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Working Paper

Employer Size-Effectsin the Nordic Countries

ETLA Discussion Papers, No. 532

Provided in Cooperation with:
The Research Institute of the Finnish Economy (ETLA), Helsinki

Suggested Citation: Albaek, Karsten; Arai, Mahmood; Asplund, Rita (1995) : Employer Size-Effectsin the Nordic Countries, ETLA Discussion Papers, No. 532, The Research Institute of the Finnish Economy (ETLA), Helsinki

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Keskusteluaiheita - Discussion papers

No. 532

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EMPLOYER SIZE-WAGE EFFECTS IN THE NORDIC COUNTRIES

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Financial support by the Nordic Economic Research Council is gratefully acknowledged.

ISSN 0781-6847 13.03.1995

Albæk, Karsten, **Arai,** Mahmood, **Asplund,** Rita, **Barth,** Erling and **Madsen,** Erik Strøyer, **EMPLOYER SIZE-WAGE EFFECTS IN THE NORDIC COUNTRIES.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1995, 38 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 532).

Abstract: This paper examines employer plant size-wage effects in Denmark, Finland, Norway and Sweden. The empirical results indicate that there exists a positive significant size-wage effect in all four Nordic countries under study, a size-wage premium that cannot be explained by differences in worker and employer characteristics, such as labour quality, working conditions, monitoring difficulties, union status and wage bargaining. Moreover, the size-wage effects estimated for Denmark, Finland and Norway are fairly close in magnitude to the size-wage gap reported by Brown and Medoff (1989) for the US. This is a remarkable outcome in view of the very different institutional settings of the labour markets in the Nordic countries and in the US. The plant size-wage effect obtained for Sweden is very small but, nevertheless, statistically significant. When, however, controlling for time-invariant unobserved worker heterogeneity by estimating a first difference standard wage equation, the size-wage effect for Sweden turns insignificant. Hence, a cautious conclusion to be drawn is that the Swedish plant size-wage gap might be due to unmeasured worker abilities.

KEY WORDS: employer size, labour quality, wage premiums, Nordic countries

Albæk, Karsten, **Arai,** Mahmood, **Asplund,** Rita, **Barth,** Erling and **Madsen,** Erik Strøyer, **TYÖNANTAJAN KOKOON LIITTYVÄT PALKKAEROT POHJOISMAISSA.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1995, 38 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 532).

Tiivistelmä: Tässä tutkimuksessa tarkastellaan ja vertaillaan työpaikan kokoon liittyviä palkka-eroja Norjassa, Ruotsissa, Suomessa ja Tanskassa. Työpaikan koolla on tilastollisesti merkitsevä, positiivinen vaikutus palkkatasoon kaikissa neljässä pohjoismaassa. Tämä työpaikan kokoon liittyvä "palkkapreemio" ei häviä - ei edes olennaisesti pienene - vaikka otamme huomioon erikokoisten työpaikkojen työntekijöiden ja työnantajien välillä esiintyvät erot työvoiman laadussa (esim. koulutus, työkokemus), työympäristössä, työsuorituksen valvonnassa, työvoiman järjestäytymisasteessa sekä palkkaneuvottelujärjestelmissä. Erikokoisten työpaikkojen välillä esiintyvä palkkaero vakioituna edellä mainittujen ominaisuuksien suhteen, on Norjassa, Suomessa ja Tanskassa suuruudeltaan varsin lähellä Brownin ja Medoffin (1989) Yhdysvalloille työnantajan kokoon estimoimaa palkkapreemiota. Tämä on varteenotettava tulos ottaen huomioon työmarkkinainstituutioiden erilaisuus pohjoismaissa ja Yhdysvalloissa. Ruotsissa työpaikan kokoon liittyvä palkkavaikutus on muihin pohjoismaihin verrattuna hyvin pieni, joskin tilastollisesti merkitsevä. Tämä palkkavaikutus muuttuu kuitenkin tilastollisesti ei-merkitseväksi, kun vakioidaan työvoiman ei-mitattavissa olevien, yli ajan muuttumattomien ominaisuuksien vaikutus estimoimalla ensimmäisen asteen differenssiyhtälö. Ruotsia koskeva työpaikan kokoon liittyvä palkkavaikutus saattaa siis selittyä erikokoisiin työpaikkoihin liittyvällä ei-mitattavissa olevalla osaamisella.

AVAINSANAT: työpaikan koko, osaaminen, palkkaerot, pohjoismaat

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Summary[1]

Many empirical studies of individual wage determination report a strong positive relationship between employer size and wages. Results obtained by Brown and Medoff (1989) for the US imply that when comparing two workers with observationally equivalent qualifications and jobs, but working at different-sized employers with the size of one employer being double the size of the other, the individual working for the larger employer receives a wage premium of 1.5 to 3.8 per cent. Similar evidence pointing to a positive and significant employer size-wage effect has also been reported for Canada (Morissette, 1993), Germany (Gerlach and Schmidt, 1990; Schmidt and Zimmerman, 1991), Great Britain (Main and Reilly, 1993), and Japan (Rebick, 1993).

Previous studies examining the employer size-wage effect in the Nordic countries confirm the existence of a positive size effect: Albæk and Madsen (1994) for Denmark, Arai (1990) for Sweden, and Barth (1993) and Dale (1994) for Norway. The purpose of the present paper is to re-examine and compare the employer-size effect on wages across the Nordic countries. This is done using as comparable national data sets and variable definitions as possible. Also the years investigated are chosen to be as close in time as possible.

Theoretical explanations as to why workers of large employers receive higher wages have been the subject of much debate and investigation. Though there are several well-established empirical results indicating that there exists such a wage premium, most of the hypothesized causes of the employer size-wage relationship fail to find empirical support in individual-level data.

Cross-country comparisons play a potential role in the search for explanations of the empirical existence of a strong positive employer size-wage relationship. Both wage setting procedures and the distribution of employer size differ across countries. If the institutions of the wage formation process contribute substantially to the existence of employer size-wage effects, the magnitude of the size-wage effect could be expected to vary across countries with different labour market institutions. In accordance, since the distribution of employer size as well as the institutions of wage formation are very similar in the Nordic countries, also the employer-size effects on wages could be expected to be fairly close in these countries.

Moreover, the size-wage premiums would be expected to be much smaller in the Nordic countries than in the US. One rationale for this is that measures of wage differentials in different dimensions point to a fairly compressed wage structure in the Nordic countries as compared to most other industrialised countries. This is the case for, *inter alia*, inter-industry wage differentials (Albaek et al., 1995).

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[1] A preliminary version of the present paper was presented at the EALE conference in Warsaw 22-25.9.1994. We would like to thank the participants for valuable comments.

The empirical analysis uses national data sets of private-sector employees in Denmark, Finland, Norway and Sweden. The data for Denmark, Norway and Sweden are representative of the whole private sector. The Finnish data, on the other hand, cover full-time employees in private-sector manufacturing only. The data for Denmark are from a Danish Longitudinal Data Base. The data for Finland are collected by the Confederation of Finnish Industry and Employers (TT) and cover full-time white-collar and blue-collar workers employed in TT-member firms. The data for Norway come from the Norwegian Study of Organisations and Employees. The data for Sweden are from the Level of Living Survey as well as from firm register data.

All data sets used contain register information on plant size measured as the exact number of persons employed in each individual plant. This allows estimation results to be reported for two alternative ways of measuring size-wage effects: one where plant size enters the wage equation as a continuous variable using the reported numbers of employees, and another where plant size enters as a categorial variable, i.e. as size-class dummy variables.

The starting point is a simple wage model estimated for each country, where the log hourly wages of the sample individuals are explained by individual human capital endowments (schooling, experience, seniority), gender, worker status, and employer size. Apart from this basic wage model including standard controls, we also run regressions for various extended models, the limits of which being dictated by the information on various size-wage relevant variables available in each national data set. In particular, the basic wage model is supplemented with a broad set of other relevant wage-related explanatory variables in order to investigate the dependency of the observed positive employer size-wage gap on working conditions, monitoring, union density and bargaining. Panel data are used to uncover the role of unobserved worker characteristics in explaining the observed size-related variation in wages.

Our results indicate that there is a positive significant plant size-wage effect in all four Nordic countries under study even after controlling for a broad set of individual and job-related characteristics, such as observed labour quality, industry affiliation, region, working conditions, monitoring difficulties, union density and wage bargaining institutions. In other words, large plants tend to pay higher wages than small plants also after having accounted for differences in worker and employer characteristics across different-sized plants.

The estimated size-wage effects are comparatively large in Denmark and Norway, slightly smaller in Finland and almost negligible in Sweden. The estimated size-wage effects for Denmark, Finland and Norway are, in fact, fairly close in magnitude to the size-wage effects reported for the US by Brown and Medoff (1989). This is a remarkable result in view of the different institutions of wage determination in the Nordic countries and in the US.

1. Introduction

Many empirical studies of individual wage determination report a strong positive relationship between employer size and wages. Results obtained by Brown and Medoff (1989) for the US imply that when comparing two workers with observationally equivalent qualifications and jobs, but working at different-sized employers with the size of one employer being double the size of the other, the individual working for the larger employer receives a wage premium of 1.5 to 3.8 per cent.[1] Similar evidence pointing to a positive and significant employer size-wage effect has also been reported for Canada (Morissette, 1993), Germany (Gerlach and Schmidt, 1990; Schmidt and Zimmerman, 1991), Great Britain (Main and Reilly, 1993), and Japan (Rebick, 1993).

Previous studies examining the employer size-wage effect in the Nordic countries confirm the existence of a positive size effect: Albæk and Madsen (1994) for Denmark, Arai (1990) for Sweden, and Barth (1993) and Dale (1994) for Norway. The purpose of the present paper is to re-examine and compare the employer-size effect on wages across the Nordic countries. This is done using as comparable national data sets and variable definitions as possible.

Theoretical explanations as to why workers of large employers receive higher wages have been the subject of much debate and investigation. Though there are several well-established empirical results indicating that there exists such a wage premium, most of the hypothesized causes of the employer size-wage relationship fail to find empirical support in individual-level data.

Cross-country comparisons play a potential role in the search for explanations of the empirical existence of a strong positive employer size-wage relationship. Both wage setting procedures and the distribution of employer size differ across countries. If the institutions of the wage formation process contribute substantially to the existence of employer size-wage effects, the magnitude of the size-wage effect could be expected to vary across countries with different labour market institutions. In accordance, since the distribution of employer size as well as the institutions of wage formation are very similar in the Nordic countries, also the employer-size effects on wages could be expected to be fairly close in these countries.

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[1] Other recent US studies providing empirical evidence on a strong positive employer-size wage gap are e.g. Evans and Leighton (1989), Idson and Feaster (1990), Pearce (1990), Rebitzer and Robinson (1991), Davis and Haltiwanger (1994), and Even and Macpherson (1994).

Moreover, the size-wage premiums would be expected to be much smaller in the Nordic countries than in the US. One rationale for this is that measures of wage differentials in different dimensions point to a fairly compressed wage structure in the Nordic countries as compared to most other industrialised countries. This is the case for, *inter alia*, inter-industry wage differentials (Albaek et al., 1995).

Our findings point to a positive and significant plant size-wage effect in Denmark, Finland and Norway, the magnitude of which is comparable to the size effect obtained for the US as reported by Brown and Medoff (1989). This is a remarkable result in view of the different institutions of wage determination in the Nordic countries and in the US. Moreover, the size-wage effect estimated for Denmark, Finland and Norway remains also after controlling for a large set of individual and job-related characteristics. The very small, albeit significant, size-wage effect obtained for Sweden can obviously be attributed to the relatively aggressive wage compression policy pursued in Sweden.

The study is organised as follows. Section 2 gives an overview of the overall employer-size structure of Nordic firms compared to other European countries. Section 3 contains a discussion of the most crucial theoretical explanations for the observed positive employer size-wage effects. The data sets used for the four Nordic countries under study are described in Section 4. Section 5 outlines the empirical methodology applied in analysing different dimensions of the employer size-wage relationship. The main results are discussed in Section 6, with the emphasis being on the role of different key entities in explaining the observed employer size-wage differential, such as education, seniority, working conditions, monitoring, and union density. Apart from this, also panel data methods are used in order to control for time-invariant unmeasured individual characteristics. Section 7 comments briefly on measurement errors arising from errors in the reported employer size. This extension of the analysis is, however, possible to carry out for only two of the countries, for which both self-reported employer size data and size data from administrative registers are available. Concluding remarks are presented in Section 8.

2. The Overall Structure of Nordic Firms

In comparing the overall structure of firms across industrialised countries, the focus has mainly been on the distribution of firms by size. Two features have thereby been emphasized (e.g. Eurostat, 1992).

Firstly, small firms account for a much larger share of the total number of firms in the EU as compared to Japan and the US.[2] Conversely, the share of firms with 100 or more employees is clearly smaller in the EU than in the US and Japan. This explains the considerably higher average-firm size in the US (83 persons per firm) compared to that in the EU (62 persons per firm).[3]

Secondly, the geographical ranking of firms by size is noted to vary substantially across the different European countries. In particular, the northern countries are characterised by a relatively large number of medium-sized and large firms. In contrast, in the southern European countries micro-firms, i.e. firms with less than 10 employees, account for a substantial share of the total number of enterprises: over 90 per cent of all firms within the EU are recorded as micro-firms, the average size of an EU enterprise being some seven persons. This low average size is found in all "old" EU countries, except in Denmark where the average number of employees per firm is about 13. As shown in *Table 1*, the average-firm size is relatively high also in the three "new" EU countries - Austria, Finland and Sweden. Only 1 per 1,000 firms in the EU has a workforce exceeding 500 persons.

This strong emphasis of the size distribution of firms has generally overshadowed the fact that despite their huge number, micro-firms play a much less dominant role when analysed in terms of total employment. In the late 1980s, the micro-firms within the EU accounted for only 29 per cent of total employment. The corresponding number was 41 per cent for small and medium-sized firms and some 30 per cent for large firms.

In the Nordic countries, where small and medium-sized enterprises play a more important role than in the rest of Europe, the micro-firms account for less than 20 per cent of total employment *(Table 1)*. At the other end of the scale, firms with 100 or more employees are the largest employers and account for about 21 per cent of

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[2] Most probably also the density of micro-firms (less than 10 employees) is much higher in the EU than in Japan and the US. Data on micro-firms are, however, not available for the two non-European countries.

[3] These figures do not account for micro-firms (cf. footnote 1 above). Unfortunately information on large firms (500 employees or more) is not available for Japan.

Table 1. Distribution of employment by firm size-class in selected European countries

Country	Share of employment by firm size-class, %				Average no. of employees per firm
	Micro -9	Small 10-99	Medium 100-499	Large 500+	
EC countries:					
Belgium (1988)	17*	28	19	36	4
Denmark (1989)	20*	38	18	24	13
Germany (1988)	17	29	18	36	9
France (1988)	28	25	14	33	7
Italy (1988)**	48	24	10	19	7
Luxembourg (1987)	22	29	23	26	9
Netherlands (1988)	24***	37	14	21	10
Portugal (1988)	24*	32	20	23	3
Spain (1988)	24*	36	20	20	3
UK (1988)	26	20	17	37	3
Austria (1988)	n.a.	n.a.	n.a.	n.a.	12
Finland (1989)	17	27	17	39	11
Sweden (1990)****	19	49	23	9	12
EFTA countries:					
Iceland (1988)	36*	33	← 31 →		4
Norway (1989)*****	29	51	← 21 →		8

Notes:
* Size class refers to 1-9 employees
** Exclusive of social and personal services.
*** (1-9) for industry; (0-9) for services.
**** The employment shares are calculated from the sample data used in this study.
***** Exclusive of transport and communication. The micro-firm class refers to 2-9 employees.

Source: Eurostat (1992)

employment in Norway, some 32 per cent in Sweden[4], over 40 per cent in Denmark, and no less than 56 per cent in Finland.

A sectoral breakdown of employment shows that the situation in Denmark and Finland differs only slightly from that seen at the EUR 12 level. In particular, the service

[4] The share for Sweden is calculated from the sample data used in this study, because official statistics on the distribution of employment by firm size-class are not available.

sector represents about 60 per cent of total employment in Denmark and half of the employment in Finland as compared to some 52 per cent in the EU. In Norway and Sweden, on the other hand, the service sector accounts for significantly less than half of total employment.[5]

A common feature across the EU countries is that the micro-firms are the main employers in the construction industry and the service sector. The small and medium-sized firms dominate the consumer goods sector, while large firms are the main employers in the intermediate and investment goods sectors and, especially, in the energy and transport sectors.

In the Nordic countries, on the other hand, most sectors are dominated by small and medium-sized enterprises. Only the service sector is mainly composed of micro-firms, whereas the dominance of the large firm size-class is concentrated to a few activities, mainly the transport and communication sector and the energy sector. In the Norwegian energy sector, for example, there are over 800 employees per plant. In Finland, there is a clear predominance of small and medium-sized firms as well as of large firms across practically all industry and service sectors. Hence, the overall structure of firms in Finland can be seen as an extreme also in a Nordic perspective.

3. Theoretical Explanations

Various theoretical explanations for a positive employer size-wage effect have been discussed in the literature. A first intuitive explanation is that this effect is simply due to differences in measured and unmeasured dimensions of labour quality and/or to compensating differentials originating in different job and employer characteristics.

According to the labour quality hypothesis large employers hire higher-quality workers. There are several potential reasons for this to occur, one being the relatively greater capital intensity and capital-skill complementarity of large plants (Hamermesh, 1980). The higher levels of both human and physical capital per worker at large employers are, in turn, seen to be due to scale economies and/or preferential access to credit in imperfect capital markets. Lucas (1978), on the other hand, argues that the higher-quality workers of large employers is due to more able entrepreneurs at large

[5] The figure for Norway does not include the transportation and communication sector.

employers and complementarities between entrepreneurial and worker abilities. And according to Kremer (1993), the greater skill complementarity across workers at large employers can be explained by the greater complexity of tasks induced by the technology adopted by large employers.[6] Related to these cross-employer differences in labour quality is also the conjunction that large employers pay higher returns to human capital.

In a fully competitive labour market, observed wage differentials not explained by labour quality differences must, by assumption, be due to differences in working conditions. Suppose that job characteristics do differ systematically across different-sized employers in the sense that less pleasant working conditions are more often offered at larger employers. The inferior working conditions of larger employers may arise from, *inter alia*, greater reliance on rules and less freedom of action and scheduling (Masters, 1969; Stafford, 1980), a more impersonal work athmosphere (Lester, 1967), or longer commuting (Scherer, 1976). According to the theory of equalising wage differences (Smith, [1776] 1986) these employers - in order to recruit workers of a given quality - will have to pay higher wages to compensate for the unattractive features of the job.

This neoclassical approach may offer the only way to explain, within the framework of the standard competitive model, the significant wage premium estimated for employer size. The situation arises even when employers operating in a perfectly competitive market, are fully informed about the ability and actual productivity of the workers at the workplace.

Labour and product markets are generally not perfectly competitive, though. Moreover, empirical results clearly show that accounting for human capital, ability, and compensating wage differentials is not sufficient to explain existing employer size-wage differentials.[7] Instead several other explanations for the existence of a strong positive employer size-wage effect have been put forth in the theoretical literature. These have mostly been linked either to the problem of imperfect information or to the problem of imperfect competition in the labour and/or product markets, or to both.

According to the ability-to-pay argument larger plants/firms are more likely to operate in imperfect competitive markets, that is product markets characterized by

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[6] This type of sorting by worker ability among employers generated by technological heterogeneity across different-sized plants/firms is discussed in detail in Davis and Haltiwanger (1994).

[7] See e.g. the comprehensive survey of the sources of employer wage differentials in Groshen (1991) as well as the literature referred to previously in the text.

inelastic demand, than are smaller plants/firms. This product market power is likely to give rise to monopoly rents, which the employers may be willing to share with their workers (Weiss, 1966; Mellow, 1982). A frequently raised question in relation to this hypothesis is, however, why large employers would depart from cost-minimising behaviour and overpay their workers. It seems reasonable, though, to assume that such excess profits might lead to wage premiums especially if the labour market is organised.[8]

Let's then turn to a brief discussion about the role of imperfect information and problems of monitoring related to size. Coase (1937) discusses how the costs of operating on a market - alternatively within an organisation - determine the optimal size of the firm. Essential in this set-up is how the costs of co-ordinating various activities within a firm relate to the transaction costs from purchasing these same services at the market. According to Coase, the firms will increase in size until the point, where the cost of co-ordinating an extra transaction inside the firm equalises the transaction cost on the market.

The firm's average costs of handling transactions may decline with size, since part of the transaction costs in the market is transformed into co-ordination costs within the firm. The co-ordination costs are, in other words, increasing with employer size. These co-ordination costs are in part made up of different types of monitoring costs. For example, the information problem caused by quality control of a component produced in one division for use in another gives rise to monitoring costs in the absence of a price system. According to Eaton and White (1983) a cost minimising employer faced with an imperfect ability to accurately monitor workers' efforts, has the option of substituting costly monitoring with wage premiums. Due to efficiency wage considerations, large firms might, in other words, prefer to pay above-market wages for a given quality of workers.[9]

Other discussions relating the higher monitoring costs of larger employers to the search for higher-quality workers in order to reduce costly monitoring can be found in

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[8] As pointed out by Rebick (1993) the accruing above-normal profits may also be the result of higher productivity of the workforce of large employers. Empirically this explanation may, however, be indistinguishable from the higher return to human capital argument discussed above.

[9] Bulow and Summers (1986) offer a similar explanation, albeit not in connection to determinants of employer size. Apart from the use of higher wages as a worker discipline device, other efficiency wage considerations have also been put forth in an attempt to explain the positive employer size-wage relationship. Thus it has been argued that larger employers use higher wages: (1) to reduce turnover because of their higher training costs, and (2) to raise the work norms of their workers above the minimum required because of a greater reliance on teamwork. See e.g. Morissette (1993).

e.g. Stigler (1962), Oi (1983), Garen (1985) and Barron et al. (1987). This approach, however, can basically be characterized as a selection problem as opposed to the incentive problem discussed above.[10]

Another institutionally related explanation departs from the assumption that large employers facing a great threat of unionization tend to follow a strategy of "positive labour relations" to avoid unionism at their plant/firm, thereby paying higher wages than otherwise similar non-union employers (Podgursky, 1986). According to this union avoidance hypothesis, union wage differentials can be expected to vary inversely with employer size. A closely related argument is that large employers are more likely to be unionized.[11]

Finally it has also been hypothesized that larger employers pay higher wages in order to offset a lower applicant-to-job vacancy ratio (Weiss and Landau, 1984). The key assumption underlying this argument of larger employers facing smaller pools of applicants relative to vacancies is that the number of applicants per vacancy declines because the number of units of labour to be employed and the size of the available labour pool do not increase in the same proportion. From this follows that at any minimum level of worker quality chosen by the employer, the larger employer will be forced to offer higher wages in order to satisfy the greater labour input requirement. Brown and Medoff (1989) argue, though, that the introduction of positive hiring costs results in a model that is "too complicated to have derivable predictions about the relationship between employer size and quality of worker hired" (p. 1048).

In this section a number of theoretical explanations for the existence of a positive employer size-wage effect have been briefly discussed.[12] The overall impression is that what is lacking is not reasonable explanations, but firm evidence linking the size-wage effects observed for different countries to the various potential explanations put forth in the theoretical literature.

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[10] See Brown and Medoff (1989) for a detailed discussion.

[11] If, however, unions act to compress wage differentials across different-sized employers, then a negative relationship between employer size and wages is to be expected (Davis and Haltiwanger, 1994).

[12] As shown by e.g. Davis and Haltiwanger (1994), several of these key factors offering potential explanations for the wage gap observed between employers of different sizes, can be extended to provide hypothesized causes of within-plant/firm wage dispersion by size class. These extensions are, however, not discussed here since the subsequent empirical analysis focuses entirely on between-plant wage differentials in the Nordic countries.

4. Data

The subsequent empirical analysis uses national data sets of private-sector employees in Denmark, Finland, Norway and Sweden. All data sets contain register information on employer size. This is a notable advantage over the employees' self-reported employer size - a commonly used measure in studies of the employer size-wage relationship. It is reasonable to assume that the measurement error is more serious when individual workers report the size of the plant or firm in which they work.[13]

The data for Denmark, Norway and Sweden are representative of the whole private sector. The Finnish data, on the other hand, cover full-time employees in private-sector manufacturing only.

The data for Denmark are from a Danish Longitudinal Data Base (IDA) covering the years 1980 to 1987. The data set contains information on workers in about 1,000 plants employing a total of some 20,000 individuals in each year. The workers included in the sample change from year to year: newcomers are included and individuals having separated from the plant are excluded. The sample plants are selected from plants existing in both the first and the last year of the sample period 1980-87. Since each plant in IDA had the same probability of being drawn, workers in large plants are over-sampled.

The data for Finland are collected by the Confederation of Finnish Industry and Employers (TT) and cover full-time blue-collar and white-collar workers employed in TT-member firms. A large majority (some 75 per cent) of all private-sector manufacturing firms are members of the confederation, implying that the database is roughly representative of the private manufacturing sector. Cross-section data are available for three years: 1980, 1985, and 1990. After excluding observations with missing values the data contain 21,578, 23,495 and 21,501 individuals for the respective years. The results for Finland are based mainly on the 1985 data, which contain information on plant size. The data sets for 1980 (plant size) and 1990 (firm size) are used only occasionally for comparative purposes.

The data for Norway come from the 1989 Norwegian Study of Organisations and Employees (NSOE). The survey is conducted in co-operation by the Institute for Social Research and the Bureau of Statistics, Oslo. The data set covers a sample of 1,050

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[13] See further Section 7 below.

plants with a total of 4,494 employees, constructed to be representative of the Norwegian labour market.[14] A follow-up was performed four years later. This 1993 panel study included all employees interviewed in the 1989 study.

The data for Sweden come from the Level of Living Survey (LNU) for 1981 and 1991, conducted by the Swedish Institute for Social Research and Statistics Sweden (SCB), as well as from firm register data collected by SCB. The LNU data cover about 6,000 individuals representative of the Swedish population aged 18 or more.

5. Methodology

All data sets used contain register information on plant size measured as the exact number of persons employed in each individual plant. This allows estimation results to be reported for two alternative ways of measuring size-wage effects: one where plant size enters the wage equation as a continuous variable using the reported numbers of employees, and another where plant size enters as a categorial variable, i.e. as size-class dummy variables.

The basic wage equation estimated for all four countries is of the form

$$(1) \quad lnWAGE_i = \alpha_0 + \alpha_1 SCHOOLING_i + \alpha_2 EXPERIENCE_i + \alpha_3 (EXPERIENCE_i)^2$$

$$+ \alpha_4 SENIORITY_i + \alpha_5 WOMAN_i + \alpha_6 BLUE\text{-}COLLAR_i + \alpha_7 SIZE_i + u_i$$

$$N = 1, \ldots, i \qquad u_i \sim N(0, \sigma^2)$$

where *lnWAGE* stands for the log hourly wage of the ith individual, *SCHOOLING* for the total years of completed formal education, *EXPERIENCE* for the total years of work experience, and *SENIORITY* for the length (in years) of the current employment relationship. *WOMAN* and *BLUE-COLLAR* are dummy variable indicators for being, respectively, a female worker and a blue-collar worker. *SIZE* is defined either as the log of plant size or as a vector of plant-size dummies for five of the following six plant-size

[14] For details of sample construction, see Barth (1993).

intervals: less than 10, 10-49, 50-99, 100-499, 500-999, and 1000 or more employees.[15] As a curiosity it may be noted that this classification of plant size is roughly consistent with the official EU categorisation of firms into different sizes.

Apart from this basic wage model, we also run regressions for various extended models, the limits of which being dictated by the information on various plant size-wage relevant variables available in each national data set. Definitions of key variables used in the estimations are found in *Table A1* in the Appendix. Sample means for relevant variables broken down by size of plant categories are given in *Table A2* in the Appendix.

Most international studies report estimated coefficients for various size classes only, because information on the precise number of employees in each plant/firm is generally not available. It is worth pointing out that the data sets used in the present study do not involve the type of measurement error problems that arise when converting categorised employer-size data into a continuous size measure, a method that has been applied to several data sets used in other employer size-wage studies (e.g. in Brown and Medoff, 1989). According to the discussion in Evans and Leighton (1989), this procedure can potentially cause serious problems with respect to the precision of the estimates.

For the categorial size variable we merely report the weighted mean size-wage differentials calculated from the OLS estimates obtained for the various plant-size classes, assigning the value of zero to the omitted size class and using the percentage sample shares of the different size classes as weights. This yields a measure of the plant size-wage premium which is not dependent on the reference size class. Moreover, by weighting the reported size-wage differentials by their respective employment share, they are normalised with respect to the size distribution of plants and, therefore, comparable across the four countries under study.

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[15] As in most other empirical studies of the employer size-wage gap, workers are assumed to be randomly sorted across the different sizes of plants. Recently it has, however, been emphasized that employer size is not an exogenous variable but a decision variable based on an interaction between employer demand and workers' labour supply decisions. Idson and Feaster (1990) provide evidence for the US pointing to the presence of non-negligible self-selection of workers into firms of various sizes. In contrast, Main and Reilly (1993) found for the UK no evidence of non-random sorting of workers across plant size.

6. Estimation Results

We first report estimation results for the basic wage equation including standard human capital control variables (eq. (1) above). The basic wage model is thereafter supplemented with a broad set of other relevant wage-related explanatory variables in order to investigate the dependency of the observed employer size-wage gap on working conditions, monitoring, union density and bargaining. Two sets of interaction terms are also added: formal education interacted with size, and seniority interacted with size. Finally in this section, panel data are used to uncover the role of unobserved worker characteristics in explaining the observed size-related variation in wages.

6.1 Basic Results

Table A3 in the Appendix reports for each country the estimated plant-size elasticity as well as the plant size-wage premium for six different size intervals as calculated from the estimated size-class coefficients. The size-wage effects are obtained from estimating identically specified wage models for all four countries under study. Apart from plant size, the basic wage equation includes standard human capital variables (schooling, experience and its square, seniority), gender, and a blue-collar dummy (see eq. (1) above).

The size elasticity coefficient is obtained from regressing log hourly wages on log plant size and the aforementioned individual-specific variables. As can be seen from *Table A3*, the results point to a significant, strongly positive plant-size elasticity ranging from 0.045 for Denmark to 0.021 for Finland. Norway falls inbetween with a plant-size elasticity of 0.036. Most probably the Finnish estimate would have been closer to the Danish and Norwegian estimates, had the Finnish data covered the whole private sector instead of manufacturing only.[16] The coefficient for Sweden (0.015) is comparatively small, albeit statistically significant.

[16] As a digression of the Finnish results it may be noted that the plant-size elasticity estimated for 1980 amounts to 0.019 as compared to 0.021 for 1985. The difference in estimates is, however, not statistically significant. Accordingly, there seems to have been no clear increase in the dispersion of wages across different-sized plants in Finnish manufacturing in the early 1980s. The employer-size elasticity estimated for 1990, in turn, refers to firm size and is of the magnitude 0.024 and significantly higher than the plant-size elasticity for 1985. This points to a slightly larger dispersion of wages across firms than across plants of different size. Whether firm size or plant size is more important remains, though, an open question. Empirical evidence for the US indicates that both measures of employer size have substantial wage effects, see e.g. Mellow (1982), Brown and Medoff (1989), Rebitzer and Robinson (1991), and Even and

Table A3 also gives the plant size-wage differentials for the six size classes considered. The figures reported in the table show the percentage deviation of the wage level in each plant-size category from the average wage level calculated as the employment-weighted mean of the estimated plant-size dummy coefficients (times 100). These size-wage differentials may be interpreted as the "wage premium" of a person working in a plant of the given size relative to an average employee in the labour market.

As shown in *Figure 1*, Norway and Denmark display a fairly similar pattern of wage differentials across different-sized plants. In particular, there is a sharp rise in average pay in these two countries when shifting from plants with less than 10 employees to plants with between 10 and 49 employees; the wage increases by about 10 per cent on average over this interval. Thereafter follows a relatively flat interval, succeeded by an additional wage increase in plants with more than 100 (Denmark) and 500 (Norway) employees.

The results for Finland point to less pronounced size-wage differentials among the smallest plants. In fact, it seems that only very large plants pay substantially more in Finland. Again it should, however, be emphasized that these results may at least in part be affected by the smaller coverage of the Finnish data set. For Sweden, the size-wage effects are in general very small, except for the largest plants (1,000 or more employees).

Table A4 in the Appendix reports the size-wage differentials obtained when also controlling for the individuals' industry affiliation. The figures reported are, in other words, estimated on the basis of within-industry variation only. Adding industry dummies to the basic wage model reduces the plant-size elasticity most notably in Denmark (from 0.045 to 0.038). The drop is much smaller for Norway (from 0.036 to 0.031) and negligible for Finland. For Sweden, on the other hand, the addition of industry dummies increases slightly the estimated plant-size elasticity (from 0.015 to 0.019). On the whole, though, the change in the estimated coefficients from including industry dummies is mostly small.

The estimation results obtained when further adding a regional dummy to the basic model specification already augmented with industry dummy variables are presented in *Table A5* in the Appendix. In Denmark, Finland and Sweden, the size-wage effects turn out to be approximately the same within regions. For Norway, the addition

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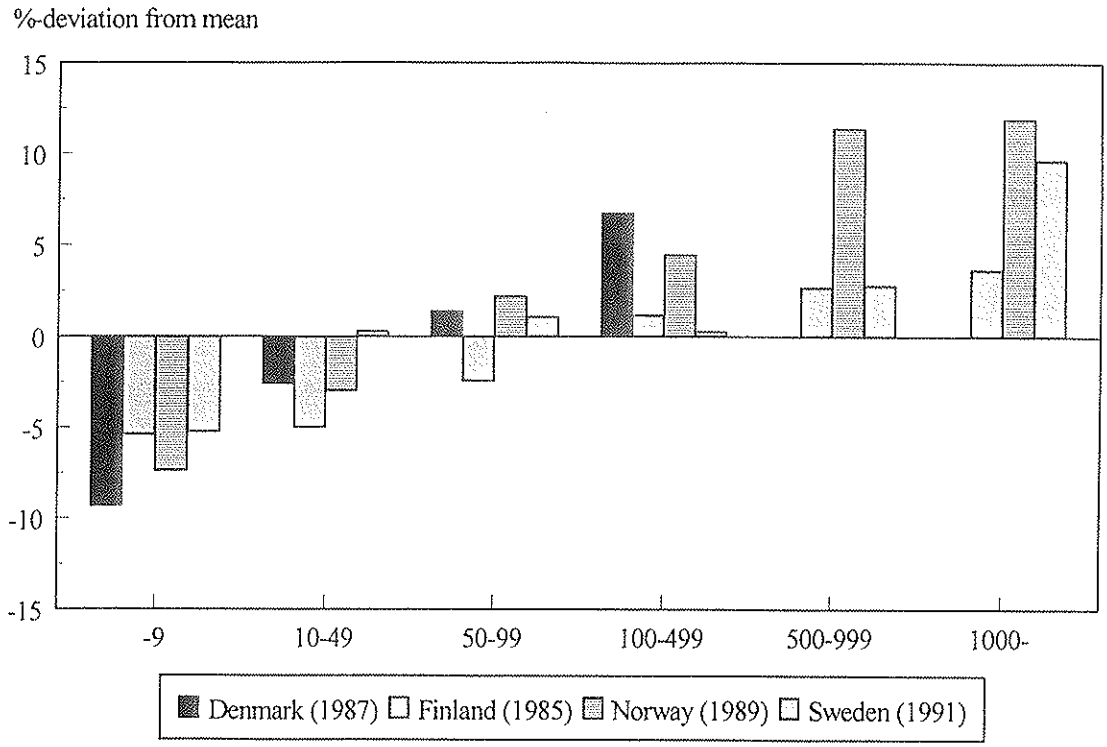
Macpherson (1994)). Unfortunately, none of the Nordic data sets allows joint investigation of firm- and plant-size effects on wages.

Figure 1. Employment-weighted mean differentials in log hourly wage levels between six plant-size categories after having controlled for human capital, gender and worker status, by country



Source: Table A3 in the Appendix.

of a regional dummy clearly reduces the estimated size-wage effects, except for plants with 500-999 employees. This points to Norway having more distinct local labour markets than the other three Nordic countries.[17]

We may thus conclude that the plant size-wage effects estimated for Denmark, Finland, Norway and Sweden arise to only a small extent within industries and regions; the overall difference in the estimated plant-size effects on wages between the four Nordic countries remains basically as displayed in *Figure 1* and in *Table A3* in the Appendix. Moreover, although dummy variables for region and industry affiliation do in part also control for variation in working conditions, we have more to say about that topic in subsection 6.3, where we include additional variables reflecting working conditions.

[17] A notable impact on wages of local labour markets in Norway is also reported by Dale (1994).

6.2 Human Capital and Plant Size

A potential explanation for the observed size-related variation in wages is that wage profiles are steeper in larger plants than in smaller plants. In this subsection we, therefore, explore the relationship between plant size and the reward to formal education. Possible variations in the seniority-wage profile across the different plant-size classes are also considered. A simple test of the hypothesis of differing returns to human capital in different-sized plants is done by interacting, first the schooling variable and then the seniority variable with the various plant-size variables introduced into the wage equation.

From the sample means (*Table A2* in the Appendix) it can be seen that the level of formal education is in all four countries fairly evenly distributed across the various plant-size categories. Large plants do no seem to be able to attract comparatively more workers with higher levels of education. *Table A6* in the Appendix, in turn, provides results on the estimated ***return to education*** across the various plant-size categories investigated. More precisely, the table reports the coefficients estimated for the schooling-plant size interaction terms added to the basic wage model.

For all four countries, a small negative interaction effect is obtained in the plant-size elasticity model. The estimated coefficient for the schooling-size interaction term is, however, significant for Denmark and Finland only. From the wage model including plant-size dummies we find, however, that very few of the interaction terms have a statistically significant coefficient. Moreover, the significant negative schooling-size interaction effect obtained for Denmark and Finland in the size elasticity model seems to be mainly due to a higher return on education in small plants. This finding of a smaller return to formal education in large plants contrasts sharply with evidence for the US pointing to a higher return to schooling in larger plants (Brown and Medoff, 1989, p. 1051). In contrast, evidence provided by Main and Reilly (1993) for the UK points to no significant differences in the estimated returns to education across different plant-size categories.

Allowing the estimated returns on education to vary across the different plant-size classes considered changes the estimated size-wage effects only marginally. It may, therefore, be concluded that differences in the level of and the reward to schooling across plants of different size do ***not*** contribute significantly to the explanation of the plant size-wage differentials observed in the Nordic countries.

Table A7 in the Appendix reports the estimated coefficients of the interaction terms for ***seniority*** and plant size. For Norway and Sweden there is no significant interaction between seniority and log plant size. In Denmark and Finland, on the other hand, there turns out to be a significant ***negative*** relationship between seniority and plant size. Closer inspection of the size dummy model reveals that these significant negative interaction effects originate in the larger plant-size categories. This finding of clearly steeper seniority-wage profiles in smaller than in larger plants in Denmark and Finland is undoubtedly somewhat surprising. In the present context, however, the main point to note is that differences in the seniority-wage profile across the various size categories are not the main rationale behind the observed plant size-wage differentials.

It is also worth noting that the average level of seniority is substantially higher in larger plants in both Norway and Finland (*Table A2* in the Appendix). In Sweden and particularly in Denmark, the variation in the length of seniority across different-sized plants is quite small.[18] It seems reasonable to conclude from this in combination with the results in *Table A7* that the higher level of seniority in larger plants in Finland and Norway is due to higher ***levels*** of wages in these plants ***rather than to steeper ladders***.

According to our results so far, differences across employer size in worker characteristics and in the reward to human capital can be excluded as major candidates for explaining the observed plant size-wage differentials in the Nordic countries.[19] We next turn to the role of differences in job characteristics in explaining the observed variation in wages across plants of different size.

6.3 Equalising Differences

We have estimated wage equations supplemented with a host of variables reflecting working conditions. *Table A8* in the Appendix accounts for the various working condition variables added to the basic wage model augmented with industry and region dummies (i.e. the wage model estimated in *Table A5* in the Appendix).

The inclusion of various job-related variables, many of which were significant and fairly large in magnitude, did little, if anything, to modify the estimated plant size-wage

[18] The data on seniority are self-reported in Finland, Norway and Sweden while taken from registers in Denmark.

[19] This finding of only marginal differences in the evaluation of formal education and seniority by different-sized employers contrasts sharply with the evidence reported by Idson and Feaster (1990) and Pearce (1990) for the US.

differentials. The plant-size elasticity changed from 0.020 to 0.021 for Finland, from 0.025 to 0.024 for Norway, and from 0.017 to 0.019 for Sweden (cf. *Tables A5 and A8*). Information on working conditions is not available in the Danish data.

Also the size-wage premiums calculated from the plant-size dummy model were roughly unchanged when controlling for different aspects of the working environment. This is a remarkable outcome in view of the broad set of highly different working conditions variables available in each national data set. It might, though, be of interest to note that the Finnish results point to a slightly stronger concentration for bad working conditions and fringe benefits to plants with 100 employees or more.[20] This finding for Finland lends weak support of the by now stylized fact for the US that fringe benefits tend to rise with employer size (cf. Brown and Medoff (1989) and Brown et al. (1990)).

It is, of course, always possible to argue that there are other unobserved job characteristics present in larger plants. We think, nevertheless, that it is fair to conclude that differences in working conditions and employment relationships offer, at most, only part of an explanation for the observed size-wage effects across Nordic plants. In other words, the estimating results provide only weak, if any, support of the hypothesis that working conditions are on average worse in large plants than in small plants in the Nordic countries.

6.4 Monitoring is More Difficult in Larger Plants

As indicated in the theoretical review, this hypothesis seems reasonable and may provide some rationale for larger plants paying higher wages. We know from previous studies on Sweden and Norway that autonomy and monitoring difficulties are positively correlated with higher wages (Arai, 1994a and 1994b; Barth, 1994). The data sets applied in the studies by Arai and Barth are the same as the ones used in the present study. Accordingly, measures of monitoring and autonomy can be added to the wage regressions for Norway and Sweden, but unfortunately not for Denmark and Finland.

The wage equation for Sweden is augmented with several monitoring-related variables. One variable indicates the degree of autonomy defined as whether or not the worker can set his own working hours and workpace. Another variable measures the degree of supervision constructed by asking individuals to rank according to a 5-level

[20] Information on fringe benefits is only available for Finland.

scale the degree to which their work effort is supervised. Apart from this, controls for the employers' possibility of monitoring the output and various interaction terms were also added to the wage equation.

In addition to a dummy for supervisory position and a variable accounting for the number of subordinates, the following monitoring variables were added to the Norwegian wage equation. Control 1 is a dummy taking a value of 1 if the employee has reported that it is difficult for his supervisor to assess the quality of his work. Control 2 is a dummy taking a value of 1 if the employee has reported that it is difficult for his supervisor to assess the quantity of the work being done. In addition, an interaction variable is also included, taking a value of 1 if the worker has reported that he is able to plan his own day (autonomy in *Table A9* in the Appendix) ***and*** that his work is difficult to control in the aforementioned 'Control 1-Control 2' dimensions. It may be noted that this latter monitoring measure turned out to have a significant and fairly large impact on Norwegian wages (8 - 9 per cent).

The overall impression mediated by the Norwegian and Swedish results is that the inclusion of monitoring indicator variables does not affect the estimated plant size-wage differentials in any noticeable way. When compared to the results obtained in the previous subsection (6.3), the coefficient of the log plant-size variable changes only marginally, from 0.024 to 0.025 for Norway and from 0.019 to 0.020 for Sweden (cf. *Tables A8 and A9* in the Appendix).

It may also be of interest to note that the degree of autonomy does not turn out to be higher in larger plants (cf. *Table A2* in the Appendix). On the contrary, the highest degree of autonomy is found in small plants. The various monitoring-related control variables included in the estimated wage equation thus seem to outweigh this effect. Moreover, the interacted variable (control times autonomy) is fairly evenly distributed across the different plant-size classes considered. The Norwegian data further indicate that the hierarchical structure of large plants (there is about the same intensity of supervisors in large and small plants) ensures some monitoring in larger plants.

Having now exhausted the four national data sets with respect to individual and job characteristics without having been able to reduce significantly the observed variation in wages across different-sized plants, it seems reasonable to assume that plant characteristics underlie the observed size-wage differentials. One particular candidate is union density and the bargaining framework.

6.5 Union Density and Bargaining

Barth et al. (1995) report results indicating that the union density of a plant/firm rather than individual union membership, influences wages. Union density affects the unions' ability to incur losses on the plants during a conflict. We know that union density increases with plant size (see *Table A2* in the Appendix), which makes this a plausible candidate for the elimination of the observed plant size-wage differentials.

Table A10 in the Appendix reports the plant-size elasticity and the size-wage premiums obtained from estimating a model including the union density of the plant. Information on union density is available for Denmark (calculated from registers) and Norway (number of unionized members as reported by the top management divided by the number of persons working in the plant).[21] For Norway union density is further interacted with a manufacturing dummy. Apart from this interaction variable and the variables of the most extended wage model discussed above, the Norwegian wage equation is also supplemented with dummy variables reflecting the bargaining framework (individual agreements only and centralised collective agreements only, with firm-specific collective agreements being the reference group).

The introduction of union density causes a minor drop in the plant-size elasticity: from 0.025 to 0.024 in Norway, and from 0.037 to 0.030 in Denmark. Clearly union density is not the "hidden explanation", albeit the variable in itself produces significant wage effects in both countries.[22]

6.6 Unmeasured Individual Heterogeneity

In the previous sections we have tested for various interactions between a broad set of observed worker and job characteristics and two types of plant-size measures using national cross-section data sets. A main finding was that the estimated plant size-wage effect turned out to be minor in Sweden and, in fact, significantly smaller than in the other three Nordic countries under study.

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[21] For Norway both union membership and union density refer to membership in the dominant union of the plant (LO, AF, YS or other).

[22] In view of these findings it is of interest to note that e.g. Davis and Haltiwanger (1994) find no evidence for the US of unionism influencing the relationship between employer size and wages. Similarly, Idson and Feaster (1990) restricted their analysis of the employer size-wage effect in the US to non-union males because they found no significant employer size-wage differential among unionized workers.

This may add to our understanding of the much larger plant size-wage differentials estimated for Denmark, Finland and Norway. In particular, it seems that we may rule out differences in observable individual characteristics, such as formal education and work experience, as a major explanation for the size-related variation in wages observed across Nordic plants. If size differentials in measured labour quality had been an important explanation, we would have expected substantial size-wage differentials to appear in Sweden as well; there is no reason to expect Swedish workers to be less mobile than workers in the other Nordic countries.

In order to provide an even better test of the individual heterogeneity hypothesis, we also report results from panel data estimations. More precisely, in order to test the hypothesis whether unmeasured individual heterogeneity is the main reason behind our size-wage effects, we have estimated fixed effect models from panel data for those countries for which this is possible, that is, for Norway and Sweden.

A neoclassical explanation for the estimated positive relationship between employer size and wages is the hypothesis of a more frequent use of pay compensations for unobserved working conditions and/or unobserved worker abilities in large plants/firms. Given that these unmeasured characteristics are constant over time, a fixed effect estimation will control for them and thereby provide consistent measures of the plant size-wage gap. Put differently, by using a fixed effect model we can effectively sweep out all fixed unobserved individual heterogeneity and thus restrict our plant size-wage gap to depend only on individual variation over the time period under study. This means, *inter alia*, that the variation in the plant-size variable will arise from two sources only: from growth of the organisation within which an individual works and/or from individual shifts between plants.

For Norway, the fixed effect model produces a plant-size effect on wages that slightly exceeds half of the size-wage effect estimated from the cross-section data; the size-wage elasticity estimated from panel data amounts to 0.011 with a t-value of 1.86. Individual heterogeneity thus seems to be one of the key factors behind the Norwegian plant size-wage differential, albeit not the only one.

The results for Sweden estimated from panel data point to the absence of a significant plant size-wage gap (the coefficient estimate is 0.005 with a t-value of 0.96). In other words, the very small but, nevertheless, significant plant size-wage differential obtained for Sweden with cross-section data disappears when controlling for unmeasured individual heterogeneity. The comparability of the panel data and the

cross-section data estimation results is, however, weakened by two circumstances. First, the panel data sample size is only about one-half of the cross-section data sample size. Second, because of the long panel (1981-91) and the consequent exclusion of the youngest age groups in the second year, the panel data cannot be taken to be representative of the underlying population. Accordingly the conclusion to be drawn is that the plant size-wage gap observed for Sweden ***may possibly*** be due to unmeasured time-invariant worker abilities.

7. Measurement Errors

The plant size-wage effects discussed in the previous sections are throughout based on register-type data on plant size as recorded in each of the national data sets used. In Denmark and Sweden, the information on plant size is taken from registers. In Finland and Norway, the plant-size data are employer-reported. In the Finnish data plant size has been reported by the administrative personnel at the plant, while in the Norwegian data plant size has been reported by the top management of the firm. A common feature thus is that none of the national data sets used comprises information on plant size reported solely by the employees. As noted earlier, the data sets used in most other studies of the employer size-wage gap contain merely employee-reported plant/firm size and, moreover, generally in the form of a size categorization instead of a continuous variable.[23]

It has occasionally been argued that the use of employee-reported employer size may give rise to more serious measurement errors than register data. The data sets used in the present study open a possibility to test the accuracy of this statement.

The Norwegian data comprise both register and manager-reported data. The register data refer to 1988 while the reported data are from 1989. Estimations with register data, on the one hand, and manager-reported data, on the other, yield almost identical results. This is, however, not surprising since the top management of a firm should know the actual size of their plant(s). Comparison of the two data sources thus seems to result in negligible measurement errors.

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[23] See e.g. Brown and Medoff (1989), Idson and Feaster (1990), Main and Reilly (1993), Morissette (1993), Rebick (1993), Davis and Haltiwanger (1994), and Even and Macpherson (1994).

The problem of measurement errors is probably more serious when it comes to the employees' self-reported employer size. This can be tested since the Swedish data contain both register and employee-reported plant size. The overall conclusion that can be drawn when comparing the estimations obtained for Sweden from using the two plant-size data sources is that employee-reported plant-size data do seem to produce less precise estimates due to more serious measurement errors.

8. Concluding Remarks

The purpose of this study has been to examine and compare the employer plant size-wage gap across the Nordic countries. This has been done using as comparable national data sets and variable definitions as possible. Also the years investigated have been chosen to be as close in time as possible.

Our results indicate that there is a positive significant plant size-wage effect in all four Nordic countries under study. The estimated size-wage effects are comparatively large in Denmark and Norway, slightly smaller in Finland and almost negligible in Sweden. The estimated size-wage effects for Denmark, Finland and Norway are, in fact, fairly close in magnitude to the size-wage effects reported by Brown and Medoff (1989) for the US.

Moreover, the plant size-wage effects estimated for the Nordic countries remain roughly unchanged even after controlling for a broad set of individual and job-related characteristics, such as observed labour quality, industry affiliation, region, working conditions and monitoring difficulties. Union density and wage bargaining institutions do not seem to be the "hidden explanation" behind the estimated plant size-wage differentials, either.

Estimations based on fixed effect models, however, seem to indicate that unmeasured individual heterogeneity contributes in part to the existence of a positive and significant plant size-wage gap. For Norway the estimated plant size-wage elasticity drops by about one-half when using first difference instead of traditional cross-section wage specifications. In Sweden, on the other hand, the very small, albeit statistically significant, plant size-wage effect obtained with cross-section data turns insignificant when estimating a fixed effect wage model. The fixed effect results for Sweden are,

however, not directly comparable with the results obtained with the cross-section data mainly because of a substantial difference in the two sample sizes and the impairment in the representativeness of the data caused by a long panel. Hence, the conclusion to be drawn is that the Swedish plant size-wage effect might be due to unmeasured worker abilities.

All in all, the results on the employer size-wage gap obtained for the Nordic countries are very similar to those obtained for other industrialized countries in the sense that even after controlling for a broad set of observed and unobserved worker and employer characteristics, a substantial wage gap remains between employers of differing sizes. Except for the labour quality hypothesis, the various theoretical explanations that have dominated previous research on determinants of the employer size-wage differential receive only minor, if any, support also in the empirical evidence obtained for the Nordic countires. Occasionally the inclusion of controls for non-wage working conditions even increases the estimated plant size-wage effects, albeit trivially. Moreover, comparison of the Nordic results with results obtained for other industrialized countries suggests that differences in labour market institutions across countries do not stand out as a key explanation of the observed employer-size effects on wages, either.

Although the reported empirical evidence on plant size-wage differentials across the Nordic countries undoubtedly adds to our knowledge of factors influencing the observed employer size-wage gap, what really underlies the unexplained wage differential remains unclear. This, in combination with the fact that the strong positive relationship between employer size and wages exists even in the absence of an institution with the main objective of raising the wage (like a union), clearly shows that much is still to be done in this particular research field of labour economics. Specifically, because of data limitations several interesting hypotheses related to the connection between employer size and wages are still largely unexplored.

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APPENDIX TABLES

Table A1. Definitions of key variables used in the estimations

Variable	Country-specific definitions
Hourly wage	Denmark: calculated from employer registers on contributions to the pension fund (ATP) and classified working hours. Finland: based on employer registers on monthly (white-collar) and quarterly (blue-collar) earnings divided by reported working hours in that same time period. The earnings for white-collar workers comprise the normal monthly wage and shift work and bonus payments. The earnings for manual workers are composed of hourly (= basic), piece-rate and bonus pay as well as compensation for shift, overtime and sunday work. Norway: calculated from self-reported wages divided by the relevant working hours. Sweden: self-reported earnings divided by self-reported hours. The self-reported information is compared and controlled with annual registers of earnings in tax rolls.
Schooling, total years	Denmark: register data. Finland: employer register data on the single highest education level completed. Norway: self-reported years of schooling. Sweden: self-reported years of schooling.
Experience, total years	Denmark: potential work experience calculated as age - schooling years - age of school start. Finland: potential work experience calculated as age - schooling years - age of school start. Norway: self-reported years of work experience. Sweden: self-reported years of work experience.
Seniority, length in years of the current employment relationship	Denmark: register data. Finland: information available for white-collar workers only, for which reason it is used solely in interaction with a white-collar worker dummy. Norway: self-reported. Sweden: self-reported.
Plant size	Denmark: register data. Finland: employer-reported data. Norway: register and manager-reported data. Sweden: register and employee-reported data.
Region	In all four countries dummy variables for urban areas.
Industry	In all four countries 2-digit ISIC industry dummy variables.
Working conditions	The dummy variables used are explained in the text and in *Table A8* below.
Monitoring	The dummy variables used are explained in the text and in *Table A9* below.
Union, bargaining	The dummy variables used are explained in the text and in *Table A10* below.

Table A2. Sample mean statistics - private-sector employees.*

Variables	Plant size (number of employees)						
	1-9	10-49	50-99	100-499	500-999	1000+	Total
Nominal hourly wage:							
Denmark (1987), DKR	102.57	109.73	113.33	120.08	-	-	112.54
Finland (1985), FIM	42.04	40.39	39.85	41.61	44.38	46.13	41.91
Norway (1989), NOK	77.36	79.70	86.73	91.52	104.54	101.38	85.81
Sweden (1991), SKR	78.99	83.43	85.80	85.27	90.37	94.12	84.03
Education, years:							
Denmark	10.69	10.92	10.90	10.94	-	-	10.89
Finland	11.09	11.02	10.88	10.90	11.23	11.47	11.01
Norway	11.09	10.88	11.27	11.26	12.26	11.34	11.13
Sweden	11.00	11.10	11.07	11.30	11.32	10.90	11.11
Experience, years:							
Denmark	13.95	13.40	14.65	15.34	-	-	14.23
Finland	15.69	16.84	17.50	18.15	18.08	16.09	17.70
Norway	15.22	15.82	15.82	18.11	16.84	19.45	16.86
Sweden	16.99	18.09	19.05	18.40	19.67	18.31	18.41
*Seniority, years:***							
Denmark	4.95	4.51	4.67	4.91	-	-	4.70
Finland	8.05	10.05	12.00	12.20	12.40	11.38	11.57
Norway	6.39	7.61	8.01	9.79	9.51	11.76	8.58
Sweden	6.73	7.48	10.40	10.28	11.74	12.01	9.77
Gender (woman=1):							
Denmark	0.36	0.33	0.31	0.26	-	-	0.31
Finland	0.41	0.36	0.37	0.38	0.34	0.24	0.36
Norway	0.46	0.40	0.39	0.34	0.28	0.22	0.37
Sweden	0.42	0.35	0.35	0.39	0.33	0.32	0.36
Blue-collar worker (=1):							
Denmark	0.43	0.46	0.53	0.62	-	-	0.51
Finland	0.33	0.59	0.73	0.72	0.66	0.63	0.68
Norway	0.27	0.39	0.36	0.45	0.42	0.50	0.41
Sweden	0.51	0.56	0.51	0.54	0.52	0.55	0.53
Region (urban area=1):							
Denmark	0.21	0.24	0.21	0.19	-	-	0.22
Finland	0.31	0.30	0.27	0.34	0.53	0.45	0.35
Norway	0.35	0.33	0.46	0.40	0.30	0.84	0.40
Sweden	0.47	0.52	0.52	0.59	0.61	0.57	0.55

Table A2. (cont.)

Variables	Plant size (number of employees)						
	1-9	10-49	50-99	100-499	500-999	1000+	Total
Supervisory:							
Norway	0.34	0.33	0.37	0.33	0.35	0.35	0.34
*No. of subordinates:****							
Norway	1.74	2.84	5.01	4.63	14.84	10.43	4.34
Autonomy:							
Norway	0.50	0.45	0.49	0.43	0.44	0.42	0.46
Sweden	0.44	0.32	0.19	0.16	0.15	0.12	0.23
Control · Autonomy:							
Norway	0.07	0.05	0.06	0.06	0.08	0.07	0.07
Sweden	0.013	0.007	0.015	0.003	0.016	0.000	0.01
Union membership:							
Norway	0.15	0.35	0.38	0.50	0.57	0.65	0.40
Union density (plant):							
Denmark	0.66	0.70	0.81	0.87	-	-	0.76
Norway	0.20	0.31	0.38	0.40	0.42	0.37	0.36
Collective agreement:							
Norway	0.59	0.76	0.83	0.85	0.80	1.00	0.77
Local collective bargaining:							
Norway	0.44	0.49	0.59	0.65	0.72	0.75	0.66
No. of observation:							
Denmark	1534	5954	2141	4024	-	-	13653
Finland	355	3442	3646	11195	2671	2186	23495
Norway	391	862	251	487	91	224	2306
Sweden	198	409	194	281	59	51	1192

* The figures for Finland refer to private-sector manufacturing. The Danish data include workers from plants with less than 500 employees only.

** The Finnish figures refer to white-collar workers, since information on seniority is not available for blue-collar workers. The information on seniority for Denmark is censored at 8 years.

*** This variable takes the value of zero for non-supervisors. Multiplying by three roughly gives the average number of sub-ordinates per supervisor.

Table A3. Employer size-wage effects: basic human capital model. Dependent variable is log hourly wage.

	Denmark (1987)	Finland[1] (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.045*	0.021*	0.036*	0.015*
	(.003)	(.001)	(.003)	(.004)
S.e.	0.369	0.197	0.246	0.238
R^2 adj.	0.335	0.582	0.442	0.425
Plant-size dummies[2]				
1-9	-9.34	-5.24	-7.40	-5.27
10-49	-2.63*	-5.00	-3.02*	0.28*
50-99	1.38*	-2.48*	2.18*	1.09*
100-499	6.71*	1.17*	4.45*	0.29*
500-999	-	2.67*	11.36*	2.77*
1000+	-	3.65*	11.92*	9.64*
S.e.	0.370	0.197	0.246	0.237
R^2 adj.	0.331	0.582	0.439	0.427
Sample size	13653	23495	2306	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, and blue-collar.

[1] The data for Finland comprise manufacturing only.
[2] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each plant-size class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

Table A4. Employer size-wage effects: within-industry effects. Dependent variable is log hourly wage.

	Denmark (1987)	Finland[1)] (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.038*	0.021*	0.031*	0.019*
	(.003)	(.001)	(.003)	(.004)
S.e.	0.362	0.184	0.238	0.231
R^2 adj.	0.358	0.636	0.478	0.457
Plant-size dummies[2)]				
1-9	-7.47	-4.17	-7.66	-5.48
10-49	-2.44*	-4.27	-2.21	0.54*
50-99	2.29*	-2.56*	3.54*	1.38*
100-499	5.24*	0.73*	3.77*	0.76*
500-999	-	2.40*	9.54*	3.67*
1000+	-	4.99*	10.55*	12.31*
S.e.	0.628	0.184	0.238	0.231
R^2 adj.	0.356	0.636	0.478	0.459
No. of industry dummies	22	9	22	23
Sample size	13653	23495	2306	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, and industry (2-digit ISIC dummies).

[1)] The data for Finland comprise manufacturing only.

[2)] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each plant-size class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

Table A5. Employer size-wage effects: within-industry and region effects. Dependent variable is log hourly wage.

	Denmark (1987)	Finland[1] (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.037*	0.020*	0.025*	0.017*
	(.003)	(.001)	(.004)	(.004)
S.e.	0.361	0.183	0.236	0.229
R^2 adj.	0.363	0.638	0.486	0.463
Plant-size dummies[2]				
1-9	-7.23	-3.91	-6.88	-5.48
10-49	-2.40*	-4.11	-1.60*	0.21*
50-99	2.31*	-2.40*	2.78*	1.25*
100-499	5.08*	0.75*	3.64*	0.72*
500-999	-	1.99*	11.96*	2.92*
1000+	-	4.83*	6.75*	11.22*
S.e.	0.361	0.183	0.235	0.229
R^2 adj.	0.332	0.638	0.489	0.465
Sample size	13653	23495	2306	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, industry (2-digit ISIC dummies) and region.

[1] The data for Finland comprise manufacturing only.

[2] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each plant-size class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

Table A6. Education and employer size-wage effects: interaction terms. Dependent variable is log hourly wage.

	Denmark (1987)	Finland[1)] (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.123*	0.032*	0.052*	0.019*
	(.014)	(.008)	(.016)	(.018)
Ln(plant size) · years of schooling	-0.0072*	-0.0010*	-0.0015	-0.0003
	(.001)	(.001)	(.001)	(.002)
S.e.	0.368	0.197	0.246	0.238
R^2 adj.	0.336	0.582	0.442	0.424
Plant-size dummies · years of schooling -interaction terms[2)]				
1-9 · schooling	-	-	-	-
10-49 · schooling	0.013*	0.012*	0.017*	-0.005
50-99 · schooling	-0.007	0.012*	0.003	0.004
100-499 · schooling	-0.006	0.008	0.009	-0.005
500-999 · schooling	-	0.014*	-0.006	-0.002
1000+ · schooling	-	0.007	0.003	0.002
S.e.	0.369	0.197	0.246	0.231
R^2 adj.	0.333	0.582	0.439	0.458
Sample size	13653	23495	2306	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, and plant size.

[1)] The data for Finland comprise manufacturing only.
[2)] Coefficients and significance levels for (plant-size dummy · years of schooling) -interaction terms.

Table A7. Seniority and employer size-wage effects: interaction terms. Dependent variable is log hourly wage.

	Denmark (1987)	Finland[1] (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.079*	0.025*	0.035*	0.021*
	(.005)	(.001)	(.004)	(.006)
Ln(plant size) · seniority	-0.0071*	-0.0010*	-0.0001	-0.0006
	(.0009)	(.0001)	(.0003)	(.0004)
S.e.	0.368	0.197	0.246	0.238
R^2 adj.	0.337	0.583	0.442	0.425
Plant-size dummies · seniority -interaction terms[2]				
1-9 · seniority	-	-	-	-
10-49 · seniority	0.003	0.001	0.000	0.001
50-99 · seniority	-0.011*	0.000	0.002	-0.003
100-499 · seniority	-0.018*	-0.001	-0.003	-0.002
500-999 · seniority	-	-0.001	0.004	0.001
1000+ · seniority	-	-0.003*	0.003	-0.003
S.e.	0.369	0.197	0.246	0.231
R^2 adj.	0.334	0.583	0.441	0.458
Sample size	13653	23495	2306	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, and plant size.

[1] The data for Finland comprise manufacturing only.
[2] Coefficients and significance levels for (plant-size dummy · seniority) -interaction terms.

Table A8. Employer size-wage effects: controlling for working conditions. Dependent variable is log hourly wage.

	Finland[1] (1985) Model 1	Finland[1] (1985) Model 2	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.021*	0.020*	0.024*	0.019*
	(.001)	(.001)	(.004)	(.005)
S.e.	0.184	0.187	0.232	0.230
R^2 adj.	0.636	0.633	0.500	0.460
Plan-size dummies[2]				
1-9	-4.00	-4.00	-6.60	-5.90
10-49	-4.29	-4.09	-1.58*	-0.91*
50-99	-2.51	-2.50	2.22*	2.52*
100-499	0.66*	0.75*	3.75*	1.47*
500-999	2.43*	2.24*	11.27*	2.03*
1000+	5.23*	4.70*	6.63*	10.60*
S.e.	0.184	0.187	0.232	0.230
R^2 adj.	0.636	0.633	0.502	0.461
Dummies reflecting working conditions	-	-	17	11
Pay compensation included	+	-	+	-
Fringe benefits included	-	+	-	-
Industry dummies	+	+	+	+
Region dummies	+	+	+	+
Sample size	23495	23495	2282	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, industry (2-digit ISIC dummies), region, and working conditions. The variables reflecting working conditions are as follows:

Sweden: Exposure to noise, vibration, poison and solvents, dust as well as strenuous working posture, physically and psychologically demanding, punch card, individual and group piece-rate night, evening and holiday hours pay, and 15 occupation group dummies.

Norway: Supervisory position, number of subordinates, exposure to noise, vibration, heat, cold, draw, light, chemicals, dust, gas, solvents as well as strenuous working posture, temporary employment, part-time, shift work and autonomy (ability to plan ones own day).

Finland: In Model 1 pay compensation for bad working conditions is included in the wage variable. In Model 2 the money value of fringe benefits is added to the wage.

[1] The data for Finland comprise manufacturing only.

[2] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each plant-size class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

Table A9. Employer size-wage effects: controlling for monitoring. Dependent variable is log hourly wage.

	Denmark (1987)	Finland (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity			0.025*	0.020*
			(.004)	(.005)
S.e.			0.232	0.229
R^2 adj.			0.501	0.466
Plant-size dummies[1)]				
1-9			-6.75	-5.99
10-49			-1.54*	-1.05*
50-99			2.34*	2.69*
100-499			3.84*	1.58*
500-999			11.29*	2.14*
1000+			6.59*	10.73*
S.e.			0.231	0.229
R^2 adj.			0.503	0.467
Dummies for monitoring			+	+
Dummies reflecting working conditions			+	+
Pay compensation included			-	+
Industry dummies			+	+
Region dummies			+	+
Sample size			2282	1192

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, industry (2-digit ISIC dummies), region, working conditions, and monitoring. The dummies reflecting working conditions are explained in *Table A8* above. The dummies reflecting monitoring are as follows:
Sweden: Autonomy is measured as the possibility of setting one's own working time and work pace. Monitoring is measured as being directly supervised.
Norway: Autonomy indicators: difficult to control quality of work, difficult to control quantity of work, and an interaction term between the two control variables and autonomy (see text).

[1)] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each -plantsize class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

Table A10. Employer size-wage effects: controlling for union. Dependent variable is log hourly wage.

	Denmark (1987)	Finland (1985)	Norway (1989)	Sweden (1991)
Plant-size elasticity	0.030*		0.024*	
	(.003)		(.005)	
S.e.	0.356		0.219	
R^2 adj.	0.379		0.499	
Plant-size dummies[1)]				
1-9	-6.17		-4.30	
10-49	-1.81*		-3.10*	
50-99	1.42*		2.02*	
100-499	4.27*		3.39*	
500-999	-		9.84*	
1000+	-		7.75*	
S.e.	0.357		0.218	
R^2 adj.	0.378		0.501	
Union density	+		+	
Union membership	-		+	
Bargaining framework	-		+	
Dummies for monitoring	-		+	
Dummies reflecting working conditions	-		+	
Industry dummies	+		+	
Region dummies	+		+	
Sample size	13653		1526	

Notes:
Standard errors are in parentheses. Other variables included are: schooling, experience, experience squared, seniority, gender, blue-collar, industry (2-digit ISIC dummies), region, working conditions, monitoring, union, and bargaining. The dummy variables reflecting working conditions and monitoring are explained in *Tables A8 and A9* above. The union and bargaining variables are as follows:
Denmark: Share of workers in the plant who are members of the unions' unemployment-inurance funds.
Norway: Union density and its square, for firms with bargaining, both interacted with a manufacturing dummy. Individual union membership. Dummies for central agreement only and no collective agreement in firm, the reference group being collective bargaining at firm level.

[1)] Deviations from the employment-weighted mean of the log hourly wage. The weights used are the sample shares of each plant-size class. Coefficients marked with a "*" are significantly different from the coefficient for the lowest plant-size class, i.e. less than 10 employees (reference class in the estimations and consequently not to be marked as significant).

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