	0.025
Texp <sup>2</sup>	-0.0004	-0.0003	-0.0003	-0.0005	-0.0005	-0.0004
Cempl	0.023	0.022		0.033	0.032	0.030
Mhours	-0.0006	-0.0014	-0.002	-0.0013	-0.0012	-0.0021
Edlev3	0.070	0.058**	0.070*	0.076	0.109	0.064*
Edlev4	0.108	0.098	0.168	0.205	0.208	0.142
Edlev5	0.227	0.201	0.278	0.286	0.363	0.286
Edlev6	0.341	0.313	0.361	0.481	0.501	0.394
Edinstr1 <sup>20</sup>	-0.081	0.010**	-0.075	-0.072	-0.089	-0.059
Edinstr3	-0.021**	0.040*	-0.041**	-0.041	-0.037	-0.041
Fsize#	0.00005	0.00005**	0.000008	0.00003	0.00001	0.000008*
Skill lev3 <sup>21</sup>	0.048	0.066	0.110	0.066	0.040*	0.063
Skill lev5	0.108	0.110	0.136	0.134	0.102	0.157
Skill lev6 <sup>22</sup>	0.279	0.302	0.283	0.279	0.212	0.264
Sub	0.095	0.082	0.071	0.058	0.080	0.045
Fsect1	0.031**	0.010**	0.015**	0.023	0.018**	0.010**

Dependent Variable: LN HW

\* Insignificant at 5% level

\*\* Insignificant at 10% level

### Age, gender and hours worked

From the estimation results it can easily be inferred that being female implies that one would earn about 16 per cent less of the mean wage, when compared to otherwise similar males, although this percentage fluctuates over the years. However, it can also be inferred that working part-time instead of full time (70 in stead of 140 hours per month) yields a premium of approximately 11 per cent on the mean hourly wage, an outcome that also fluctuates over years.<sup>23</sup> Since most women work part-time in the

<sup>19</sup> For the year 1992 the variables *pexp* and *cempl* are estimated by one variable total experience.

<sup>20</sup> *Edinstr1* replaces the aggregate of former *Edinstr* 1, 2 and 4.

<sup>21</sup> *Skill lev3* replaces the aggregate of former skill levels 3 and 4.

<sup>22</sup> *Skill lev6* replaces the aggregate of former skill levels 6 and 7.

<sup>23</sup> At first sight this premium is a surprising result since usually a negative impact of part-time work on wages is found. However, here we analyse the impact on net wages, i.e. after deduction of taxes and

Netherlands, it seems reasonable to take these two outcomes together, which would imply a deficit of about 5 per cent for female workers.<sup>24</sup> In this context Hartog (1992) also finds that access to better-qualified jobs is more difficult for women – cf. also Asselberghs Cs. (1998, Ch. 4). The latter also find, however, that the gap between women and men is decreasing over time. This can also be inferred from our results when we correct for part-time work: this deficit decreases gradually from 15 per cent in 1986 to 4 per cent in 1998, with 1988 as an outlier.

Finally, the impact of the low level of the youth minimum wage shows up in the premium of being 20 years or older, which varies in the range of 26 to 33 per cent.

### *Experience and education*

We want to look at the returns to experience and education in more detail since they are crucial elements of a skill variable. First the estimation results in Table 3 show that the direction of educational instruction has a rather modest impact on earnings. Compared to general of education, all more specific directions have a negative impact. The disadvantage of directions other than medicine, economics and law is the largest.

Second, it is remarkable that the returns to previous employment are very similar to those of current employment – Table 3 indicates that only for 1998 a small difference can be observed. This suggests that learning is not a very specific process confined to a specific job within a specific firm, but of a more general nature. Therefore we look at the return to total experience below.

Figure 4 shows the estimated impact of total experience after 17 years for each year in our sample. One sees that this estimated impact is quite stable over the sample period – it lies in the range 0.6–0.8, except for the years 1994 and 1996. Moreover, due to the diminishing returns to experience, the maximum return to experience is obtained after around 33 years.<sup>25</sup>

The estimated impact of the various forms of education, compared to basic education, is depicted in Figure 5. The figure shows positive returns to education, as

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social security premiums. Since these are relatively lower for low incomes, the net hourly wages may be higher for part-time jobs when compared to full-time jobs. This argument is also given in OSA (1994).

<sup>24</sup> Similar results are found in, for instance, Hartog (1992), OSA (1994) and Pomp (1998).

<sup>25</sup> Pomp (1998) finds a similar profile, although he finds no decrease, but a flattening out at the end. However, he finds a surprising jump for the age category over 60 years of age, which we think is due to self selection: only very fit men will still be working at that age, and therefore be very productive.

one might expect. Moreover, the estimated returns are rather constant over the sample period, although the returns generally are somewhat higher in 1994 and 1996. As one might expect, the ranking of the returns is according to the level of education, while extended basic education has a relatively low premium compared to basic education, that university education scores by far the highest.

Figure 4 Impact of 17 years of total experience, 1986 – 1998<sup>26</sup>

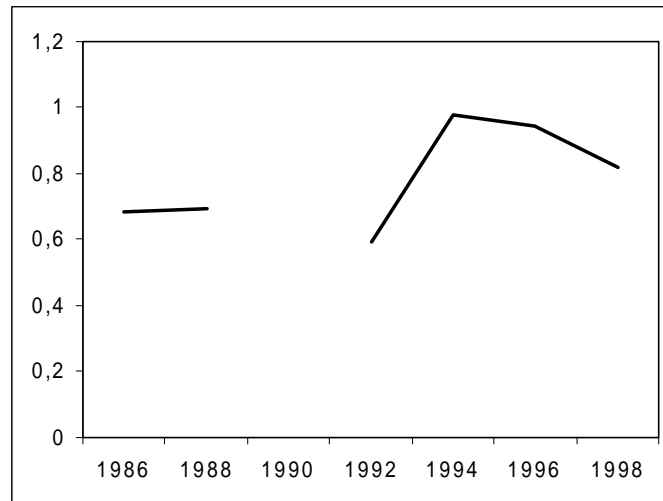
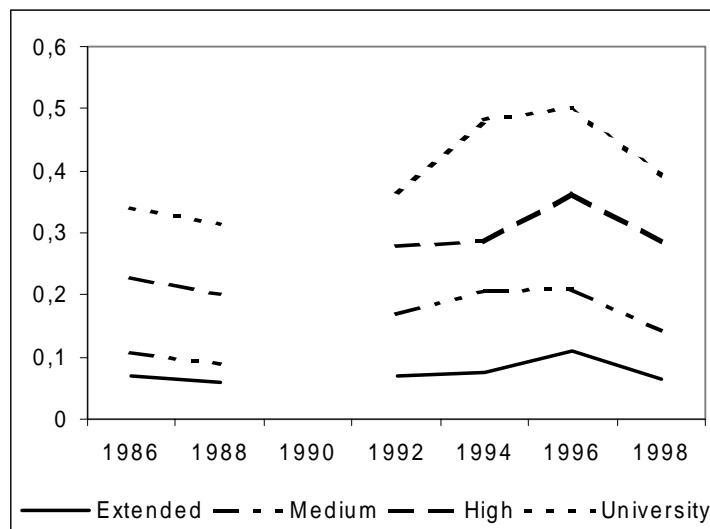


Figure 5 Impact of various levels of education, 1986 – 1998<sup>27</sup>



It is quite interesting to calculate the number of years of experience necessary to compensate for lack of education. The results give the impression that the educational

<sup>26</sup> Source: the estimation results presented in Table 3.

<sup>27</sup> Source: the estimation results presented in Table 3.

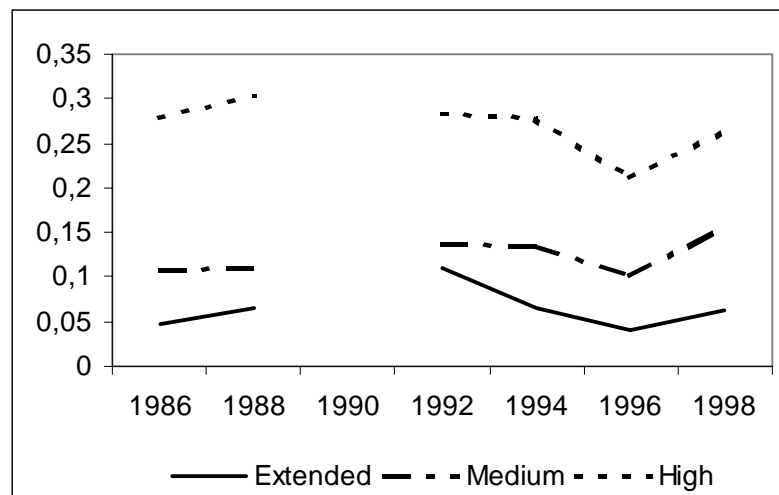
levels 3 and 4 are not worthwhile to attain, since they can already be compensated by 2,5 and 5,5 years of experience, respectively – the schooling necessary to obtain these levels takes more years. High vocational training starts to pay off and university study really pays off, since to compensate these 13 and 20 years of experience are needed, respectively.

These results are consistent with the findings from various Dutch studies summarised in OSA (1994, pp. 61-2) that returns to education are very low in the Netherlands, except may be for higher vocational and university education. However, when we compare our results to those generally found, our estimation results show a much lower overall impact of both education and experience.<sup>28</sup> This can be explained by the fact that we also take job characteristics into account in our analysis.

### *Job skills required*

As one might expect, having subordinates in the job earns a premium. This is estimated to be 7 per cent of the mean wage. Working in a larger firm earns a similar premium. The sector in which a person is working has hardly any significant impact on earnings.

*Figure 6 Impact of various levels of required skills, 1986 – 1998<sup>29</sup>*



An interesting variable for our analysis is the level of skills required for the job. Figure 6 presents the impact of various levels of required skills, compared to no skills

<sup>28</sup> Pomp (1998) finds an impact of education, which is roughly speaking, twice as large.



required. One sees that the impact increases with higher requirements.<sup>30</sup> However, although we distinguish between 7 skill levels, with levels 1 and 2 comprising the basic skills, our estimation results show that there is no difference between the impact of levels 3 and 4, which we have grouped as "extended" skills. Also, the levels 6 and 7 could be grouped as "high skills".

Finally, an interesting observation follows from comparing Figure 6 with Figures 4 and 5. The impact of a higher required skill level is lower in the period 1992-1998, with a trough in 1996, when compared to the earlier period. However, both the returns to total experience and of higher education are higher in the period 199-1998, with a peak in 1996. These opposite movements in required skills and skills obtained do suggest some interaction effect, although we couldn't observe this directly from our estimation results.

## **5. Wage differences due to personal and job characteristics**

The wage equation contains both personal characteristics and job characteristics. An interesting question then is to which extent both contribute to wage differences. We investigate this by a further analysis of the estimation results.

Figure 7 presents various manipulations with the wage equation of 1994 – the results are very similar for the other years. First we compare the fit of the equation to the observed data for various educational levels. One sees that the wage is slightly under estimated for all levels.<sup>31</sup>

The hourly wage for a "basic function" indicates a standardisation of job characteristics. That is, the firm size is set at more than 20 employees, there are no subordinates, there are no skills required for the job and the firm sector is the sheltered sector. It is interesting to observe that this hardly affects the mean wage of workers with educational levels 1-4, which constitute at least 80 per cent of our sample. However, Figure 8 shows that the distribution of the log of wages is definitely

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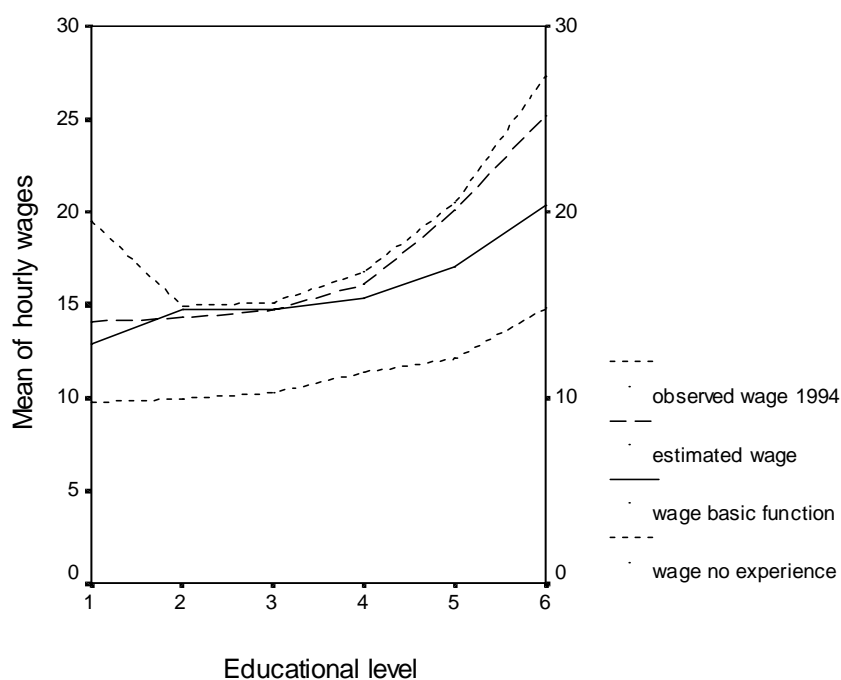
<sup>29</sup> Source: the estimation results presented in Table 3.

<sup>30</sup> An increase of return with higher job requirements is also found in Hartog (1992).

<sup>31</sup> For the years 1986 and 1988 the under estimation for the high educational levels 5 and 6 is stronger.

affected by the correction.<sup>32</sup> Whereas the estimated distribution is Bell shaped around its mode – mean and mode more or less coincide – the standardised distribution is highly skewed to the left, with a somewhat higher mode exceeding the mean. Thus wage differences become smaller when differences in job characteristics are ignored, which is a typical example of compensating wage differentials. The latter is due in particular to differences in skill levels at which workers are employed, and whether one has subordinates or not. Moreover, since in particular the higher educated persons will occupy jobs with higher skill levels and have subordinates, it is not surprising to see that the mean income for the educational levels 5 and 6 clearly is lower due to the correction for job characteristics. This also explains why the standardised distribution is skewed to the left.

Figure 7 The mean hourly wage rate for 1994, standardised for jobs and experience<sup>33</sup>



As a final point it is interesting to observe that whereas, after the standardisation, the mean hourly wage differs from 15 at educational levels 1-4 to 20 at educational level 6 – cf. Figure 7 – the dispersion of the wage for educational level

<sup>32</sup> The figure shows the results for educational level 3, but the results for the levels 2 and 4 are similar.  
<sup>33</sup> Source: the estimation results presented in Table 3 and OSA (1994).

3 ranges from below 10 to above 20 – cf. Figure 8. This indicates that wage dispersion within educational groups is considerable, even after correction for job characteristics.

Next the hourly wage with “no experience” shows the additional standardisation for the personal characteristic of experience. That is, in the estimated wages also current and previous experience, and total experience squared are set equal to zero. From Figure 7 one sees that this leads to a more or less equal reduction in the hourly wage for all educational levels. This is not surprising as long as experience is more or less equally distributed over all educational levels. Experience accounts for roughly an additional 20-30 per cent of the hourly wage. Moreover, when comparing both standardisations, one sees from the figure that education cannot compensate for a total lack of experience. This is consistent with our discussion of the estimation results on education and experience above.

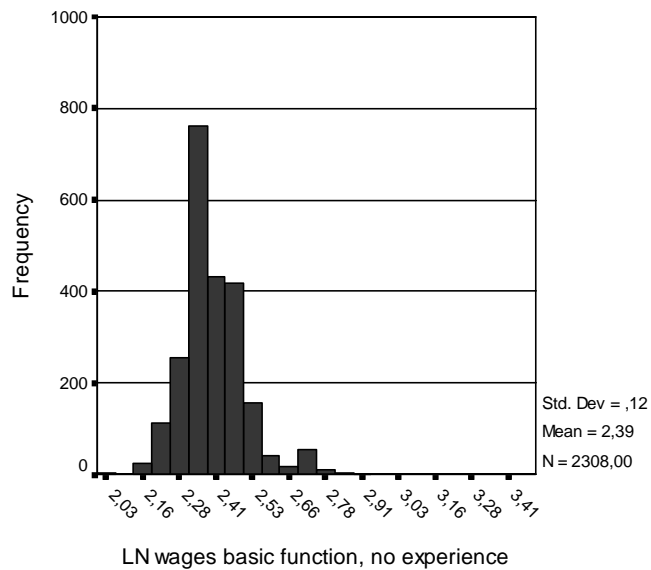
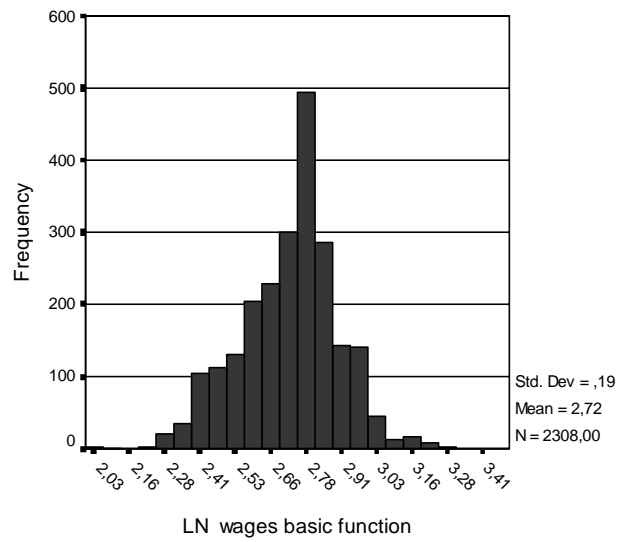
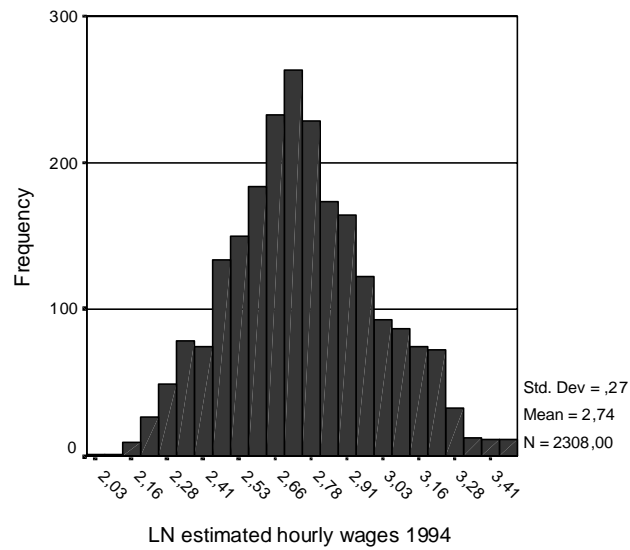
Figure 8 shows the quite interesting result that correction for experience leads to an enormous reduction in wage dispersion. That is, most of the dispersion per educational level observed after job standardisation is due to experience. The remaining factors – gender, hours worked, youth and direction of education – only contribute little to wage dispersion per educational level. And since the mean wage is almost equal for the educational levels 1-4, which constitutes the majority of the workers, and only is marginally higher for the levels 5 and 6, this implies that the overall wage dispersion after all these corrections also is quite low.

Figure 9 considers the wage equation of 1994 from the perspective of skill requirements. It is set up in the same way as Figure 7. Again comparison of the fit of the equation to the observed data for various skill levels shows that the wage is slightly under estimated for all levels.

The standardisation of educational levels, that is when the wage for all workers is calculated as if they have a “basic education” only, shows at each functional level a lower mean wage. The mean wage for the extended functional levels 3 and 4 becomes almost equal to that of the basic functional levels 1 and 2. The gap with the estimated wage is widening at higher functional levels. When the wage is also standardised for experience, the difference in mean wages between the various functional levels becomes very small.

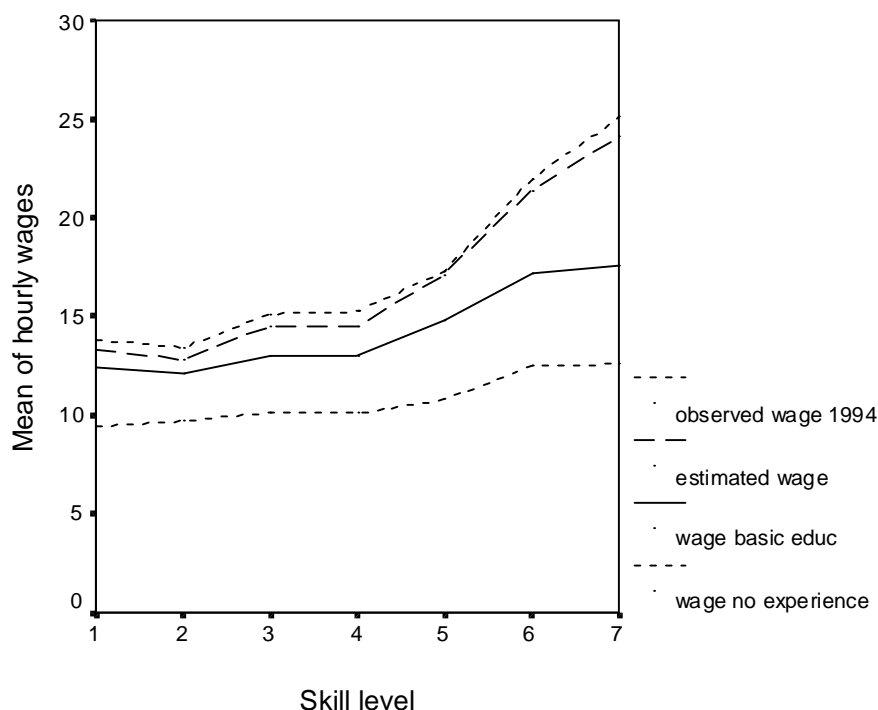
Comparison between Figures 7 and 9 shows the mean wage differs somewhat stronger according to education received than according to skills required. However, differences in experience, skill levels and education together explain the main

Figure 8 *Estimated and corrected hourly wages (educational level 3, 1994)*<sup>34</sup>



<sup>34</sup> Source: the estimation results presented in Table 3 and OSA (1994).

Figure 9 The mean hourly wage rate for 1994, standardised for education and experience<sup>35</sup>



differences in wage levels on average when classified either according to educational levels or required skills. Actually, one third to one half of the total mean wage is independent of additional educational attainment, experience and job characteristics. For the lower educational/skill levels experience fills most of the gap, for higher levels both education and skills requirements for jobs also start to pay off. However, the latter applies only to about 20 per cent of the work force.

With respect to the variation in wages, job characteristics play an important role. Together with experience they explain the main part of the wage differences amongst workers. Neither educational attainment as such, nor other personal characteristics turn out to be very important in the explanation of these wage differences.<sup>36</sup> Sels *cs.* (2000) also find for Belgian white-collar workers in 1998 that wage differences are explained for about 56 per cent by personal characteristics and the remaining part by job and organisation characteristics.

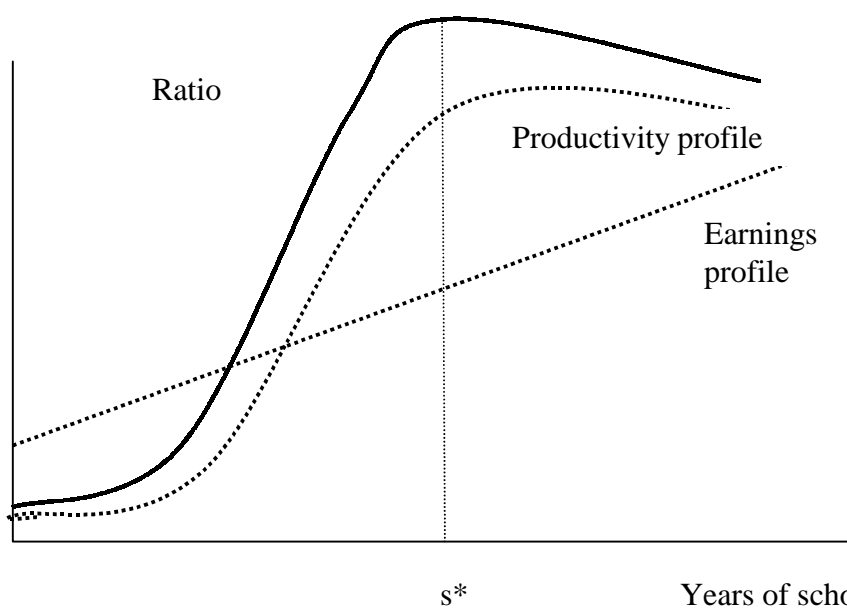
<sup>35</sup> Source: the estimation results presented in Table 3 and OSA (1994).

<sup>36</sup> That educational attainment is not important in explaining variation cannot be inferred from the discussion above, but follows from a comparison of the impact of the correction on the total sample. Mean (standard deviation) decrease from 18.16 (4.86) at the estimated figures to 12.30 (1.61) after corrections. The corresponding figures for educational level 3 are 16.2 (3.73) and 11.45 (1.15).

## 6. A reflection on upgrading and overschooling

We have until here not discussed the possible reasons which might explain why high skilled persons are employed on low-skilled jobs – cf. also the discussion of Table 1 above. A typical explanation in line with assignment theory would be the presence of comparative advantages as Table 2 shows. In that context we would also like to mention the framework of Borghans and de Grip (2000) who present a situation in which for a certain occupation the wage increases linearly with years of schooling, whereas the productivity of a worker in that occupation increases in a sigmoid fashion with schooling. Figure 10 reproduces this framework, where the optimal allocation of years of schooling for that occupation  $s^*$  is given at the maximum of productivity relative to the wage.

Figure 10 Earnings and productivity profiles and optimal skill for a given occupation<sup>37</sup>



An increase in the supply of skilled workers may lead to a flatter earnings profile, and hence a higher optimal years of schooling for that job. Borghans and De Grip dub this apparent phenomenon of overschooling “intertemporal underutilisation of skills”. Similarly technological change might lead to upgrading, which implies an increase in

<sup>37</sup> Source: Borghans and de Grip (2000), Figure 1.1.

the productivity profile in Figure 10. Again higher optimal years of schooling might result for that job, which is dubbed “alleged underutilisation”. In both cases the phenomena can be explained in the context of an optimal allocation of skills to jobs. Finally “genuine underutilisation” occurs, when the increase in years of schooling cannot be explained in that context.

*Table 4 Low-skilled jobs according to educational level further analysed (1994)*<sup>38</sup>

Variables \ Education	Low-skilled jobs				Total population
	Low	Medium	Extended	High	
log wage	2.60	2.54	2.58	2.75	2.75
gender	0.55	0.62	0.62	0.53	0.39
past experience	15.0	9.8	7.3	8.8	11.3
current employment	8.6	5.6	4.1	4.1	5.9
man hours	140	137	140	147	146
firm size (nrs.)	256	193	163	901	290
subordinates	0.06	0.07	0.06	0.03	0.30
observations	161	361	117	14	

Against this background we turn back to question why high skilled persons are employed on low-skilled jobs – cf. Table 1 above. Table 4 shows the mean values of various variables for persons working on jobs requiring low skills only. The wages paid on such jobs typically increase with the educational level of the persons working there. This is consistent with the analysis in Figure 10. Moreover, compared to the total population, persons working in low-skilled jobs are predominantly female, which might point at gender discrimination. Also the workers have few subordinates and little experience – only workers with low education on these jobs have above average experience. It finally is remarkable that the persons with a high education working in low-skilled jobs on average work in very large firms. This suggests that these jobs typically are entry jobs, which give access to an internal labour market.

<sup>38</sup> Source: OSA (1994), our calculation.

To a certain extent lack of experience and internal labour market considerations can be associated with comparative advantages for high skilled persons on low skilled jobs – or at least it might be ‘rational’ to employ them in those jobs. But this is more difficult to defend for gender discrimination. Therefore it remains an open question to what extent overschooling can be explained in a rational way. Apart from theoretical difficulties, our observations – admittedly rather casual – do not enable us to distinguish to what extent next to “alleged” or “intertemporal” also “genuine” underutilisation of skills occurs. This typically deserves further research.

## 7. The impact of education on productivity growth

One of the interesting areas of research in which the analysis above can be applied is that of the development of productivity and economic growth. Here human capital plays an important role as a factor of production.<sup>39</sup> And once we assume that the change in labour productivity is reflected in that of the average wage rate, we can estimate the impact of human capital on productivity growth through changes in the employment composition that affect the development of wages. In spite of various obvious objections to this approach, cf. Van de Ven and Pomp (1999) and Van Ark (1999), it is frequently used and can yield interesting insights.

Pomp (1988) used micro data for 1979, 1985, 1989 and 1994 to estimate typical Mincerian wage equations. In order to explain the observed productivity slow-down in the Netherlands, he used the results to estimate the impact of changes in underlying variables that reflect the change in the employment composition on labour productivity in the Netherlands.<sup>40</sup> However, Pomp finds that changes in the employment composition cannot be shown to reflect the productivity slow-down. "An analysis of shifts in the wage distribution indicates that the share of low-paid jobs has increased. Assuming that wages reflect productivity, this would imply that the

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<sup>39</sup> For productivity analysis see for instance Van Ark (1996) and Jorgenson and Fraumeni (1992), for economic growth Barro and Sala-i-Martin (1995).

<sup>40</sup> Pomp estimates the earnings function  $\ln(w_{i,t}) = \alpha_t X_{i,t} + \epsilon_{i,t}$  where  $w_{i,t}$  is the wage rate of individual  $i$  in the year  $t$  and  $X_{i,t}$  the vector with personal characteristics. Since he assumes that the growth in wages reflects productivity growth, Pomp calculates the latter from  $\alpha_{t-1}(x_t - x_{t-1})$ . Here  $x_t$  represents the vector of shares in employment in period  $t$  of the various personal characteristics.



employment composition has shifted to less productive workers - contrary to what our employment index shows." (p. 52) Therefore "unmeasured changes in the employment composition did play a role".

Since we recognise in our analysis the importance of assignment problems, this provides us with an obvious clue to the solution of Pomp's measurement problems. When we compare our estimation results to those of Pomp (1998) an important distinction is that we also used job characteristics next to personal characteristics. One advantage is that this will enable us to take skill-biased technical change into account, since this will be reflected in a change in the composition of skill requirements of jobs, as we observed in the discussion of the survey data above. Moreover, three variables reflecting job characteristics – i.e. skill requirements, subordinates and firm size – consistently turned out to be significant in our estimation results. They may reflect an important element of the "unmeasured changes in employment composition" in the analysis of Pomp. For instance, Pomp finds at least twice as high an impact of education on wages as we do - probably because he does not allow for the fact that a higher education often gives access to a job with a higher skill premium. However, since upgrading takes place, the increase in better-paid jobs is not as strong as that of persons with a better education – see also Figure 3 above.

An interesting way to illustrate the difference between our results and those found by Pomp is to analyse the impact of changes in educational attainment and job characteristics on wages in the period 1985 – 1995.<sup>41</sup> Using the data from Table 3 and the estimation results for 1992 by Pomp – cf. Pomp (1998, Annex 7) – we find that the increase in wages for that period would be 5.7 per cent, due to changes in education only. When we use our estimation results for 1994, we find an increase in wages of 2.9 per cent. This is much lower, as might be expected. The change in job characteristics accounts for an additional 2.3 per cent change in wages.<sup>42</sup>

It therefore is not surprising that when Pomp extrapolates the impact of educational attainment, he overestimates its impact on wage growth, *ceteris paribus*, by almost 100 per cent. But as always is the case in economics, the *ceteris paribus* clause does not hold. Part of the increased educational attainment went hand in hand with the increase in skill requirements for jobs. However, as already predicted by

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<sup>41</sup> On other personal characteristics we have similar findings.

<sup>42</sup> That is, changes in skills required for jobs imply another 1.7 per cent and firm size and subordinates 0.6 per cent. Sector composition is also included in Pomp's estimation results.

Sattinger (1975, p. 465), in case of comparative advantage “the distribution of earnings must be skewed to the right relative to the distribution of abilities.” This might explain the divergence between the distributions of wages and employment as observed by Pomp. Moreover, the presence of comparative advantage might explain why wage changes do not fully reflect changes in productivity. Apart from that, both “intertemporal” and “genuine” underutilisation in the form of overschooling might induce a further gap between wages and productivity.

## **8. Concluding remarks**

We estimate wage equations on yearly individual data for the Netherlands, 1986 – 1998. In the tradition of the assignment approach we include, next to personal characteristics (e.g. skills obtained) also job characteristics (e.g. skills required) to explain wages.

The equations are estimated in a rather straightforward way, using weighted least squares. The estimated coefficients of the wage equation are rather stable over time, although some trade-off can be observed between higher required skills and high skills obtained. However, we cannot find interaction effects between the level of education and the level of skills required.

Elaboration of the estimation results shows that experience and job characteristics are much more important in explaining the variation in wages, than educational attainment is. While about 50 percent of the variation in wages can be explained by variation in personal characteristics, the other half is explained by the variation in job characteristics.

We use these estimation results also to analyse the impact of education on productivity growth. Pomp (1998) who used a Mincerian wage function for the Netherlands, would predict a wage increase of 5.7 per cent over the period 1985 – 1995 from the increase in education, our results imply that this would be only 2.9 per cent while changing job characteristics account for an additional 2.3 per cent.

The question is, however, how changes in job characteristics should be evaluated. Partly these changes in job characteristics will indicate skill biased technical change and partly they may be supply induced. Both the findings in Figure 3 and our estimation results in Table 3 indicate that the job characteristics are not

perfectly correlated with educational attainment. This is consistent with the finding that overschooling does occur and is increasing over time for the Netherlands. Increases in education then contribute less to productivity growth, which might be a plausible explanation for the productivity slow-down.

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## **Annex          The data used**

### **a) Dependent Variable**

**LN HW:** Natural logarithm of hourly wage, where

$$\text{Hourly wage} = (\text{number of yearly periods net income is paid} * \text{net income per period}) / (12 * \text{hours worked per month})$$

### **b) Personal characteristics**

<b>Gender:</b>	Gender Dummy equal to 1 if person is a woman, zero otherwise
<b>Agedum:</b>	Age dummy equal to one for persons younger than 20, zero otherwise
<b>Pexp:</b>	Previous experience in years
<b>Tex<sup>2</sup>:</b>	Total experience squared
<b>Cempl:</b>	Current employment in years
<b>Mhours:</b>	Hours worked per month
<b>Edlev3:</b>	Education level Dummy equal to one for LBO/MAVO, zero otherwise
<b>Edlev4:</b>	Education level Dummy equal to one for MBO/VWO, zero otherwise
<b>Edlev5:</b>	Education level Dummy equal to one for HBO, zero otherwise
<b>Edlev6:</b>	Education level Dummy equal to one for WO, zero otherwise
<b>Control Group:</b>	Educational level 1 and 2, namely no education and LO
<b>Edinstr1:</b>	Educational instruction Dummy equal to one for teaching staff, social sciences and theology, zero otherwise
<b>Edinstr2:</b>	Educational instruction Dummy equal to one for agriculture, maths, natural sciences, technical education, transport and communication, zero otherwise
<b>Edinstr3:</b>	Educational instruction Dummy equal to one for medical, economic, jurist and socio-cultural education, zero otherwise
<b>Edinstr4:</b>	Educational instruction Dummy equal to one for personal and social care, zero otherwise
<b>Control Group:</b>	Educational instruction 5, namely general education, arts, public security and other education

**c) Firm characteristics**

<b>Fsize:</b>	Firm size Dummy equal to one for firms with less than 20 employees, zero otherwise
<b>Skill lev3:</b>	Required skills Dummy equal to one for skilled I, zero otherwise
<b>Skill lev4:</b>	Required skills Dummy equal to one for skilled II, zero otherwise
<b>Skill lev5:</b>	Required skills Dummy equal to one for specialised higher skills I, zero otherwise
<b>Skill lev6:</b>	Required skills Dummy equal to one for specialised higher skills II, zero otherwise
<b>Skill lev7:</b>	Required skills level Dummy equal to one for specialised higher skills III, zero otherwise
<b>Control Group:</b>	Required skills level 1 and 2, namely unskilled and half-skilled
<b>Sub:</b>	Subordinate Dummy equal to one for those who have subordinates and 0 for those who do not
<b>Fsect1:</b>	Firm sector Dummy equal to one for the exposed sector, namely agriculture, industry, transport and communication, zero otherwise
<b>Fsect2:</b>	Firm sector Dummy equal to one for the sheltered market sector, namely construction and installation, trade, hotel, banks and insurances, zero otherwise
<b>Fsect3:</b>	Firm sector Dummy equal to one for the sheltered non-market sector, namely public utilities and other services, zero otherwise
<b>Control group:</b>	Firm sector 2 and 3

Table A Summary of data used 1986-1998

Variables	OSA 86	OSA 88	OSA 92	OSA 94	OSA 96	OSA 98
LN HW	2.69	2.49	2.72	2.75	2.79	2.86
Gender	0.34	0.39	0.36	0.39	0.40	0.44
Agedum	0.01	0.04	0.01	0.01	0.04	0.03
Pexp	7.67	7.58	17.53 <sup>43</sup>	11.30	10.75	8.3
Texp^2	400.6	280.1	424.5	412.3	415.2	438.4
Cempl	9.69	6.94		5.89	6.51	9.72
Mhours	152.1	150.1	159.8	146.0	142.9	139.4
Edlev3	0.21	0.15	0.38	0.42	0.38	0.38
Edlev4	0.42	0.24	0.34	0.29	0.32	0.35
Edlev5	0.19	0.10	0.15	0.12	0.14	0.19
Edlev6	0.05	0.02	0.02	0.04	0.04	0.04
Edinstr1	0.07	0.10	0.06	0.06	0.07	0.09
Edinstr2	0.33	0.21	0.30	0.30	0.29	0.29
Edinstr3	0.16	0.37	0.24	0.15	0.17	0.23
Edinstr4	0.08	0.10	0.09	0.09	0.09	0.09
Fsize	794.9	130.9	363.3	290.3	363.3	337.0
Skill lev3	0.24	0.26	0.17	0.14	0.15	0.14
Skill lev4	0.19	0.17	0.24	0.21	0.22	0.20
Skill lev5	0.12	0.12	0.18	0.16	0.14	0.15
Skill lev6	0.15	0.14	0.13	0.15	0.17	0.21
Skilllev7	0.06	0.05	0.15	0.06	0.06	0.05
Sub	0.31	0.30	0.32	0.30	0.29	0.29
Fsect1	0.10	0.22	0.26	0.25	0.24	0.20
Fsect2	0.14	0.28	0.33	0.34	0.35	0.33
Fsect2	0.77	0.50	0.40	0.42	0.41	0.47
OBS used	1479	1250	2276	2308	2574	2136
OBS total	6854	6854	4536	4538	4538	4780

<sup>43</sup> For the year 1992 the variables *pexp* and *cempl* are estimated by the variable *texp* meaning total experience.



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