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Corporate job ladders in Europe: wage premia for university- versus high school-level jobs

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Summary

■ Investment in human capital is a central issue in the literature on economic growth. The purpose of this study is to shed light on the economic incentives for investment in university education across countries. It presents an empirical investigation of earnings for private-sector engineers and business administrators in seven European countries (Belgium, Denmark, France, Germany, Italy, Sweden, and the UK). The analysis is based on a large micro data set that is ideally suited for international comparisons. It contains information on earnings, age, occupation, responsibility level, industry, and firm size. Standardised wage premia for university- versus high school-level jobs are computed for each country and field of work. The results indicate that the wage premia are higher for business administrators than for engineers in all the countries considered and that the premia for engineers are remarkably similar across countries. Aggregation over fields of work, which is common in studies on the returns to education, therefore seems to be questionable practice when comparing the returns in different countries. ■

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This paper presents an empirical investigation of earnings for private-sector engineers and business administrators in seven European countries (Belgium, Denmark, France, Germany, Italy, Sweden, and the UK). The analysis is based on a large micro data set that contains more than 32,000 observations during the 1993-96 period and is ideally suited for international comparisons. It has been collected by *Watson Wyatt*, an international consulting firm that specialises in cross-country analyses of wage and employment conditions. Information exists on earnings, age, occupation, responsibility level, firm size, and industry for each person. Human capital earnings functions are estimated for each country in the sample.[1] To the best of our knowledge, this is the first empirical study on labour market earnings in various countries based on internationally comparable micro data of this kind.

For engineers and business administrators, we have information about several high- and low-level jobs. The high-level jobs roughly correspond to jobs that require a university degree, while the low-level jobs were selected to approximate high school education. This enable us to run within-country wage regressions by means of which we can compute standardised wage premia similar to wage premia computed for university as opposed to high school education. While most studies of the returns to education are highly aggregated over fields of work and occupations, we analyse engineers and business administrators separately and also control for different occupations within the two categories.

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[1] Mincer (1974) is a standard reference on human capital earnings functions.

Previous analyses of the returns to education use single-country databases.[2] Comparability of these estimates across countries is often limited due to the different wage measures and time periods typically being used. Like the aggregational issues, these comparability problems are well known but rarely addressed in the literature. Our multi-country data set offers an opportunity to overcome them.

The purpose of this study is to shed light on the economic incentives for investment in university education across countries. Investment in human capital is a central issue in the literature on economic growth. Changes over time in the quality of labour have been put forward as an explanation for the residual in growth accounting studies.[3] The growth perspective provides another rationale for not grouping education categories in the analysis and for focusing on engineering and business administration. It is argued that an increased supply of graduates in engineering or business administration is more important for growth than an increase in, say, theoretical philosophy or the fine arts. Murphy et al. (1991) find evidence that countries with a large share of students in engineering grow faster than other countries.

A graduate in engineering (or business administration) may, however, not necessarily remain in the country of origin. Because of the integration of labour markets within the European Union (EU), earnings differentials, which will induce labour flows between countries, are smaller today than a decade ago and will probably decrease even further. Although labour migration among EU countries is still negligible, the migration that occurs seems to be concentrated to well-educated people and to be growing.[4] So there is potential for growth-reducing brain drain from countries that turn out to be less successful in competing for key segments of the labour force.

A discussion of the brain-drain problem is beyond the scope of this paper; such a discussion would require an explicit analysis of wage differentials *between* countries. But besides cross-country wage differentials, the relative wage structure *within* countries probably influences migration decisions. To this extent, our analysis should be of

[2] See, e.g., Psacharopoulos (1994) for an extensive review.

[3] See, e.g., Denison (1962) or Griliches (1970).

[4] See NorBo Economics (1998) for Swedish evidence on international migration of highly skilled labour.

relevance for the debate on the driving forces behind the brain-drain phenomenon.[5]

The paper is organised as follows. Section 1 describes the data. Section 2 considers several aggregational issues that arise in the empirical analysis. Section 3 specifies the wage premia computations and the underlying wage equations. Section 4 reports the empirical results, and Section 5 contains concluding comments and suggestions for further research.

1. The data

Our data come from yearly surveys conducted by Watson Wyatt. The responding firms are not sampled (but possibly contacted) by Watson Wyatt; the firms decide whether they want to participate, in exchange for access to reports on the results. Firms that operate internationally are over-represented because by participating, they get updated information about employment terms and conditions in countries where they are operating or planning to set up business. The large majority of firms are foreign owned, with parent companies based predominantly in the US.[6]

The non-random nature of the data limits the population for which we can make inferences. But there are quite a few people who work in internationally active firms in the private sector. Moreover, by confining our attention to people in competitive labour markets, we can be confident that the wages we observe are outcomes of the interplay between supply and demand forces, in accordance with assumptions underlying human capital theory. In nationally representative surveys, this presumption probably does not apply to all persons; some may be working in, e.g., highly regulated labour markets. And,

5 The present study concerns relative wages across European countries in the recent past. Other studies deal with relative-wage developments over longer time periods. For example, while OECD (1996) reports that in the UK the relative wages of high-skilled workers have risen sharply since the mid-1980s, Gunnarsson and Mellander (1999) show that in Sweden, relative wages were almost constant during the same period.

6 Before the 1998 survey, Watson Wyatt did not collect information about the parent company's nationality. So it is not available for the 1993-96 period of our study. In 1998, the share of firms with a foreign parent company was: Belgium 89%, Denmark 98%, France 91%, Germany 91%, Italy 93%, Sweden 83%, and the UK 95%. In the seven countries, between 47% and 70% of the firms were associated with a US parent company. According to Watson Wyatt, the figures for the 1993-96 sample are probably not very different.

to extend this comparison, national surveys generally differ across countries. This is not the case here; the same questionnaire was used in all countries. Furthermore, great care is taken in the data collection to ascertain that the responses are directly comparable across individuals, firms, and countries. For example, a Watson Wyatt representative will always assist the firm the first time it participates in the survey. So while we will not be able to draw general conclusions, the population for which we can make inference is substantial in magnitude and of considerable interest, and the data upon which our inference is to be based is of unusual quality.

The data consist of annual cross-sections for engineers and business administrators during 1993-1996. The cross-sections partly overlap in the sense that the same people may be included for several years. Unfortunately, we lack employee identifiers and thus cannot construct a panel data set. But firm identifiers are available, and this enables us to do better than just treat our data as repeated cross-sections.

As a complement to the four cross-sections, we have used the firm identifiers to construct two-year overlapping panels of firms for 1993-94, 1994-95, and 1995-96 for each country.[7] In this way, we can avoid noise due to entry and exit of firms when we compare wage premia between the years t and $t+1$. Together, the three panels yield six different wage premia (1993, 1994:I, 1994:II, 1995:I, 1995:II, and 1996).

Altogether, our data set covers 15 different jobs: 8 engineering jobs and 7 business administration jobs. In Table 1, we classify the jobs by field of work and education level.

[7] In principle, we could go further and construct data sets containing observations from the same set of firms for all of the four years. However, that would result in data sets with too few observations to permit meaningful statistical analyses.

Table 1. Jobs by field of work and education level

Education level	Engineering	Business administration
Graduate jobs	Industrial engineer	Financial analyst
	Manufacturing engineering engineer	Chief accountant
	Head of R&D	Internal auditor
	R&D specialist	
	Laboratory specialist	
Nongraduate jobs	Workshop specialist	Accounting clerk
	Field service engineer	Accountant
	Quality control technician	Payroll specialist
		Buyer

In Watson Wyatt's survey, jobs are specified in great detail. Appendix A contains four examples of these job specifications, one for each of the four categories in Table 1. Watson Wyatt also devotes considerable effort to ensure that the classification of employees into various jobs is comparable across firms and countries.

The classification by education level in Table 1 is not based on explicit information about the employees' education, because this information is not collected by Watson Wyatt. But the considered jobs were selected because, *on average*, they probably require either a university-level education (the graduate jobs) or an education corresponding to high school or upper secondary school (the nongraduate jobs). To examine the validity of cross-classifications in Table 1, we performed several validity checks, based on complementary information. These checks, which are in Appendix B, largely support the education categories in Table 1.[8]

[8] The validity checks indicate that our data probably contain some observations on people who occupy graduate jobs without having university degrees. Also, while not indicated by our checks, it is theoretically possible that there are observations where university-educated workers are holding nongraduate jobs. To the extent that these anomalies are the results of workers who sort themselves into jobs based on unobserved characteristics, such as productivity, this is not a problem. It just

Table 2 presents the number of observations broken down by country, graduate/nongraduate jobs, and year.

Table 2. Number of observations by country and education level, 1993-96.

Country	1993		1994		1995		1996	
	Grad	*Non-grad*	*Grad*	*Non-grad*	*Grad*	*Non-grad*	*Grad*	*Non-grad*
a. Engineers								
Belgium	495	340	454	235	464	294	471	289
Denmark	143	94	126	85	64	70	30	48
France	297	449	323	366	317	377	397	290
Germany	284	335	452	383	450	416	470	432
Italy	220	319	293	344	241	253	193	200
Sweden	71	108	112	106	247	203	214	172
UK	231	426	206	298	215	269	242	274
Sum	1741	2071	1966	1817	1998	1882	2017	1705
b. Business administrators								
Belgium	292	678	253	584	318	770	318	663
Denmark	38	131	45	131	37	90	36	63
France	208	470	182	435	264	511	245	427
Germany	137	465	266	678	294	678	307	613
Italy	133	407	178	462	169	461	145	380
Sweden	77	154	104	179	183	414	133	335
UK	175	442	136	412	171	473	166	406
Sum	1060	2747	1164	2881	1436	3397	1350	2887

Some countries, particularly Denmark and Sweden, exhibit considerable changes in the number of observations over time. For

goes to show that competence and education are not necessarily the same thing. The labour market primarily rewards competencies, at least in the long run. So it is natural to define the university wage premium as the relative wage difference between competencies that *normally* require university and high school degrees, respectively, within a given field. If a high-school educated person has been able to acquire the competence usually associated with a university education, then it is appropriate in this context to treat her as if university educated. And the fact that a person with a university degree is holding a high-school level job may be due, e.g., to having a degree in another field of work (such as history) or simply that he has gone through the university without increasing his competence (very much). In either case, there is no reason to treat such a person as university educated *with respect to the work for which he or she is employed.*

Denmark, the numbers of observations decrease over time while the opposite is true for Sweden. Regarding Denmark, note that the numbers of observations are quite small; except for engineering graduates and business administration nongraduates in 1993 and 1994, there are less than 100 observations on the aggregates of graduate-level and nongraduate-level jobs.

Besides job and country, we have the following data for each person in every year: wage, age, responsibility level, the number of employees at the work site, and an industry code.

The wage corresponds to full-time employment and is the sum of three components:

1. The fixed (base) salary plus guaranteed additional payments, such as legal vacation and extra contractual months[9]
2. Variable rewards in the form of bonuses, such as profit-sharing schemes
3. Sales commissions, to the extent that these are related to sales performance.

Table 3 presents the real wages, denominated in local currencies and expressed in 1996 prices, broken down by country and graduate versus nongraduate jobs.

It can be seen that within the four categories of employees (graduate and nongraduate jobs in engineering and business administration, respectively), real wages were quite stable over the four-year period in all countries. Another observation is that graduate jobs in business administration seem to be better paid than graduate engineering jobs. This particularly applies in Belgium, France, the UK, and Germany. Denmark is an exception in this context; average wages of Danish business administration graduate jobs are consistently *lower* than average wages of Danish engineering graduate jobs. For nongraduate jobs, the relationship between engineers and business administrators is reversed: average wages of engineers are always higher than average wages of business administrators.

Given these observed wage levels for graduate and undergraduate jobs, the raw wage premia, that is, premia unadjusted for age, job, responsibility, firm size, and industry, should be markedly higher in business administration than in engineering. Table 4 also shows this.

[9] Cf. the system of an extra month's pay for Christmas, which is common in, e.g., Germany.

Table 3. Means of real annual salary by country and ...

a. Engineers

	1993		1994	
Country	*Graduate*	*Nongraduate*	*Graduate*	*Nongraduate*
Belgium (BFR)	17,320	13,007	17,551	13,690
Denmark (DKK)	435,445	317,151	414,506	336,741
France (FFR)	276,930	196,580	275,617	202,373
Germany (DEM)	111,089	78,901	117,898	82,226
Italy (ITL)	72,288	47,305	66,188	49,097
Sweden (SEK)	333,848	228,697	340,591	228,132
UK (GBP)	25,569	18,829	24,396	19,021

b. Business administrators

Belgium (BFR)	20,612	12,470	20,980	12,736
Denmark (DKK)	392,607	264,398	389,967	262,794
France (FFR)	310,169	180,734	316,888	177,355
Germany (DEM)	123,095	70,928	122,765	73,536
Italy (ITL)	78,880	44,221	72,326	44,388
Sweden (SEK)	324,050	199,885	338,439	211,071
UK (GBP)	34,577	17,618	35,561	17,960

... education level, 1993-96 (local currencies).

1995		1996	
Graduate	*Nongraduate*	*Graduate*	*Nongraduate*
18,411	13,072	18,801	12,739
448,345	319,255	500,046	343,105
279,041	208,122	280,321	189,277
117,250	78,656	125,142	75,640
71,502	51,062	70,669	49,641
306,575	213,505	306,625	234,539
24,280	19,286	26,894	18,710
20,412	12,472	20,487	12,607
365,458	263,736	385,624	270,073
307,976	168,722	311,298	168,570
118,553	74,151	122,014	78,950
69,976	45,611	66,734	45,986
331,348	199,221	345,268	212,430
32,597	17,096	34,696	17,774

Notes: Salaries include bonus and commission and are in 1996 prices. *OECD: Main Economic Indicators* is the source for the consumer price index in each country. Belgian and Italian salaries are in BFR x 100 and ITL x 1000.

Table 4. Raw wage premia for graduate vs. nongraduate jobs, by country, 1993-96 (%).

a. Engineers

Period	Belgium	Denmark	France	Germany.	Italy	Sweden	UK
1993	33.2	37.3	40.9	40.8	52.8	46.0	35.8
1994	28.2	23.1	36.2	43.4	34.8	49.3	28.3
1995	40.8	40.4	34.1	49.1	40.0	43.6	25.9
1996	47.6	45.7	48.1	65.4	42.4	30.7	43.7
1993-96	37.5	36.6	39.8	49.7	42.6	42.4	33.4

b. Business administrators

1993	65.3	48.5	71.6	73.5	78.4	62.1	96.3
1994	64.7	48.4	78.7	66.9	62.9	60.3	98.0
1995	63.7	38.6	82.5	59.9	53.4	66.3	90.7
1996	62.5	42.8	84.7	54.5	45.1	62.5	95.2
1993-96	64.1	44.6	79.4	63.7	60.0	62.8	95.1

Note: The wage premium is computed by dividing the wage for the university-level jobs with the wage for the high school-level jobs (from Table 3), subtracting 1 from the resulting number and multiplying by 100.

For example, the largest of the average wage premia for engineers is in Germany and amounts to 50%. This is only slightly higher than the *lowest* of the raw premia for business administrators—45% in Denmark. The spread among the countries is also much larger for business administrators; the premia vary from 45% in Denmark to 96% in the UK. The corresponding spread for engineers is from 33% in the UK to 50% in Germany. Also note that rankings over countries for the raw wage premia look quite different for engineers and business administrators. In particular, for engineers the UK wage premia are ranked last, while for business administrators the UK premia are the highest.

Table 5 provides information about age, responsibility level, and size of the respondent's workplace, by education level and country. To save space, only the mean values, averaged over the four-year period 1993-96 are given.

Table 5. Means of selected variables by country and education level, 1993-96.

a. Engineers

Country	Age		Responsibility level		No. employees	
	Grad	*Non-grad*	*Grad*	*Non-grad*	*Grad*	*Non-grad*
Belgium	37.1	37.5	25/42	25/50	573	362
Denmark	42.5	39.4	33/36	36/49	616	172
France	38.3	36.6	31/41	26/52	1071	432
Germany	40.6	38.7	30/40	31/53	2571	1109
Italy	40.0	36.8	23/39	27/48	622	329
Sweden	42.3	38.1	30/45	34/54	1679	176
UK	40.6	37.4	30/50	38/49	626	385
All 7	39.5	37.6	28/42	30/51	1194	509
b. Business administrators						
Belgium	38.6	36.6	25/51	23/55	1053	651
Denmark	40.2	40.2	16/66	17/59	391	281
France	38.4	37.8	23/47	24/53	1185	802
Germany	40.0	38.8	19/52	23/56	2979	1916
Italy	38.8	37.8	15/50	28/47	526	501
Sweden	39.5	41.9	27/45	21/57	1486	747
UK	36.6	35.9	24/52	24/51	1405	849
All 7	38.7	37.9	22/50	24/53	1465	936

Note: The two figures for responsibility level refer to the share, in percent, of workers at 'A' and 'B' levels, respectively.

It can be seen that the mean ages are very similar, across countries, between graduate- and nongraduate-level jobs and across fields of work (i.e., engineering and business administration). The corresponding averages are all between 36 and 43 years.

The person's *responsibility level* is measured on an ordinal scale that contains three levels: A (highest), B, and C (lowest). These are relative concepts, defined in relation to the respective jobs; cf. Appendix A. In general, the responsibility level tends to increase with age, which lends support to the interpretation of this variable as defining career ladders.[10] Column 2 in Tables 5a and 5b show the average shares of the employees at A and B responsibility levels. For example, the entry 31/53 for German nongraduate-level jobs in Table 5a

[10] A simple test of the null hypothesis that the age distributions and the responsibility-level distributions are uncorrelated is rejected for engineers and for business administrators.

means that, of the German nongraduate engineers, 31% have A-level responsibility and 53% B-level. This implies that 16% of the German nongraduate engineers have the lowest responsibility level (C level).

Regarding responsibility levels, considerable variation exists. For engineers, large differences exist between countries among graduates and nongraduates. The shares of graduate-level jobs with A-level responsibility range from 23% in Italy to one-third in Denmark. And for the nongraduate-level jobs, the corresponding spread is even larger. But the distributions over responsibility level differ between the graduate and the nongraduate-level jobs. The shares of A- and B-level responsibilities are higher for the nongraduates than for the graduates. This difference between the graduate and undergraduate-level jobs does not prevail for the business administrators. But for these, the variation across countries is even larger than for the engineers. For instance, the shares of graduates with A-level responsibility range from 27% in Sweden to 15% in Italy.

Regarding the size of the respondent's workplace, measured in terms of the number of employees, the most striking observation is that the size of workplace for the average person is quite large.[11] Given the previously noted overrepresentation of multinational firms, this is no surprise. But it should be emphasised that not all firms are large; small firms are represented in the samples of all the countries. Disaggregating for graduate- and nongraduate-level jobs, we see that, on average, the workplaces of the latter are smaller than the workplaces of those with graduate-level jobs. This holds for every country, albeit to highly varying degrees. Sweden stands out: for engineers, the average size of the workplace for people in graduate-level jobs is almost 10 times the size of the workplace for their nongraduate counterparts. For business administrators, the differences in workplace sizes between graduates and nongraduates are much smaller. Again, the difference is largest for Sweden, where the average size of the workplace for those in graduate jobs is about twice that of people in nongraduate-level jobs.

The keen reader might have observed that we lack data on sex. Section 3.2 discusses this.

[11] In the survey, participating companies are asked to report on the total number of employees "....at the local unit only". The employment figures thus pertain to workplaces rather than firms.

2. Aggregational issues

Given our data, we can, in principle, compute a lot of (standardised) wage premia for university-level jobs versus high school-level jobs: by fields of work, by country, by time period, and by jobs. Already the first three dimensions yield 2 x 7 x 4 = 56 premia altogether. Moreover, within the two fields of work, many pair-wise comparisons can be made between university- and high school-level jobs, yielding altogether more than 700 possible wage premia. To compute these would be impractical and, in some cases, unfeasible. Impractical, because the sheer number of results would not submit itself to a meaningful discussion. Unfeasible, because the number of observations in some cells, e.g., for Denmark, would be too small to yield sufficient degrees of freedom. For practical purposes, we must limit the number of possible combinations. This amounts to four aggregation issues:

1. Fields of work
2. Countries
3. Time
4. Jobs

Regarding the first issue, the discussion in the previous section strongly indicates that separate analyses should be done for engineering and business administration. The data also point to some important cross-country differences, making it also worthwhile to treat the seven countries separately. More importantly, aggregation over countries requires that wages are expressed in a common currency. Exchange-rate fluctuations would then tend to produce considerable noise in the measurement of cross-country wage differentials.

Aggregation over time does not seem to impose overly strong constraints on the data:

- The time period considered is very short.
- It is not necessary to impose the constraint that the relationships studied should be identical over time; it is sufficient that some of the parameters in the underlying model are constant over time.

As mentioned previously, aggregation over jobs is necessary if we want to be able to estimate identical models for all seven countries. Just like in the case of aggregation over time, aggregation over jobs does not necessarily require that all university- (high-school) level jobs must be assumed to be identical; job-specific effects of varying degrees of complexity can be considered.

In the empirical section, we impose aggregational constraints with respect to time and jobs. These restrictions imply that we take many parameters to be constant over time and, within the four categories in Table 1, across jobs.

3. Estimation of wage equations and standardised wage premia

3.1 The wage equations

For each country, we estimate separate wage equations for the four categories in Table 1. Log wages are explained by age, age squared, dummy variables for responsibility levels and for jobs, the size of the workplace in terms of number of employees, industry dummies and time dummies. Estimations are done on two types of data sets that correspond to two different aggregation schemes over time.

In the first case, we simply pool data over the entire 1993-96 period, i.e., we make use of the full sample. The assumption made for time aggregation is that changes over time can be accounted for by simply allowing for time-varying intercepts in the wage equations.

In the second case, we make the same assumption, but for given sets of firms. As Section 1 explains, we have access to firm identifiers that enable us to construct two-year overlapping firm panels. This yields three sets of data for 1993-94, 1994-95, and 1995-96, respectively, for each of the four categories in Table 1. Altogether, we thus estimate 3 x 4 = 12 wage equations for each country. The explanatory variables are the same as under the first specification and so is the assumption made for time changes, *within* the two-year periods.

Conceptually, the two specifications are fundamentally different. Under the first specification, we assume that unobserved firm-specific effects can be treated as purely random. That firms enter and exit our database thus has no effect on our parameter estimates. In the second case, we assume that unobserved firm-specific effects are systematic. This assumption implies that changes in the set of firms will affect our estimates because of changes in the unobserved firm-specific effects, even if the observed characteristics are unchanged. To eliminate this possibility as much as possible, we base our estimations on observations that correspond to given sets of firms. And when the set of firms changes, for instance, from the 1993-94 data for engineers with university-level jobs to the corresponding 1994-95 data, we allow the parameters in the wage regression to change, too.

3.2 Missing control variables and methods of estimation

We lack three pieces of information, which are generally held to be important in earnings regressions: gender, innate ability, and family background. To assess how this might affect our analysis, we must consider two issues. First, the possibilities of getting around these omissions, by, e.g., using other variables that carry similar information or by accounting for them by choice of estimation method. Second, the likely econometric consequences of problems that we cannot deal with by means of either of these approaches. In particular, what might the effects be on the standardised wage premia that we ultimately want to estimate?

Regarding gender, the first issue is highly relevant. As noted in other contexts, gender wage differences tend to become very small when occupation and responsibility are controlled for. This finding is especially prominent for white-collar workers, i.e., the kind of workers who we study here. [12] Because our data contain very detailed information about these dimensions, the fact that we lack data on gender is probably a minor problem.

Regarding family background and innate ability, our data contain no proxy variables. In a context where people can be repeatedly observed, the natural solution is to assume that these characteristics are constant over time, in which case they can be controlled for by means of the fixed-effects estimator; see, e.g., Hsiao (1986). But the fact that we cannot follow individuals over time makes this approach unfeasible. Instead, we must let family background and ability become part of the residual disturbances in our earnings regressions.

This has two effects for the earnings regressions. The first is that by leaving out potentially important information, we will be able to explain less of the variation in (log) wages than if this information was available. But in our case, this should be much less of a problem than when wage equations are estimated using nationally representative samples, as is usually the case. In such situations, observed individuals represent all types of occupations and education and are thus

[12] Cf. Petersen and Morgan (1995), Petersen et al. (1996), and Petersen et al. (1997) for studies using very detailed data for the US, Sweden, and Norway.

extremely heterogeneous compared to the persons who make up our data sets. Accordingly, the loss in explanatory power should be comparatively small in the present context. Still, including individual-specific characteristics in the residual will tend to make the residual individual-specific, too. A natural way to account for this is to allow for heteroskedastic residuals, i.e., residuals with non-constant variance over individuals. We do so by complementing our OLS estimates with White's (1980) procedure for computing heteroskedasticity-consistent standard errors.

The other effect arises if the residuals, including family background and ability, are correlated with some of the observed variables. This is probably the case concerning, e.g., the dummy variables for occupation and responsibility level. Such correlations will yield biased estimates of the coefficients for occupational categories and responsibility levels.

But we are not primarily interested in the wage regressions *per se*, but rather in the corresponding wage premia, and these are not necessarily biased. The reason is that the wage premium, in principle, is given by the difference between the predicted log wage for university-level jobs and the predicted log wage for high school-level jobs.[13] Thus, the wage premium will be (almost) unbiased if the two equations suffer from (almost) the same bias, and this might actually not be a totally unreasonable assumption. Consider, e.g., the dummy variable for responsibility-level A, which is equal to 1 for the highest responsibility level and 0 otherwise. This variable is probably positively correlated with the residual in the wage equation. But this is true for both wage equations. We can thus safely assume that the biases in the two wage equations will have the same sign. Of course, there is no reason to believe that they are of exactly the same magnitude, but there is no obvious reason to believe them to be very different in size, either.

For Sweden, there is a study that lends some empirical support to this argument, namely Kjellström (1999). He estimates the returns to education, with and without controls for ability and family background, for two cohorts (born in 1948 and 1953) and various education categories in Sweden. Ability is measured with scores from intelligence tests, achievement tests, and school marks when the respon-

[13] Computing the wage premium as the difference in log wages is a strictly valid procedure only for small differences. But for the sake of the argument here, this qualification is immaterial.

dents were 12-13 years old. Parents' education and occupation capture family background. Based on these estimates, we have computed wage premia for university (at least three years, but no doctoral degree) versus high school (more than two years) education. It turns out that the premia for the two cohorts without such controls are both 26%, whereas the premia vary between 20% and 24% when the controls are included, depending on cohort and the ability measure used. Controlling for ability and family background thus leads to a reduction of the wage premia, but the magnitude of the bias is small.

3.3 Computation of wage premia

Given the estimated wage equations, we compute predicted log wages by country, field of work, and job level, evaluated at the mean values of the explanatory variables across the seven countries. The predicted log wages are thus standardised in the sense that they are computed for hypothetical persons with "average European characteristics". Accordingly, for a given category in Table 1, cross-country differences in predicted wages are solely attributable to differences in parameter estimates.

For a given country and field, the estimated wage premium is computed by dividing the anti-log of the predicted log wage for the university-level jobs with the anti-log of the predicted log wage for the high school-level jobs.[14] Subtracting 1 from the resulting number and multiplying by 100, we get the wage premium in percent.

4. Results

4.1 The wage regressions

The model in Section 3 can be implemented by means of OLS. Table 6 shows the parameter estimates for each country, using the full sample. Table 6a presents the regressions for engineers with graduate jobs. The estimates pertain to personal characteristics (age, responsibility level, and job), firm characteristics (number of employees), year, and type of industry.

[14] Actually, to obtain unbiased estimates of the wages in levels, we add a term to the predicted log wages before they are anti-logged, namely, the estimated residual variance of the corresponding wage equation, divided by 2. For a discussion of this procedure, cf. Miller (1984).

Regarding personal characteristics, we find that earnings rise with age, at a diminishing rate. This result agrees with human capital theory. In Belgium, an additional year, evaluated at age 40, increases wages by 0.9%. Estimates for the six other countries are of similar magnitudes. These are rather low estimates compared to other studies. Presumably, it reflects the fact that our regressions are augmented with responsibility level, which tends to increase with age. The responsibility indicators are highly significant. Employees at the highest level (A) receive a wage premium ranging from 40% (Denmark) to 70 (Italy), compared to employees at the lowest responsibility level (C).[15] B-level workers receive a premium of about half that size.

Not surprisingly, the type of job seems to matter a lot for earnings. According to the estimates, the most highly paid job in all countries is *head of R&D*. Except for Sweden, *laboratory specialist* is the lowest paid job, everywhere. Although the ranking of jobs within each country is quite similar, notable differences exist in the relative size of the wage premia across countries. The premium for *heads of R&D*, in relation to *industrial engineers* (the reference job), ranges from 52%, in Denmark, to 133%, in the UK.

Turning to the company characteristics, we find that wages are increasing in firm size. This is in line with many other studies (see, e.g., Brown and Medoff, 1989). An increase in the number of employees by 1% causes earnings to go up by roughly 0.01 to 0.05%. The year dummies capture variations in the real wage for the typical engineer and effects of changing the compositions of the samples over time. In most cases, the dummies are insignificant.[16]

[15] Note that the coefficient estimates (c) of dummy variables in semilogarithmic equations cannot readily be interpreted as percentage effects (p), unless c is small. An approximation, used throughout in this study, is p = [exp (c) - 1] x 100. See Halvorsen and Palmquist (1980) and Kennedy (1981) for further details.

[16] For brevity, we do not report the estimates of the industry dummies.

The regressions for engineers with nongraduate jobs are presented in Table 6b, which retains the basic format of the previous table. Some of the results are similar, but there are also a few differences. The payoff for achieving a higher responsibility level is lower among nongraduate engineers. An employee at the A level receives a salary that is between 29% and 44% higher than that of a C-level employee, depending on country. Also, some of the countries in which additional responsibility pays well for graduate-level engineers, show rather modest rewards for high responsibilities taken on by nongraduate-level engineers. Italy is the most striking example; while for graduate-level engineers Italy values an A-level responsibility higher than all of the other countries, the extra pay according to nongraduate A-level engineers is smallest in Italy among the seven countries.

The job-specific wage differentials among the nongraduates are not large; the most highly paid job is *field service engineer*, with coefficient estimates around 0.10 to 0.20. Firm size does not seem to matter much for earnings and in most cases, the coefficients are insignificant. In one country (Sweden), the estimate turns out to be negative and significant.

Otherwise, the overall impression of Tables 6a and 6b is that the regressions perform quite well in terms of explanatory power. For the graduate jobs, the regressions explain two-thirds of the variations in (log) wages and for the nongraduate jobs the corresponding figure is one-half. The main reason for this high explanatory power is our information about responsibility, the indicators of which are the most important variables in wage regressions.

Table 6a. Estimated wage equations for engineers, graduate jobs, 1993-96 by country. OLS. Dependent variable: log of real annual salary, in local currency.

Variable	Belgium	Denmark	France	Germany	Italy	Sweden	UK
Intercept	12.933 (141.56)	11.266 (59.86)	10.983 (84.93)	10.157 (87.61)	9.593 (64.94)	11.015 (75.73)	8.721 (67.65)
Age	0.035 (7.32)	0.045 (5.04)	0.037 (5.55)	0.028 (4.79)	0.028 (3.72)	0.042 (6.08)	0.042 (6.89)
Age squared x 1,000	-0.242 (4.04)	-0.448 (4.44)	-0.305 (3.74)	-0.214 (3.07)	-0.174 (1.88)	-0.412 (5.18)	-0.449 (6.24)
Responsibility level A	0.398 (28.59)	0.338 (12.42)	0.482 (31.41)	0.430 (27.99)	0.531 (24.98)	0.447 (21.19)	0.452 (18.10)
Responsibility level B	0.193 (18.49)	0.216 (8.82)	0.235 (16.70)	0.181 (14.42)	0.261 (16.10)	0.193 (10.28)	0.189 (9.15)
Manufacturing engineering engineer	0.115 (8.09)	0.043 (1.17)	0.025 (1.46)	0.103 (6.13)	0.109 (4.77)	0.061 (1.85)	0.102 (4.35)
Head of R&D	0.586 (23.47)	0.420 (12.16)	0.603 (26.95)	0.736 (30.76)	0.799 (27.68)	0.619 (17.66)	0.848 (17.90)
R&D specialist	0.120 (8.44)	0.132 (4.35)	0.079 (4.99)	0.099 (6.41)	0.118 (5.89)	0.213 (7.42)	0.114 (5.44)
Laboratory specialist	-0.137 (9.70)	-0.113 (3.34)	-0.119 (5.77)	-0.144 (7.22)	-0.109 (4.86)	0.071 (2.16)	-0.075 (2.62)
Log of no. of employees	0.031 (7.20)	0.051 (4.64)	0.034 (7.66)	0.048 (14.77)	0.041 (6.05)	0.038 (7.15)	0.012 (1.68)
1994	0.018 (1.49)	-0.017 (0.80)	0.006 (0.35)	-0.029 (1.90)	-0.036 (1.82)	-0.018 (0.62)	-0.021 (0.89)
1995	0.003 (0.26)	0.008 (0.31)	-0.020 (1.17)	-0.041 (2.67)	-0.022 (1.09)	-0.136 (5.21)	-0.030 (1.33)
1996	-0.007 (0.54)	-0.107 (1.82)	-0.030 (1.79)	-0.019 (1.25)	-0.007 (0.34)	-0.041 (1.51)	0.013 (0.62)
No. of observations	1,884	362	1,334	1,656	947	644	893
Test for hetero-skedasticity χ^2, (p-value)	307.95 (0.000)	133.81 (0.054)	242.84 (0.000)	172.07 (0.007)	231.31 (0.000)	144.21 (0.364)	191.48 (0.011)
R^2 (adj.)	0.774	0.744	0.719	0.784	0.774	0.729	0.669

Notes: Absolute t-values in parentheses. T-values corrected for heteroskedasticity where indicated (see White, 1980). The references for the responsibility level, job, and year dummies are C level, industrial engineer, and 1993, respectively. Industry dummies are included in all regressions, but not shown.

Table 6b. Estimated wage equations for engineers, nongraduate jobs, 1993-96, by country. OLS. Dependent variable: log of real annual salary, in local currency.

Variable	Belgium	Denmark	France	Germany	Italy	Sweden	UK
Intercept	12.742	11.214	10.972	10.182	9.047	11.317	8.697
	(124.45)	(58.72)	(119.70)	(101.41)	(84.76)	(120.74)	(97.38)
Age	0.042	0.055	0.041	0.034	0.061	0.035	0.035
	(8.05)	(5.65)	(8.71)	(6.61)	(10.73)	(6.90)	(8.31)
Age squared x	-0.376	-0.625	-0.394	-0.329	-0.589	-0.350	-0.380
1000	(5.66)	(5.28)	(6.91)	(5.18)	(8.10)	(5.39)	(7.44)
Responsibility	0.300	0.315	0.363	0.345	0.253	0.296	0.353
level A	(20.05)	(10.26)	(22.69)	(21.41)	(14.68)	(13.99)	(18.37)
Responsibility	0.131	0.142	0.156	0.180	0.105	0.210	0.218
level B	(11.51)	(5.32)	(11.61)	(13.91)	(7.49)	(11.43)	(12.28)
Field service	0.090	0.129	0.191	0.085	0.185	0.090	0.144
engineer	(6.14)	(5.16)	(13.55)	(7.63)	(11.00)	(4.98)	(6.42)
Quality control	0.015	-0.037	-0.038	0.029	0.125	0.015	-0.118
technician	(0.86)	(0.81)	(1.98)	(1.93)	(5.94)	(0.61)	(4.24)
Log of no. of	0.013	0.009	-0.004	-0.002	0.004	-0.031	0.002
employees	(2.61)	(1.17)	(0.89)	(0.45)	(0.74)	(6.16)	(0.40)
1994	0.047	0.026	-0.016	0.029	0.018	0.016	0.019
	(3.10)	(1.18)	(1.18)	(2.08)	(1.30)	(0.74)	(1.35)
1995	0.022	-0.014	-0.003	-0.019	0.006	-0.028	0.048
	(1.57)	(0.58)	(0.21)	(1.44)	(0.36)	(1.56)	(3.44)
1996	-0.002	0.053	-0.039	-0.037	-0.016	0.055	0.070
	(0.16)	(1.95)	(2.61)	(2.92)	(0.99)	(2.92)	(4.75)
No. of observations	1,158	297	1,482	1,566	1,116	589	1,266
Test for heteroskedasticity χ^2, (p-value)	202.20 (0.000)	98.68 (0.101)	187.68 (0.000)	180.45 (0.000)	149.05 (0.011)	186.02 (0.000)	203.47 (0.000)
R^2 (adj.)	0.565	0.578	0.573	0.489	0.561	0.558	0.597

Notes: Workshop specialist is the reference for the job dummies. See also notes for Table 6a.

Table 6c. Estimated wage equations for business administrators, graduate jobs, 1993-96, by country. OLS. Dependent variable: log of real annual salary, in local currency.

Variable	Belgium	Denmark	France	Germany	Italy	Sweden	UK
Intercept	12.682	11.635	10.985	9.783	9.134	10.932	8.191
	(107.20)	(52.81)	(73.88)	(61.79)	(34.85)	(61.22)	(36.58)
Age	0.050	0.025	0.041	0.056	0.076	0.048	0.065
	(8.40)	(2.53)	(5.46)	(6.96)	(5.70)	(5.53)	(5.46)
Age squared x 1000	-0.448	-0.221	-0.404	-0.549	-0.774	-0.511	-0.727
	(6.21)	(2.01)	(4.41)	(5.69)	(4.72)	(5.00)	(4.96)
Responsibility level A	0.420	0.252	0.499	0.423	0.646	0.425	0.463
	(22.27)	(5.68)	(27.02)	(18.82)	(20.31)	(17.68)	(14.85)
Responsibility level B	0.156	0.117	0.218	0.200	0.283	0.209	0.245
	(10.39)	(3.59)	(13.60)	(12.92)	(14.42)	(10.38)	(9.63)
Chief accountant	0.171	0.233	0.249	0.189	0.202	0.231	0.297
	(11.31)	(7.74)	(15.09)	(11.63)	(9.59)	(11.88)	(11.65)
Internal auditor	0.103	0.007	0.136	0.071	0.109	-0.036	0.019
	(5.09)	(0.11)	(5.90)	(3.40)	(3.02)	(1.46)	(0.47)
Log of no. of employees	0.045	0.058	0.045	0.039	-0.016	0.040	0.065
	(9.67)	(6.36)	(9.06)	(9.04)	(1.58)	(7.78)	(9.08)
1994	0.010	0.057	0.024	-0.056	-0.047	0.054	-0.002
	(0.61)	(1.74)	(1.23)	(2.88)	(1.61)	(1.92)	(0.08)
1995	0.003	0.028	-0.012	-0.070	-0.084	0.026	-0.052
	(0.19)	(0.78)	(0.67)	(3.55)	(3.00)	(1.00)	(1.87)
1996	-0.010	0.057	-0.026	-0.039	-0.095	0.055	-0.007
	(0.61)	(1.49)	(1.40)	(1.92)	(3.20)	(2.06)	(0.26)
No. of observations	1,181	156	899	1,004	625	497	648
Test for heteroskedasticity χ^2, (p-value)	229.20 (0.000)	83.92 (0.763)	170.54 (0.018)	248.60 (0.000)	166.92 (0.028)	152.01 (0.196)	162.01 (0.256)
R^2 (adj.)	0.580	0.577	0.617	0.584	0.605	0.680	0.515

Notes: Financial analyst is the reference for the job dummies. See also notes to Table 6a.

In Tables 6c and 6d, wage equations are presented for business administrators. The regressions look quite similar to the regressions for the corresponding categories of engineers. One difference is that increases in firm size tend to increase earnings for both categories of business administrators, i.e., also for those with nongraduate jobs. Italy and Sweden are the only exceptions. In Table 6d, it is notable that the estimate for *accountants*, in the UK regression, is much higher than in the other countries. This result is in line with the findings regarding the non-standardised wage levels in the Section 2.[17]

[17]This may possibly be due to a high education level among UK accountants compared to the other countries, cf. Appendix B.

Table 6d. Estimated wage equations for business administrators, nongraduate jobs, 1993-96, by country. OLS. Dependent variable: log of real annual salary, in local currency.

Variable	Belgium	Denmark	France	Germany	Italy	Sweden	UK
Intercept	12.877	11.364	11.159	9.932	9.726	11.488	8.525
	(243.43)	(70.50)	(118.97)	(162.49)	(136.73)	(186.89)	(110.66)
Age	0.028	0.027	0.019	0.030	0.029	0.018	0.027
	(10.28)	(3.64)	(3.76)	(9.12)	(7.41)	(6.14)	(6.73)
Age squared x 1,000	-0.209	-0.261	-0.167	-0.271	-0.241	-0.154	-0.310
	(6.03)	(2.96)	(2.55)	(6.85)	(4.90)	(4.40)	(6.30)
Responsibility level A	0.299	0.274	0.426	0.374	0.279	0.302	0.429
	(28.47)	(10.38)	(27.94)	(28.82)	(20.75)	(21.61)	(25.45)
Responsibility level B	0.118	0.153	0.168	0.172	0.121	0.123	0.219
	(14.84)	(8.36)	(15.47)	(15.87)	(12.01)	(12.30)	(16.26)
Accountant	0.153	0.142	0.184	0.128	0.104	0.092	0.488
	(20.62)	(8.20)	(15.71)	(12.96)	(10.14)	(8.08)	(35.92)
Payroll specialist	0.236	0.102	0.216	0.226	0.262	0.081	0.122
	(16.67)	(4.36)	(13.80)	(18.63)	(16.53)	(6.17)	(5.99)
Buyer	0.150	0.134	0.235	0.153	0.125	0.139	0.220
	(16.10)	(4.93)	(16.16)	(14.27)	(9.32)	(12.44)	(15.27)
Log of no. of employees	0.028	0.048	0.014	0.036	-0.005	0.002	0.036
	(9.09)	(7.56)	(3.75)	(12.50)	(1.17)	(0.48)	(8.58)
1994	0.012	-0.009	-0.016	-0.012	-0.001	0.030	-0.005
	(1.27)	(0.49)	(1.13)	(1.04)	(0.09)	(1.95)	(0.31)
1995	0.006	0.016	-0.056	-0.009	0.000	-0.006	-0.042
	(0.65)	(0.74)	(4.34)	(0.81)	(0.03)	(0.48)	(2.73)
1996	-0.013	0.038	-0.062	0.050	0.004	0.052	-0.027
	(1.37)	(1.73)	(4.45)	(4.13)	(0.29)	(3.73)	(1.71)
No. of observations	2,695	415	1,843	2,434	1,710	1,082	1,733
Test for heteroskedasticity χ^2, (p-value)	318.25 (0.000)	204.65 (0.000)	245.74 (0.000)	282.32 (0.000)	310.68 (0.000)	203.32 (0.023)	286.54 (0.000)
R^2 (adj.)	0.609	0.493	0.537	0.571	0.516	0.521	0.661

Notes: The reference for the job dummies is accounting clerk. See also notes to Table 6a.

We also performed various regressions to test for robustness. First, the basic model in Section 3 was extended to include various interactions. The job dummies were interacted with responsibility-level dummies. The rationale behind this formulation is that the responsibility levels are defined separately for each job (see Appendix A) and thus also may yield different payoffs depending on job. But we find that the hypothesis that wage premia for a given responsibility level are equal across jobs cannot be rejected in the majority of cases.

Second, we have constructed a subsample with two-year overlapping panels of firms. (See the discussion in Section 3.) Separate regressions were run for the 1993-94, 1994-95 and 1995-96 periods, with a time dummy for the last year of the period and otherwise using the same variables as in Table 6. Appendix C shows the number of firms in the full sample (i.e., the sample used in Table 6) and the number of firms (and observations) in the subsample of firm panels.

There is a notable increase in the explanatory power of the panel regressions, as compared to the full-sample regressions in Table 6. For example, the regressions for engineers with graduate jobs now explain about three-quarters of the variations in (log) wages and in the regressions for engineers with nongraduate jobs, the corresponding figure is two-thirds. The estimates are basically robust across years and in comparison to the estimates in Table 6.

Because the results take up a lot of space, we do not present regressions of the extended model and the panels of firms.[18]

4.2. Standardised wage premia

For each country and field of work, we computed standardised wage premia, as Section 3 describes. The set of results in Table 7 pertains to the predicted wage levels derived from the basic model, applied to the full sample, in Table 6.

Tables 7a and 7b show the wage premia for engineers and business administrators, respectively.

The wage premia for engineers do not, on average, differ greatly across countries. The estimates are about 31% to 38%, although Denmark seems to have consistently lower premia at about 24%. For some countries, there are quite large fluctuations over years, which must be interpreted as noise. This is particularly true for Denmark, where the premium in 1996 is only one-third of the size of the premium the previous year, and for Sweden, where the premium in 1995 is about 10 percentage points smaller than in 1994.

[18]The results are available from the authors upon request.

Table 7. Standardised wage premia for graduate versus non-graduate jobs, by country, 1993-96 (%).

a. Engineers

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	38.7	29.7	30.8	38.7	40.7	43.5	41.7
1994	34.8	24.3	33.7	30.8	33.4	38.6	36.1
1995	36.2	32.6	28.5	35.7	36.9	28.8	31.0
1996	38.1	10.6	32.0	41.2	41.9	30.4	33.9
1993-96	37.0	24.0	31.0	36.4	38.1	35.1	35.8

b. Business administrators

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	57.6	37.5	75.6	73.2	71.3	61.8	89.3
1994	57.4	46.9	82.9	65.7	63.6	65.7	89.8
1995	57.2	39.3	83.7	63.0	57.4	67.1	87.2
1996	58.0	40.1	82.2	58.4	55.1	62.3	93.1
1993-96	57.5	41.0	81.1	64.7	61.1	64.5	89.7

Notes: The calculations are based on the estimates in Tables 6a and 6b and Tables 6c and 6d, respectively. See text for further details.

It is interesting to note that these standardised wage premia produce a ranking across countries, which is partly different from the ranking according to the raw, non-standardised, wage premia in Table 4.a. For example, in terms of the average standardised wage premia, Germany's rank is 3. A ranking based on the raw wage premia puts Germany in first place. But British engineers rank much higher in terms of the standardised wage premia than in terms of the raw wage premia. The range of the standardised wage premia is smaller than the range of the raw wage premia, however. Accordingly, the changes in relative positions of the countries correspond to rather small differences in standardised wage premia.

Corresponding results for business administrators indicate that the standardised wage premia are much larger for this group as a whole, but there is also more variation across countries. The estimates range from, on average, 41% (Denmark) to 90% (UK). Among business administrators, the wage premia tend to be less unstable across years in most countries. In contrast to results obtained for engineers, the rankings based on the estimated wage premia agree quite well with the rankings based on the raw wage premia in Table 4b. The main exception is Belgium, which ranks only in sixth place regarding the standardised wage premia, whereas it attains a rank of 3 in the raw premia.

The result that wage premia are larger for business administrators than for engineers is, technically speaking, due to two factors. On the one hand, predicted wages for graduate jobs are higher among business administrators. On the other hand, predicted wages for non-graduates are lower in this job category.

Comparing Tables 7a and 7b, we see that the estimated wage premia for engineers and business administrators not only differ with respect to magnitude. The relative positions of the countries differ a lot, too. The most remarkable examples are Italy and the UK, which rank as number 1 with respect to one of the fields of work (engineering and business administration, respectively) but rank quite poorly in the other field of work. Thus, how the countries compare in terms of wage premia for university-level jobs depends, in general, heavily on the line of work considered. The exception to this rule is Denmark, which ranks last for both engineering and business administration.

For comparison, we also provide the wage premia obtained using the subsample with panels of firms in Table 8.[19] The results are based on separate regressions for the 1993-94, 1994-95 and 1995-96 periods. Because the periods overlap, there are two wage premia computed for 1994 (1994:I and 1994:II) and 1995 (1995:I and 1995:II) for each country and field of work. As can be seen, the average premia for engineers and business administrators are not very different from those in Table 7, with Sweden as the one exception.[20] The wage premia for Swedish engineers are larger in Table 8 than in Table 7 (42% versus 35% on average), whereas the premia for business administrators are smaller (59% versus 65%). The rankings based on the panels of firms puts Swedish engineers in first place instead of fifth. In general, the changes in the relative positions of countries are rather small.

Firm turnover may cause noise in the estimates across subsequent years. If this is true, subsequent wage premia based on the same panel of firms in Table 8 should differ less than the corresponding premia not based on the same set of firms. Thus, e.g., the 1993 and 1994:I

[19] The wage premia obtained under the extended model, with job and responsibility level interacted, are similar to those in Table 7 and are available upon request.

[20] The results for Denmark are based on a relatively small sample and should be interpreted with care.

premia should differ less than the 1993 and 1994:II premia and so forth. This is also largely what is observed. But also note in Table 8 that some of the pairs of premia, e.g., for Italian engineers (1993-1994:I) and business administrators (1994:II-1995:I) and for Swedish engineers (1993-1994:I), are not robust across years. These results indicate that entry and exit of individuals in the sample, which we have not been able to control for, may contribute to the observed noise.

Table 8. Standardised wage premia for graduate versus nongraduate jobs, by country, 1993-96, based on regressions with two-year overlapping panels of firms (%).

a. Engineers

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	36.9	23.2	31.2	35.1	43.5	29.9	33.1
1994:I	35.2	21.6	30.9	36.1	34.9	42.2	39.4
1994:II	32.8	12.6	30.0	35.3	35.3	44.3	35.2
1995:I	35.8	13.7	25.8	36.3	39.3	43.6	35.5
1995:II	39.7	-	30.9	37.3	39.1	45.2	40.4
1996	36.9	-	28.9	40.2	41.6	48.7	40.5
1993-96	36.4	-	29.7	37.0	39.9	41.6	37.2

b. Business administrators

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	57.4	49.7	76.8	70.1	73.6	56.8	92.2
1994:I	56.4	48.8	74.3	67.3	73.2	62.0	91.5
1994:II	57.2	40.8	79.7	62.0	64.1	59.1	90.9
1995:I	58.1	42.8	76.9	62.2	56.9	60.2	95.7
1995:II	58.2	39.6	84.7	66.0	56.8	60.6	85.2
1996	55.7	36.2	84.9	60.8	52.8	58.3	82.1
1993-96	57.0	43.0	79.9	64.9	63.0	59.0	89.0

Notes: The calculations are based on unreported estimates. Wage premia could not be computed for Danish engineers 1995:II and 1996, due to too few degrees of freedom. See text for further details.

5. Concluding comments

In this study, we estimated wage regressions for engineers and business administrators in internationally active firms, for employees with graduate- and nongraduate-level jobs, respectively, in seven European countries over the 1993-96 period. Based on these estimates, we have computed directly comparable standardised wage premia for engineers and business administrators in each country. To test for robustness, two different samples were used. The first sample contains all observations, while the second one is a subsample of overlapping panels of firms. The results generated by the two samples turned out to be similar.

When computing the wage premia, we find that business administrators generally receive larger premia than engineers. As regards the ranking of the countries, the field of work seems to matter a great deal. In engineering, Germany, Italy, and Sweden (panels sample only) rank highly, while the UK and France come out on top in business administration. But Denmark ranks at the bottom in both lines of work. Aggregation over fields of work, which is common in studies on the returns to education, therefore seems to be a questionable practice when comparing the returns in different countries. In this paper, we have not set out to explain the differences in the returns across fields of work. We have simply aimed at measuring the returns as carefully as possible. An understanding of the mechanisms behind the observed differences requires the development of a structural model and is subject to further research. The wage premia for engineers are quite similar across countries. This may be surprising, because it is not difficult to think of important differences in, e.g., education systems. For instance, the length of a typical university education for engineers varies across the countries in our sample.[21] There may also be quality differences, which are more difficult to observe.

Our results regarding wage premia are merely suggestive of the actual incentives for undertaking higher education in engineering and business administration across the countries. For several reasons, the numbers should not be regarded as final evidence. For instance, we have not considered income taxes. Because the tax system is progressive in all of the countries, net-of-tax wage premia would, in all countries, be lower than the gross wage premia in Tables 7 and 8. How the inclusion of taxes would affect the ranking of countries is less certain. We have also abstracted from non-pecuniary benefits, which tend to be frequent among highly skilled workers, and costs of higher education. Some of these issues we intend to investigate in the future.

21 See, e.g., Kowalewska (1994).

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Appendix A. Some examples of considered jobs

To illustrate how the jobs, which we are considering, are specified in Watson Wyatt's annual *Compensation Survey*, we reproduce, *in extenso*, four of the job specifications, one for each of the Table 1 categories: engineering/graduate job, engineering/nongraduate job, business administration/graduate job, and business administration/nongraduate job. The examples we selected are the jobs *that we use as reference jobs* in our four different earnings regressions, i.e., *industrial engineer*, *workshop specialist*, *financial analyst*, and *accounting clerk*.

Industrial engineer

Responsible for developing and designing new production processes to improve efficiency. Studies work flow, industrial systems, and production methods as well as equipment layout, material handling, manpower, and equipment utilization to improve operating performance. Recommends and introduces efficient work practices, organisations and possibly productivity payment systems to provide effective use of people, systems, and equipment. Reports to the *head of engineering* or the *head of manufacturing* . Alternative job titles: *manufacturing systems engineer*, *works engineer*, *plant engineer*, *production engineer*, *process engineer*.

Level	Description
A	*Middle management.* Formulates and recommends industrial engineering policies to improve operating performance, reduce waste and delays, and promote cost reductions. Directs cost control programs, conducts organisation studies, and prepares operating manuals. Is likely to work in a highly complex environment which necessitates the expert application of advanced engineering knowledge. Typically a team leader or project leader with supervisory responsibility.
B	*Employee.* Develops manufacturing methods for machines, tools and equipment. Establishes time and motion standards. Assists with cost control programs, and recommends production control and scheduling methods to meet completion dates and technical specifications. Plans equipment layout, work flow, and accident prevention measures. May liaise with other engineering disciplines to introduce CAD/CAM and robotics. Senior engineer with experience.

C *Employee.* Performs engineering assignments in work measurement for the establishment of standards, using standard company procedures. Carries out engineering assignments of specific parts, elements or phases of a major project, translating technical guidance received from senior levels into applicable engineering data. Final responsibility remains at a more senior level.

Workshop specialist

Works on bench servicing, repairs, and/or testing of products. Duties involve diagnosis and rectification of faults, and use of test equipment. Reports to *field service manager* or equivalent.

Level	Description
A	*Employee.* Responsible for all in-house service requirements and maybe for warranty claims, spares and liaison with distribution centres and contractors. Is likely to have regular customer contact and supervise a team of technicians dealing with highly technical products. May be called *workshop supervisor.*
B	*Employee.* As *senior repair technician,* is responsible for some in-house service requirements with repairs likely to be restricted to key assembly faults and major problems being referred elsewhere. Technical background and some experience are required.
C	*Employee.* As *repair technician,* limited to simple board changes, works under constant supervision and handles routine maintenance issues on reasonably straightforward equipment.

Financial analyst

Provides a basis for management planning, operating controls, and financial performance appraisal. Prepares forecasts and analyses trends in manufacturing, sales, finance, and general business conditions. Conducts economic studies such as return rate, depreciation, working capital, financial and expense performances, and assists other departments in the preparation of budgets. Responsible for the preparation, consolidation, and distribution of company profit and loss and capital expenditure budgets. Reports to the *head of finance and administration* or equivalent. Alternative job titles: *economist, budget analyst.*

Level Description

A *Middle management.* As *budgetary manager* or *senior economist*, recommends budgetary policies, develops methods and procedures for the preparation of budgets. Analyses products' profit and loss statements, and consolidates inventory and capital expenditure budgets. Evaluates economic and business conditions and presents solutions to problems for which there is no established approach. Manages a team of support staff in larger companies.

B *Employee.* As *budget analyst* or *economist*, analyses risk and economic trends. Prepares operating budgets based on previous budget figures or estimated revenue and expense reports. Reviews actual against budgeted performance, and prepares reports explaining budget deviations. No supervisory responsibility but several years of experience are required. May give guidance to other financial staff.

C As *junior budget analyst* or *junior economist*, provides under close supervision research data covering various economic fields. Maintains records of expenses, inventories, and budget balances. Prepares display materials for presentations.

Accounting clerk

Responsible for performing a variety of routine accounting activities in accordance with standard procedures. Reconciles bank accounts, posts and balances, general or subsidiary ledgers, processes payments, and compiles segments of monthly closings. Reports to the *chief accountant* or equivalent. Alternative job titles: *bookkeeper*, *accounts assistant*.

Level Description

A *Employee.* As *senior accounting clerk*, handles a wide variety of advanced accounting work including maintenance and preparing of reports on more complex budget or income and expenditure records. May direct and check the work of more junior staff.

B *Employee.* As *accounting clerk*, performs a variety of routine accounting duties as directed. Verifies the accuracy, completeness, and consistency of accounting information received. Reconciles accounts, balances ledgers, etc.

C *Employee.* As *junior accounting clerk*, performs simple repetitive tasks under close supervision. Procedures are well-defined. Checks matching payments to accounts receivable, plus invoice and order items. Assists in preparing bank statements and journal vouchers.

Appendix B. The link between job and education

The classification of jobs by education level in Table 1 is not based on explicit information about the employees' education, because Watson Wyatt does not collect information on education. But the jobs considered were selected because, on average, they probably require either a university-level education (graduate jobs) or an education corresponding to high school or upper secondary school (non-graduate jobs).

The education requirements of the graduate jobs were partly validated in a special Watson Wyatt survey done in 1994. Random samples of companies in the seven countries considered in this study were asked about the levels of education associated with seven jobs in Table 1, all of which were expected to require university-level education. The jobs considered were *R&D specialist*, *laboratory specialist*, *manufacturing engineering engineer*, *industrial engineer*, *internal auditor*, *financial analyst*, and *accountant*. For each of these, the companies were asked to indicate one option out of five levels:

1. Below university level
2. Less than two years of university education
3. Two to three years of university education
4. Three to four years of university education
5. More than four years of university education

Unfortunately, the response rates in this special survey were too low to allow any firm conclusions; in total, only 34 companies responded. In particular, no inferences regarding individual countries were possible. Taken together, the results indicated that with one exception, these jobs seem to require a college or university degree. The exception was the accountant job, for which 50% of the companies indicated options 1 or 2. As can be seen in Table 1, this information has resulted in the accountant job being classified among the non-graduate jobs rather than in the graduate jobs category.[22] For the six other jobs investigated, at least two-thirds of the companies indicated that two or more years of university education were required (i.e.,

[22] For one country (the UK), this might not be appropriate. In a survey of *qualified* accountants in the UK, reported by Pierce-Brown (1996), 65% of the males and 71% of the females held university degrees. To the extent that the UK accountants in Watson Wyatt's survey are qualified, they should be categorised in the graduate category. Unfortunately, we have no information about whether this is the case.

options 3-4). For four of these six jobs—*R&D specialist*, *manufacturing engineering engineer*, *industrial engineer*, and *financial analyst*—a majority of the responding companies indicated that at least three years of university education were required.

For 1996, there is additional possibility to check to the link between job and education. In this year, Watson Wyatt added a section about starting salaries to their annual compensation survey. This section marked a change in the general outline of the survey in the sense that for the first time, questions were included that explicitly related to the education levels of the companies' employees. The companies were asked to provide data on the minimum (and maximum) starting salaries paid to employees in three education categories: first-degree graduates, MBAs, and PhDs. By itself, we cannot make much use of this information. But for some of the countries that we study (Belgium, Denmark, Sweden, and the UK), there are also questions about starting salaries for a small number of job categories as well. Of interest to us are the engineer, research analyst/scientist, and accountant jobs. The first category roughly corresponds to the industrial engineer and manufacturing engineering engineer jobs in Table 1. The research analyst/scientist category can be taken to be equivalent to the R&D specialist job in Table 1.[23] The accountant category is identical to the job with the same name in Table 1.

On the whole, the information on the starting salaries supports the cross-classification by jobs and education levels in Table 1. The average minimum starting salary for the engineer category exceeds the average starting salary of first-degree graduates in each of the countries, except Sweden where its only marginally lower (about 0.5%).[24] Moreover, the research analyst/scientist employees definitely seem to have a university degree; the starting salary for this category is always higher than for the engineer category and thus, *a fortiori*, higher than that of first-degree graduates. For *accountant*, the findings are generally in line with those from the special survey discussed earlier. In Belgium, Denmark, and Sweden, the average starting salaries are well below the average starting salaries for first-degree graduates.

[23] The correspondences between *industrial engineer* and *manufacturing engineering engineer* and between *research analyst/scientist* and *R&D specialist* were checked with Watson Wyatt representatives.

[24] This is in line with Hemström (1998), who finds support for the hypothesis that a group of large Swedish companies, by acting as a monopsonist, has been able to force the starting salaries of graduate engineers below the competitive level.

In the UK, the average starting salary for the accountant category is surprisingly high. It exceeds the average starting salary of first-degree graduates by 13% and is even slightly higher than the average starting salary of the UK engineer category. Thus, for the UK, information on both education levels (cf. footnote 22) and on starting salaries would motivate putting the accountant job in Table 1 among the graduate jobs instead of among the nongraduate jobs. In the regression analyses, we have not made this change, because we wanted to use the same specifications for all of the countries.[25]

Altogether, these validity checks indicate that the jobs that we denote graduate jobs seem to require university-level education. Except for Sweden, we were not able to check whether education levels associated with the nongraduate jobs correspond to high school or upper secondary school. For Sweden, we have aggregate data on wages for engineers and business administrators, with university or high school education (collected by Statistics Sweden). These data are not directly comparable to our Watson Wyatt data because they cover males only and because the range of jobs is broader; all male jobs are included. Excluding females probably results in higher wage levels. The effect of broadening the coverage in terms of job categories is more uncertain but, to the extent that top-level jobs have a large influence on average wage levels, the fact that CEOs are excluded in our data might work in the same direction. Still, the differences are surprisingly large: for all four job categories in Table 1, the average wages (as measured by Statistics Sweden) are about 15% higher.[26] A possible explanation could be that the average levels of education in all the jobs in Table 1 are below the levels of education that they are supposed to represent. But if so, the wage premia for university versus high school-level jobs, which we want to measure, should not be much affected because the relative deviations are of the same magnitude for the graduate and the nongraduate jobs alike.

25 The wage level for the aggregate of UK nongraduate jobs will thus tend to be upwards biased. As a consequence, the wage differential between the graduate and the nongraduate jobs is probably underestimated for the UK. Nevertheless, the wage premium for UK graduate jobs in business administration, compared to nongraduate jobs, is much higher than in all of the other countries studied. Reclassifying accountant as graduate jobs would probably increase the difference even further.

26 In particular, these differentials seem large in view of the fact that the Watson Wyatt data are from large, internationally active companies, which can be expected to pay higher wages than small, domestic firms, cf the data section.

Appendix C. The number of firms in the data sets

Table C1. Number of firms in the full sample.

a. Engineers

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	122	34	85	72	73	33	80
1994	108	32	85	93	80	35	73
1995	129	22	104	109	83	68	78
1996	114	18	88	112	60	52	81

b. Business administrators

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993	173	43	108	104	92	51	109
1994	163	39	110	128	101	62	104
1995	196	37	131	140	107	104	116
1996	155	31	112	142	75	84	104

Table C2. Number of firms and observations (in parentheses) in the panel data set. Two-year overlapping panels of firms.

a. Engineers

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993- 1994	74 (1,058)	22 (332)	63 (1,039)	46 (821)	49 (785)	14 (133)	43 (615)
1994- 1995	65 (819)	13 (218)	63 (949)	55 (982)	55 (753)	17 (291)	37 (492)
1995- 1996	76 (1,046)	13 (97)	54 (809)	64 (1,124)	44 (601)	25 (328)	37 (507)

b. Business administrators

Period	Belgium	Denmark	France	Germany	Italy	Sweden	UK
1993- 1994	111 (1,241)	30 (249)	82 (990)	67 (1,722)	64 (782)	28 (224)	57 (648)
1994- 1995	106 (1,130)	22 (146)	81 (908)	80 (1,160)	68 (878)	32 (347)	62 (669)
1995- 1996	110 (1,388)	21 (128)	68 (815)	81 (1,095)	55 (718)	48 (536)	57 (593)