Chapter 8

Employer Wage Differentials in the United States and Denmark

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1. Introduction

A growing body of empirical evidence indicates that the characteristics of both workers and employers are important determinants of equilibrium wages. In recent years empirical studies of wage determination have been greatly enhanced by access to matched employer-employee data sets. Most of the empirical studies analyzing these matched data sets use samples from European countries such as Denmark, Finland, France, Germany, the Netherlands, Norway, and Sweden.[1] Many of these data sets have been created by matching administrative records of workers and firms that contain extremely valuable information about the relationships among wages, turnover, and worker and employer characteristics in each of these countries. Although there are a number of important and innovative studies using matched employer-employee data sets in the United States, studies using U.S. data have been limited by a lack of nationally representative random samples of worker-employer matches.[2]

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[1] See, for example, Bingley and Westergard-Nielsen (1996); Ilmakunnas et al. (1998); Abowd, Kramarz and Margolis (1994); Stephan (1998); Gautier et al. (1998); Haegeland and Klette (1998); and Persson (1998).

[2] Most of the early studies using U.S. data have used industry wage differentials as a proxy for firm wage effects. These studies include: Gibbons and Katz; Helwege; Katz and Summers; Keane; Krueger and Summers; and Murphy and Topel. Important exceptions are the U.S. studies of Groshen (1991), which has limited individual demographic information (sex and occupation), and Troske (1993 and 1998), which use a sample of manufacturing workers who can be linked to a manufacturing plant through geographic information. Troske's studies cannot link workers to any employer located near another employer in the same detailed industry. A key limitation of this type of geographic matching is that many employers in the same industry are located near each other because of agglomeration effects (or easier access to key suppliers of inputs) and are systematically excluded from the matched sample.

Researchers and public policy analysts in the United States would like to apply the insights gained from empirical analyses of European matched data sets to studies of the U.S. labor market. The first step in this process is to determine which features of the empirical distribution of wages and which aspects of the relationships among worker characteristics, employer characteristics, and wages are common across countries, and which empirical findings are dissimilar across countries. This paper presents a detailed empirical analysis and comparison of two matched employer-employee data sets from the United States and Denmark. We use identical empirical methodologies to analyze the distribution of wages and employer wage differentials, and to quantify the correlations among key components of wages in both the United States and Denmark. Although there are a number of differences in the labor market institutions in the two countries, the results of our cross-country comparison are very important given the limitations of existing U.S. matched worker-employer data.

A primary focus of this paper is to compare the distributions of estimated employer wage differentials, conditional on worker characteristics, in the United States and Denmark. We find that although there is considerably more wage dispersion in the United States than in Denmark, the standard deviation of conditional employer wage differentials for white-collar workers are virtually identical in both countries. Thus conditional employer wage differentials are *relatively* more important in wage determination in Denmark.

A second goal is to examine the magnitude of the correlation between wages and tenure both within and across employers, and to measure the dispersion in employer wage effects after controlling for job tenure. Employer wage differentials may reflect different specific human capital investments across worker-firm matches. If job tenure is a good proxy for specific human capital, there could be a substantial correlation in average wages and tenure within and across employers, and conditioning on job tenure could substantially affect the measured amount of dispersion in employer wage differentials. We find, however, that the dispersion and correlation structure of employer wage differentials in both the United States and Denmark is essentially the same whether or not we control for job tenure in our analysis. Thus, there is little evidence that employer wage differentials merely proxy for specific human capital investments. The most salient cross-country difference we observe is that in the United States, high-wage employers tend to have high-tenure workers, while in Denmark high-wage establishments tend to employ workers with the same or lower tenure than other employers, all else equal.

Some of the empirical work in this paper extends the analysis of Bronars and Famulari (1997), who established some important empirical facts about the conditional employer wage and tenure differentials of white-collar workers in the United States. A limitation of this earlier study is that it used a data set with no information about the wages, employment, or demographic characteristics of blue-collar workers. Therefore, an important component of this paper is the comparison of the

structure of wages across white- and blue-collar workers in addition to our cross-country comparisons of results.

One of the most compelling theoretical explanations for inter-employer and inter-industry wage differentials is team production or the presence of skill complementarities in production (see Kremer 1993, or Rosen 1982). If production processes exhibit these complementarities, the most skilled and talented managers would sort into the same firms that employ the most skilled office workers and most skilled production workers. This sorting occurs because any team member is capable of substantially lowering the quantity or quality of the team's output. Therefore, the cost of a mistake (foregone output) by a low-quality worker at any stage of the production process is high if other team members are highly skilled.

In this type of team production model, firms segregate workers on the basis of their observed and unobserved (to the econometrician) skills. Firms that produce high-quality output attract the relatively most skilled workers in each occupation, and because many components of skills are unobserved to the econometrician, high-quality-output firms appear to pay higher wages, all else equal. The team production model predicts that both employer wage differentials and observed measures of worker skills should be significantly positively correlated across occupations. Bronars and Famulari tested these hypotheses across broad occupation groups within white-collar occupations and found strong evidence in favor of the team production model. The result that there are important skill complementarities among managers, professionals, and their clerical and support staff is perhaps unsurprising. Although these workers have different occupational titles (e.g., chemist and lab technician, lawyer and legal secretary), they are likely to be working together on the same tasks in the same office environment.

In this paper we measure and test the correlation in employer wage differentials and average skills across white-collar and blue-collar occupations. These comparisons provide a much more stringent test of the team production model. In fact, we find strong empirical evidence in the Danish data that wage differentials and measured skills are significantly positively correlated between white-collar workers in the establishment's office and blue-collar workers on the factory floor. We find evidence that production complementarities extend beyond groups of workers who interact in performing their daily job tasks. Our results are consistent with the hypothesis that white-collar managers and professionals affect the productivity of blue-collar workers on the production line, not by direct contact or interactions, but by efficiently directing and managing the firm's resources.

2. Data

The U.S. Data

Our U.S. data set is based on a supplement to the Bureau of Labor Statistics' (BLS's) White-Collar Pay Survey (WCP) conducted in 1989 and 1990. The purpose of the WCP is to obtain accurate straight-time wages of full-time workers in narrowly defined occupations in private-sector establishments.[3] The straight-time wage excludes pay for overtime, performance bonuses, profit sharing, and tips, and the BLS converts all wages into monthly rates of pay. BLS employees visit establishments in person and obtain wage, hours, and earnings data from payroll or other records. The BLS defines an establishment as an economic unit generally at a single physical location, where business is conducted or services are performed. A firm may consist of one or more establishments. The WCP samples goods-producing establishments in even-numbered years and service-producing establishments in odd-numbered years. The probability that an establishment is sampled is approximately proportional to its employment.[4]

In a test survey conducted in 1989 and 1990, 354 establishments in the full WCP were asked questions about a random sample of their employees in "matched" white-collar occupations. Employers were asked to report matched workers' starting pay, age, race, sex, years of education, highest educational degree obtained, and tenure with the employer, in addition to the usual current wage, hours, and occupation information. Our primary data set contains information on 1,681 workers in the 241 establishments that report information for multiple workers.[5] The mean establishment reported information for 6.98 workers. The median worker in our primary sample has 9 coworkers in the pilot survey.

A possible concern with the subset of the WCP used in this paper is that the sample is not representative of the population of white-collar workers in the United States. Bronars and Famulari (1997) assessed this potential problem by comparing the WCP sample of 1,681 workers with a Current Population Survey (CPS) sample

[3] The WCP occupations are those that are similar to occupations in the federal sector: accountant, chief accountant, auditor, public accountant, personnel specialist, personnel supervisor/manager, director of personnel, attorney, buyer, computer programmer, computer systems analyst, computer systems analyst supervisor/manager, chemist, engineer, tax collector, registered nurse, licensed practical nurse, nursing assistant, medical machine operating technician, civil engineering technician, engineering technician, drafter, computer operator, photographer, accounting clerk, file clerk, key entry operator, messenger, secretary, typist, personnel clerk/assistant, purchasing clerk/assistant, and general clerk.

[4] See the BLS *Handbook of Methods* (April 1998) for a complete description of this survey.

[5] Establishments were asked to report demographic data for a total of 2,386 workers. In the pilot survey, 570 observations were excluded because of missing age and education variables. Another 76 observations were excluded for missing race or tenure variables, or because age, tenure, or experience variables fell outside valid ranges.

of white-collar workers in similar industries and occupations. They found that the WCP sample contains workers who earn 12.3 percent more, on average, than CPS workers. Observed differences in worker skills and demographic characteristics explain 5.9 percent of this wage differential. Wage differentials by worker demographic characteristics and measured skills are quite similar in both the WCP and CPS. The finding that WCP workers are more skilled and earn more than CPS workers is consistent with the notion that a typical WCP employer is larger and relatively more successful than the typical employer of a CPS respondent.

Bronars and Famulari also show that the variance of log wages is significantly higher in the CPS than in the WCP. Virtually all of the additional variation in log wages in the CPS is unexplained by worker characteristics or geographic or industry dummy variables. The explained variation in a standard log wage regression is quite similar across the WCP and CPS, but the overall R-squared of the regression is much higher in the WCP because the residual variation in log wages is substantially smaller. The empirical evidence is consistent with the conjecture that the straight-time pay per period reported by establishments is measured with considerably less error than the usual weekly wage reported by CPS respondents.

The sample design of the Danish data does not allow us to measure a worker's job tenure if his or her current job spell has lasted more than 11 years. To make the U.S. data comparable to our Danish cross-section for much of the empirical analysis to follow, we restrict our WCP sample to workers with job tenure of 11 years or less. This reduces our sample size to 1,165 workers in 209 establishments (with at least two workers per establishment).

The Danish Data

The Danish IDA Integrated Database for Labor Market Research data are based on a 5 percent sample of private-sector workplaces. A workplace is defined as a legally registered unit with a unique physical address. A number of workplaces belong to multiplant firms, but for 70 percent of the workplaces there is a one-to-one relation between workplace and firm. The sampling frame is workplaces with 5 to 500 primary employees in 1980, where a primary employee is defined as a worker whose main source of labor market earnings is attributed to this workplace. Each workplace is followed until 1991, with replacement of workplaces representative of workplace birth in the population. All primary workers are matched each year on the basis of their November employment. For this study we focus on the cross-section of workers and employers in the IDA in 1991. Workers are dropped from the sample if we do not observe a positive wage for them (about 7 percent of the sample), or if some of the demographic variables are invalid (about 5 percent of the sample). The 1991 IDA cross-section consists of 11,297 white-collar workers at 815 establishments (with at least two white-collar workers at each of these establishments) and 7,780 blue-collar workers at 599 establishments (with at least two blue-collar workers at each of these establishments).

One limitation of the IDA is that job tenure is not reported as one of the worker demographic variables. We therefore construct a subset of the primary IDA sample that includes only workers who become attached to an establishment in 1981 or later. For these workers we assume that job tenure with an establishment begins when we are first able to match a worker to a workplace. Workers who were already employed by an establishment in 1980 have a measure of job tenure that is left censored, because we do not observe when their job spell began. We delete these workers from much of the empirical analysis that follows. The remaining cross-section sample is composed of 9,328 white-collar workers at 749 establishments (with at least two white-collar workers at each of these establishments) and 6,655 blue-collar workers at 553 establishments (with at least two blue-collar workers at each of these establishments).

Comparison of Sample Statistics

Sample statistics (means and standard deviations) for the U.S. data are reported in the first two columns of table 1. Because of the sample design of the WCP, many of the workers in our primary data set are employed in large (500 or more employees) establishments. The Danish IDA sample is restricted to establishments with fewer than 500 employees, so for purposes of comparison we also present sample statistics for U.S. workers at these "small employers." Means and standard deviations for the Danish data are reported in the last two columns of table 1. Note that for both the U.S. and Danish data we include workers with more than 11 years of tenure.

The key dependent variables in our analysis are the logarithm of a U.S. worker's current monthly wage, measured in 1989 U.S. dollars, and the logarithm of a Danish worker's hourly wage, measured in 1991 Danish kroner. Note that the standard deviation of log pay for white-collar workers is about 20 to 25 percent higher in the United States than in Denmark. There is less than a 5 percent pay differential between mean pay for white-collar and blue-collar workers in Denmark, but the standard deviation of log pay is about 27 percent higher for white-collar workers relative to blue-collar workers in Denmark.

Job tenure is slightly higher in the U.S. data than in Denmark, but most of the differential probably results from the difference in mean employer size across samples. When we restrict our attention to U.S. workers in establishments of fewer than 500 employees, the difference in average tenure is only 0.187 years. Almost 21 percent of U.S. workers in our sample had been with their current employer for more than 11 years, and 17 percent of Danish white-collar workers in the 1991 cross-section were attached to the same employer when the IDA panel began in 1980.

The sex composition of white-collar workers is remarkably similar across the United States and Denmark: About one-half of white-collar workers in each country are female. Less than one-quarter of blue-collar workers in Denmark are female.

Table 1. Means and Standard Deviations (in parentheses)

	U.S. WCP		Danish IDA	
	All Employers	Small Employers	White Collar	Blue Collar
Monthly wage	2640.50	2443.30		
	(1204.70)	(1140.70)		
Hourly wage			148.65	137.18
			(63.61)	(42.25)
Log (wage)	7.777	7.693	3.834	3.730
	(0.457)	(0.471)	(0.383)	(0.297)
Tenure	4.284	4.021	3.834	3.730
	(3.113)	(3.005)	(2.796)	(2.816)
Log (tenure)	1.154	1.092	1.053	1.010
	(0.813)	(0.800)	(0.793)	(0.808)
Fraction tenure>11	0.291	0.209	0.170	0.140
	(0.455)	(0.407)	(0.376)	(0.347)
Female	0.468	0.489	0.490	0.231
	(0.499)	(0.500)	(0.500)	(0.421)
Black	0.071	0.046		
	(0.258)	(0.209)		
Other	0.083	0.084		
	(0.276)	(0.278)		
Potential experience	18.520	17.510	19.590	20.420
	(10.490)	(10.760)	(11.410)	(11.600)
Actual experience		14.160	13.600	
		(7.880)	(8.000)	
Age	38.980	37.730	38.250	37.540
	(10.250)	(10.650)	(11.010)	(11.600)
Education	14.460	14.220	11.660	10.110
	(2.180)	(2.110)	(2.440)	(1.230)
Observations per employer	12.100	6.760	58.920	58.410
	(6.610)	(4.120)	(70.620)	(60.830)
Number of workers	1681	654	11297	7780
Number of employers	241	140	815	599

Controlling for establishment size, the typical Danish white-collar worker is slightly older than his or her counterpart in the United States (by about one-half year) and has substantially more potential experience (which is defined as age-education-6 in the United States and age-education-7 in Denmark). Controlling for

establishment size, U.S. white-collar workers attend school 2.56 years more than Danish white-collar workers.[6] This sizable difference in mean educational attainment leads to an approximately two-year differential in potential experience across countries.

In Denmark, records from the mandatory labor market pension (ATP) administration can be used to construct measures of actual (rather than potential) years of labor market experience. ATP contributions are recorded beginning in 1964, so "actual experience" is actual experience from 1964 on, plus potential experience for any years before 1964. A comparison of mean actual and potential experience for white-collar workers in table 1 indicates that the typical worker was idle for 5.8 of the 19.6 years since leaving school. For blue-collar workers, the gap between actual and potential experience suggests that the typical blue-collar worker in Denmark was idle for 6.8 of the 20.4 years since leaving school.

In the empirical work below, we limit the sample of workers in both countries to those with 11 or fewer years of tenure with their current employer. Because of the relatively small sample size in the U.S. data, we include both large and small employers in the sample. The means and standard deviations for these restricted samples are generally similar to those reported in table 1: The average age and sex composition of workers is nearly identical across countries, and white-collar workers have significantly more education and less potential experience in the United States. The dispersion in white-collar pay is 15 percent higher in the United States, and within Denmark log pay dispersion is 25 to 30 percent higher for white-collar workers relative to blue-collar workers.

Figure 1 displays kernel density estimates of the log wage distributions for the samples of white-collar workers in the United States, and blue-collar and white-collar workers in Denmark with 11 or fewer years of tenure. It is apparent from figure 1 that there is considerably more log wage dispersion in the United States and that there are important differences in the kurtosis of the empirical log wage distributions. The Danish blue-collar log wage distribution has the thinnest tails, while the U.S. white-collar log wage distribution has the thickest tails. These differences can be quantified by noting that 66 percent of U.S. white-collar workers, 72 percent of Danish white-collar workers, and 77 percent of Danish blue-collar workers earn log wages within one standard deviation of the mean log wage.[7] Thus not only do Danish blue-collar workers have the smallest standard deviation of log wages, but disproportionately fewer of these workers are in the tails of the log wage distribution.

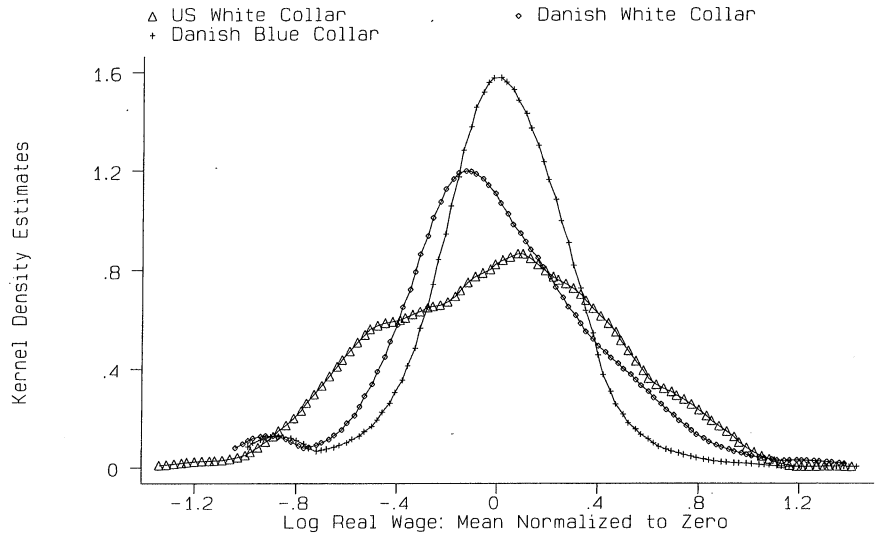
Figure 1 also indicates some differences in the skewness of the log wage distributions across samples. The log wage distribution in the United States is nearly

[6] Information on both highest degree attained and years of schooling completed were used to construct a measure of workers' educational attainment in the United States. In Denmark, data on highest degree attained was used to impute a measure of educational attainment in years.

[7] The fourth moments of the empirical distributions of log wages are 2.549 for U.S. white-collar workers, 3.633 for Danish white-collar workers, and 5.079 for Danish blue-collar workers.

symmetric, while there is right skewness in the Danish white-collar log wage distribution and left skewness in the Danish blue-collar log wage distribution.[8]

Figure 1. Log Wage Distributions in the U.S. and Denmark



3. Comparison of Inter-Industry Wage Differentials

Before turning to our analysis of employer wage differentials, it is instructive to first compare inter-industry wage differentials in the United States and Denmark. Consider the log wage regression given by:

$$\ln W_{ij} = X_{ij}\beta + Z_j\gamma + \delta_j + u_{ij} \quad (1)$$

where $\ln W_{ij}$ is the logarithm of worker i's current real wage in industry j, Xij is a vector of worker demographic characteristics, Z_j is a vector of region and/or city size dummy variables, δ_j is industry j's wage differential, and u_{ij} is an i.i.d. error term. The variables in X_{ij} include third-order polynomials in education and potential experience, and interactions between these polynomials and dummy variables for sex.[9] We consider an alternative specification of X_{ij} that includes tenure variables: a third-order polynomial in tenure and education, and interactions between a

[8] The third moments of the empirical distributions of log wages are −0.0215 for white-collar workers in the United States, 0.2397 for Danish white-collar workers, and −0.3761 for Danish blue-collar workers.

[9] In the WCP sample, we also include two race dummy variables for black and other.

female dummy variable and the polynomial terms in tenure and education. Although the preferred specification of X_{ij} is likely to depend on the question being addressed, we show below that our empirical results and cross-country comparisons are not sensitive to the inclusion of tenure variables in equation 1.

We estimate equation 1 for the U.S. and Danish data sets and present summary information from these log wage regressions in table 2. The first panel of table 2 presents the fraction of variance explained for several alternative specifications of the regression. Using all demographic variables and industry and location dummy variables, we explain 70 percent of the variation in log wages in the WCP, 43.4 percent of the variation in the Danish white-collar data, and 26 percent of the variation in the Danish blue-collar data. Note that in each of the three samples, excluding job tenure from the regression has a minor effect on the explanatory power of the regressions.

The second panel of table 2 presents the marginal variance explained by worker demographic characteristics, industry effects, and location effects.[10] There are substantial differences in the marginal explanatory power of demographic variables across samples. Demographic characteristics explain the highest fraction of wage variation for U.S. white-collar workers and explain the least for blue-collar workers in Denmark. There is a substantial difference across occupations in Denmark in the marginal explanatory power of worker characteristics: Demographic characteristics explain twice as much of white-collar log pay compared with the blue-collar regressions. In contrast, inter-industry pay differentials appear to be relatively most important for blue-collar Danish workers and least important for Danish white-collar workers.

$\ln W_{ij}$ can be decomposed into four components: an index of worker demographic characteristics, $X_{ij}\beta$; an industry wage effect, δ_j; a location wage effect, $Z_j\gamma$; and the log wage residual, u_{ij}. $X_{ij}\beta$ is the wage that worker i can be expected to receive in the mean industry and location in the sample, and can be viewed as an index of worker i's quality. Table 3 reports the standard deviation across workers of the worker quality index and log wage residual for all three samples. The standard deviations of the worker quality index are substantially different across samples. In contrast, the standard deviation of the log wage residual is quite similar across samples. It appears that the primary reason for the significant difference in wage dispersion across occupations and countries is the differences in the prices and

[10] The substantial difference in the "Fraction of Variance Explained" in the first panel of table 2 and the "Marginal Variance Explained" in the second panel of table 2 occurs because of the significant correlation among worker characteristics, industry fixed effects, and location fixed effects. The log wage residual is orthogonal with the other wage components by construction. "Fraction of Variance Explained" would be the R-squared of the log wage regression if the given set of explanatory variables were the only variables in the regression. "Marginal Variance Explained" is the difference in the R-squared of the log wage regression. This difference occurs by adding a given set of explanatory variables to a regression that already includes all the other explanatory variables. If all components of log wage variation were orthogonal, both panels of table 2 would be identical.

Table 2. Variance Decomposition of Log Wages by Worker Characteristics, Industry, and Location Dummy Variables

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Fraction of variance explained			
Worker characteristics, including tenure industry and location:			
R-squared	0.699	0.434	0.260
Adjusted R-squared	0.677	0.430	0.254
# of independent variables	81	61	62
Worker characteristics, excluding tenure industry and location:			
R-squared	0.680	0.431	0.257
Adjusted R-squared	0.660	0.428	0.251
# of independent variables	69	49	50
Industry dummy variables:			
R-squared	0.202	0.090	0.110
Adjusted R-squared	0.172	0.088	0.107
# of independent variables	42	22	23
Location dummy variables:			
R-squared	0.048	0.035	0.008
Adjusted R-squared	0.043	0.034	0.007
# of independent variables	6	8	8
Marginal variance explained			
Worker characteristics, including tenure, industry and location:			
R-squared	0.455	0.318	0.144
# of independent variables	33	31	31
Worker characteristics, excluding tenure, industry and location:			
R-squared	0.436	0.315	0.141
# of independent variables	21	19	19
Industry dummy variables:			
R-squared	0.058	0.018	0.065
# of independent variables	42	22	23
Location dummy variables:			
R-squared	0.014	0.024	0.006
# of independent variables	6	8	8

quantities of workers' skills. Differences in unobservables appear to play a minor role in explaining differences in overall wage dispersion across countries.

Table 3. Standard Deviations of Log Wage Components

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Standard deviations across workers			
Log wage	0.457	0.391	0.303
Worker characteristics, including tenure	0.324	0.245	0.125
Worker characteristics, excluding tenure	0.316	0.244	0.123
Residual, including tenure	0.246	0.294	0.260
Residual, excluding tenure	0.254	0.295	0.261
Standard deviations across industries			
Log wage	0.197	0.120	0.103
Average worker characteristics, including tenure	0.109	0.089	0.043
Average worker characteristics, excluding tenure	0.103	0.088	0.041
Industry effects	0.118	0.056	0.083

The bottom panel of table 3 presents standard deviations of wages, worker quality indices, and industry wage effects across industries. These across-industry standard deviations again show that industry wage differentials are about twice as important for white-collar workers in the United States as they are for white-collar workers in Denmark. The results also show that there are much smaller inter-industry differences in skills for blue-collar workers than for white-collar workers in Denmark.

Table 4 reports the correlations between industry wage differentials and indices of workers' skills. We are looking for evidence that workers sort across industries on the basis of their observed and unobserved skills. We again consider two different skill indices: one that includes job tenure variables and another that excludes tenure variables from X_{ij}. We present these results separately because a positive correlation between industry wage differentials and tenure is not necessarily evidence of worker sorting but may merely indicate that workers are unlikely to quit jobs in high-wage industries that offer rents. In all three samples, we find that workers with more highly valued demographic characteristics (whether or not we

view job tenure as a proxy for skills) are more likely to work in industries that pay higher wages, *ceteris paribus*.[11] The magnitude of the correlation is roughly similar for white-collar and blue-collar workers in Denmark, but the correlations in the U.S. data are about twice as large as those in Denmark's data. These sizable correlations in both countries and both occupation groups suggest that industries that use workers with high measured skills also employ workers with a relatively large endowment of unmeasured skills.

Table 4. Correlations of Wage Components

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Across workers			
Worker characteristics, including tenure, and industry effects	0.214	0.119	0.086
Worker characteristics, excluding tenure, and industry effects	0.205	0.118	0.105
Across industries			
Average worker characteristics, including tenure, and industry effects	0.643	0.334	0.256
Average worker characteristics, excluding tenure, and industry effects	0.635	0.332	0.319

4. Comparison of Employer Wage Differentials

Review

Bronars and Famulari (1997) use the entire WCP sample described in this paper and find strong evidence of substantial employer wage, tenure, and wage growth differentials. The standard deviation of log wage differentials is roughly 0.20. Education, experience, and job tenure are highly correlated within WCP establishments, and high-wage establishments tend to employ more skilled workers. Workers in high-wage-growth establishments tend to have longer tenure, all else equal.

Bingley and Westergard-Nielsen (1996) use the Danish IDA panel data to estimate establishment wage differentials using a multilevel (GLS) standard notation random effects model. Their data set includes 1,400 workplaces and 11 years of

[11] These results corroborate the findings of Dickens and Katz (1987), who show that industry wage differentials are positively correlated with average education in the industry.

annual data. Observed worker and workplace characteristics account for 20 percent of the overall variation in log wages. Unobserved heterogeneity among workers accounts for an additional 38 percent, and unobserved heterogeneity among workplaces accounts for an additional 26 percent of the total variation in log wages. Finally, worker-workplace interactions account for 6 percent of the variation in log wages.

Empirical Results

We estimate employer wage differentials conditional on worker demographic characteristics using the following model of wage determination:

$$\ln W_{ik} = X_{ik}\beta + \alpha_k + \varepsilon_{ik} \qquad (2)$$

$\ln W_{ik}$ is the log of the current wage of worker i at employer k, α_k is employer k's conditional wage differential, and ε_{ik} is an i.i.d. error term. X_{ik} is a vector of worker i's characteristics that includes third-order polynomials in education and experience; interactions between these polynomials and a female dummy variable; and in the United States, dummy variables for black and other racial groups. We also consider a specification of X_{ik} that includes tenure variables: a third-order polynomial in tenure and education, and interactions between a female dummy variable and the polynomial terms in tenure and education.

We reject the hypotheses that α_k equals zero and that α_k is uncorrelated with X_{ik} by performing Hausman specification tests for each of the samples. These results hold whether or not tenure variables are included in X_{ik}. We therefore estimate equation 2 using employer fixed effects for the two specifications of X_{ik}.

Table 5 presents summary statistics from these log wage regressions. In column 1, for the U.S. white-collar data, we see that when tenure variables are excluded from X_{ik}, worker demographic characteristics and employer effects account for 77.2 percent of the variation in log wages. If tenure variables are included in X_{ik}, the R^2 of the regression is 0.785. The explanatory power of the regressions is substantially lower in the Danish data: Employer effects and worker demographic characteristics jointly account for about 54 percent of the variation in log blue-collar wages, and 59 percent of the variation in log white-collar pay.

Table 5. Variance Decomposition of Log Wages by Worker Characteristics and Establishment Dummy Variables

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Fraction of variance explained			
Worker characteristics, including tenure, and establishment dummy variables:			
R-squared	0.785	0.588	0.544
Adjusted R-squared	0.729	0.550	0.500
# of independent variables	241	779	583
Worker characteristics, excluding tenure, and establishment dummy variables:			
R-squared	0.772	0.584	0.540
Adjusted R-squared	0.716	0.547	0.496
# of independent variables	229	767	571
Worker characteristics, including tenure:			
R-squared	0.323	0.385	0.188
Adjusted R-squared	0.615	0.383	0.184
# of independent variables	33	31	31
Worker characteristics, excluding tenure:			
R-squared	0.599	0.381	0.185
Adjusted R-squared	0.592	0.380	0.183
# of independent variables	21	19	19
Establishment dummy variables:			
R-squared	0.462	0.350	0.455
Adjusted R-squared	0.345	0.293	0.406
# of independent variables	208	748	552
Marginal variance explained			
Worker characteristics, including tenure:			
R-squared	0.323	0.238	0.089
# of independent variables	33	31	31
Worker characteristics, excluding tenure:			
R-squared	0.310	0.234	0.085
# of independent variables	21	19	19

Table 5. Variance Decomposition of Log Wages by Worker Characteristics and Establishment Dummy Variables (Continued)

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Establishment dummy variables:			
R-squared	0.159	0.203	0.356
# of independent variables	208	748	552

The results in table 5 indicate that the cross-country difference in the R-squared of these regressions is primarily due to differences in the explanatory power of demographic characteristics across samples. If employer effects are omitted from the model, worker characteristics account for about 60 percent of the variation in log pay for U.S. white-collar workers, 38.5 percent of the variation in log pay for Danish white-collar workers, and only 19 percent of the variation in log pay for Danish blue-collar workers. If worker characteristics are omitted from the regressions, establishment dummy variables account for 35 to 46 percent of the variation in log pay. The cross-country differences in the explanatory power of establishment fixed effects alone are relatively small.

The next panel of table 5 focuses on the marginal variance explained by worker characteristics and establishment effects.[12] The results show that employer wage differentials are relatively more important in Denmark than in the United States. The marginal R-squared of employer effects is one-third higher for white-collar Danish workers than for white-collar U.S. workers, and twice as large for blue-collar Danish workers than for blue-collar U.S. workers. Another way of interpreting these results is to note that in the United States, unconditional wage differentials across employers are largely explained by observed differences in worker characteristics across employers, while in Denmark the unconditional employer wage differentials are not well explained by inter-employer differences in worker characteristics. The variance decomposition in table 5 implies that 65 percent of the across-employer variance in log wages is explained by across-employer differences in worker characteristics in the United States, 42 percent of across-employer pay differentials is explained by worker characteristics in the Danish white-collar data, and only 22 percent of across-employer pay differentials is explained by worker characteristics in the Danish blue-collar data.

This variance decomposition can also be illustrated by separating $\ln W_{ik}$ into three components: $X_{ik}\beta$, an index of worker i's quality (the wage he or she can be expected to receive from the mean employer); α_k, employer k's wage differential; and ε_{ik}, the log wage residual. Table 6 presents the standard deviations of these components across workers. The standard deviation of $X_{ik}\beta$ is about 0.3 in the United States, 0.22 for Danish white-collar workers, and 0.11 for Danish blue-collar workers. The standard deviation of the log wage residual is roughly similar in size across countries and is, in fact, the largest for white-collar Danish workers.

[12] The alternative variance decompositions in table 5 depend on the correlation between employer fixed effects and individual worker characteristics.

Table 6. Standard Deviations of Log Wage Component

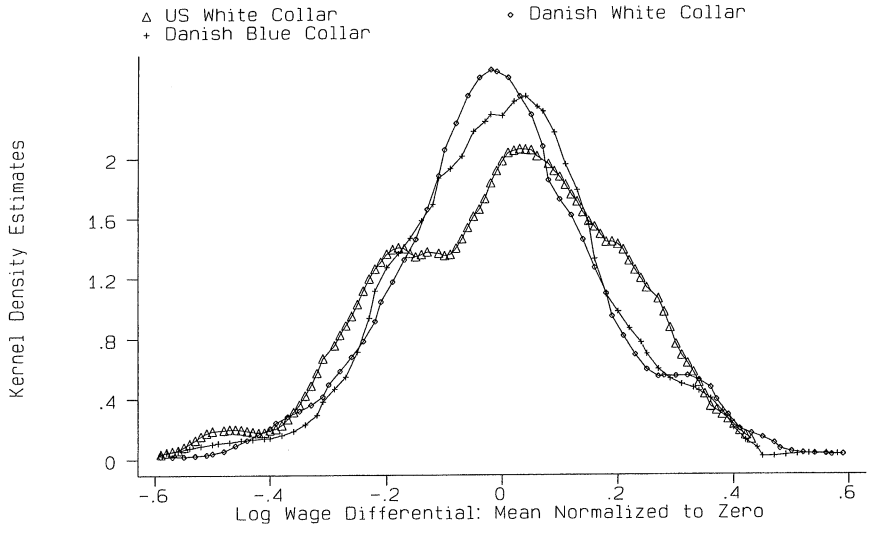
		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Standard deviations across workers			
Log wage	0.457	0.391	0.303
Worker characteristics, including tenure	0.306	0.223	0.107
Worker characteristics, excluding tenure	0.299	0.221	0.103
Residual, including tenure	0.208	0.251	0.204
Residual, excluding tenure	0.215	0.252	0.205
Standard deviations across employers wage			
Average worker characteristics, including tenure	0.169	0.116	0.058
Average worker characteristics, excluding tenure	0.165	0.115	0.053
Employer effects characteristics include tenure	0.195	0.180	0.185
Employer effects characteristics exclude tenure	0.200	0.179	0.184

The final few rows of table 6 present the standard deviations of wage components across employers. Let $X_k\beta$ denote the average index of worker quality (the average of X_{ik}) at establishment k. The standard deviation of $X_k\beta$ is substantially higher in the United States than in Denmark, and higher for white-collar workers within Denmark. The most surprising result in this table is that the standard deviation of α_k is nearly identical across white-collar and blue-collar workers, and across countries. Despite substantial differences in the overall dispersion in pay across samples, employer wage differentials are remarkably similar in magnitude

in the United States and in Denmark. In both countries a one-standard-deviation increase in the employer wage differential leads to an 18 to 20 percent pay premium. Although this pay differential is almost identical in percentage terms in both the United States and Denmark, the employer wage differential is *relatively* more important in Denmark, because there is less overall dispersion in pay.

Although the standard deviations of employer log wage differentials are quite similar across our three samples, there are some important differences in the distribution of employer pay differentials. Figure 2 displays kernel density estimates of the empirical distribution of employer log wage differentials, where each employer is weighted by the number of its workers in our sample. The differences in the kurtosis of the empirical distributions of employer pay differentials in figure 2 mirror the differences in the shapes of the individual log wage distributions presented in figure 1. The distribution of employer pay differentials for Danish blue-collar workers has the thinnest tails, while the distribution of employer differentials for U.S. white-collar workers has the thickest tails.

Figure 2. Distributions of Employer Pay Differentials in the U.S. and Denmark



Differences in the kurtosis of the employer wage differential distributions are demonstrated by the fact that 65.6 percent of U.S. white-collar workers, 73.2 percent of Danish white-collar workers, and over 75 percent of Danish blue-collar workers are employed in establishments with pay differentials within one standard deviation of the mean. Moreover, the measures of kurtosis for the distribution of employer wage differentials are nearly identical to the measures of kurtosis for the individual wage distributions illustrated in figure 1.[13]

The distribution of employer pay differentials is nearly symmetric for Danish blue-collar workers. The distribution of employer pay differentials is skewed left for U.S. white-collar workers and skewed right for Danish white-collar workers.[14] In the United States 2.92 percent of white-collar workers are employed by establishments with pay differentials more than two standard deviations below the mean, while only 1.55 percent work in establishments with pay differentials more than two standard deviations above the mean. In contrast, 2.89 percent of Danish white-collar workers are employed by establishments with pay differentials more than two standard deviations above the mean, while only 2.48 percent work in establishments with pay differentials more than two standard deviations below the mean.

Table 7 presents estimates of the correlation in establishment wage effects and worker quality indices. In both countries and both occupation groups, high-wage establishments employ more skilled workers. The correlation coefficient between employer wage effects and worker skills is roughly twice as large in the United States as it is in Denmark. If we look across employers, the correlation coefficient between average worker skills and employer wage differentials is about 0.4. In Denmark the across-employer correlation coefficient between employer wage effects and average worker skills ranges from 0.184 to 0.205 for white-collar workers and 0.191 to 0.266 for blue-collar workers.

Finally, we check whether industry dummy variables would provide an adequate proxy for employer fixed effects. In both countries a majority of the dispersion in pay across establishments results from within-industry variation in pay across employers. In the U.S. WCP data, two-digit SIC industry dummy variables explain 41.6 to 42.5 percent of the variation in employer wage differentials (depending on the specification of the wage regression). In the Danish data, there is even more within-industry variation in establishment wage differentials. Broad industry dummy variables explain 12.3 to 12.7 percent of the variation in employer wage effects for blue-collar workers, and 19.8 to 20.5 percent of the variation for white-collar workers. These results show that the use of industry dummy variables as a proxy for employer wage differentials would substantially understate the magnitude of wage variation across employers in both the United States and Denmark.

[13] The fourth moments of the empirical distributions of employer log wage differentials are 2.674 for U.S. white-collar workers, 3.875 for Danish white-collar workers, and 5.108 for Danish blue-collar workers.

[14] The third moments of the empirical distributions of employer log wage differentials are –0.2889 for U.S. white-collar workers, 0.2868 for Danish white-collar workers, and 0.0007 for Danish blue-collar workers.

Table 7. Correlations of Wage Components

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Across workers			
Worker characteristics, including tenure, and employer effects	0.226	0.096	0.103
Worker characteristics, excluding tenure, and employer effects	0.219	0.106	0.138
Across employers			
Average worker characteristics, including tenure, and employer effects	0.409	0.184	0.191
Average worker characteristics, excluding tenure, and employer effects	0.398	0.205	0.266

5. Employer Wage Differentials by Occupation Group

We are interested in estimating the correlation in employer wage differentials across occupation groups. In other words, do the establishments who pay more to white-collar workers also pay more to blue-collar workers? For 403 of the establishments in the IDA cross-section, we have estimates of both the white-collar and the blue-collar employer wage differential (because in these establishments we observe at least two white-collar and two blue-collar workers). For these employers, the correlation in employer wage effects is 0.53 to 0.54 (depending on whether job tenure variables are included in the regressions). We also examine the correlation in worker skill indices for white- and blue-collar workers in these 403 establishments. We find a correlation in skill indices of 0.36 to 0.38 (depending on whether job tenure variables are included in the skill index). These strong positive correlations support the notion of a team production model and suggest that skill complementarities in the production process extend from the factory floor to the front offices of a workplace.

Unfortunately, we do not observe the wages or demographic characteristics of blue-collar workers in the establishments sampled in the U.S. WCP data set. To investigate whether wage differentials and worker skills are correlated across occupation groups in the U.S. data, we disaggregate white-collar workers into a technical/clerical group and a professional/administrative group. We find that employer wage differentials are significantly positively correlated across these occupation groups. The estimated correlation coefficient for employer wage effects ranges from 0.59 to 0.61, depending on whether tenure variables are included in the wage regression. We also find that average worker skills are significantly correlated across broad occupation groups at the same employer: The estimated correlation coefficient for worker skill indices ranges from 0.17 to 0.22, depending on whether job tenure variables are included as measures of skills.[15]

These results are remarkably similar across the two countries. In each country, employer wage differentials by occupation group and average worker skills by occupation group are significantly positively correlated at the same employer. Team production models (e.g., Kremer, 1993) can explain the pattern of correlations in both skill indices and employer wage effects that we observe in the data. Establishments that hire relatively more skilled workers in one occupation also employ relatively more skilled workers in other occupations. Because certain components of workers' skills are unobserved, the systematic sorting of workers by skills across employers leads to a positive correlation in employer wage effects across occupation groups. Interpreted in this way, our empirical results suggest that there are important production complementarities across broad occupation groups: The best managers work with the best clerical workers in the firms that employ the most-skilled blue-collar workers.

6. Wages and Tenure

Wages and tenure are positively related in both the United States and Denmark. The correlation coefficient between log wages and log tenure is 0.272 in our WCP data set, 0.094 for white-collar workers in Denmark, and 0.111 for blue-collar Danish workers. We are interested in the relationship between wages and tenure at an employer, holding constant individual characteristics. In other words, do high-wage employers have less job turnover and longer job tenure than lower-wage employers? We examine the inter-employer relationship between wages and tenure by estimating the following log tenure regression:

$$\ln T_{ik} = X_{ik}\theta + \tau_k + u_{ik} \tag{3}$$

$\ln T_{ik}$ is the logarithm of a worker i's tenure with employer k, X_{ik} is the vector of worker characteristics described above, τ_k is employer k's conditional tenure differential, and u_{ik} is an i.i.d. error term. We reject the hypothesis that τ_k equals zero in all three data sets. Using Hausman specification tests we reject the null hypothesis that τ_k is uncorrelated with X_{ik} in the WCP data and Danish blue-collar data. We fail to reject this hypothesis for white-collar workers in Denmark, and therefore could

[15] Because of the limited sample size in the WCP data, we have estimated the occupation-specific employer wage differentials and measures of worker skills across all workers in the WCP (not just workers with 11 or fewer years of tenure). There are 109 establishments with at least two workers in each of the broad occupation groups (professional/administrative and technical/clerical) in our WCP data. There are 1,101 total workers in our sample in those 109 establishments.

use a more efficient random effects estimator in that sample. For purposes of comparability, however, we estimate equation 3 using employer fixed effects in all three data sets.

Table 8 presents some summary statistics from these regressions. In both the United States and Denmark, employer fixed effects account for a substantial component of the variation in tenure across workers. At the margin, employer effects explain 22.2 percent of the log tenure variation in the United States, and 36.5 to 38.3 percent of the log tenure variation in Denmark. Individual worker demographic characteristics explain little of the variation in log tenure across workers. At the margin, worker characteristics explain 12.6 percent of log tenure variation in the United States, and 4.3 to 6.7 percent of the log tenure variation in Denmark.

Table 8. Variance Decomposition of Log Tenure by Worker Characteristics and Establishment Dummy Variables

		Danish IDA	
	U.S. WCP	White Collar	Blue Collar
Fraction of variance explained			
Worker characteristics and establishment dummy variables:			
R-squared	0.381	0.434	0.442
Adjusted R-squared	0.229	0.383	0.390
# of independent variables	229	767	571
Worker characteristics:			
R-squared	0.159	0.069	0.059
Adjusted R-squared	0.143	0.067	0.056
# of independent variables	21	19	19
Establishment dummy variables:			
R-squared	0.255	0.367	0.399
Adjusted R-squared	0.093	0.310	0.345
# of independent variables	208	748	552
Marginal variance explained			
Worker characteristics:			
R-squared	0.126	0.067	0.043
# of independent variables	21	19	19
Establishment dummy variables:			
R-squared	0.222	0.365	0.383
# of independent variables	208	748	552

In each of our three samples, we estimate the correlation between an establishment's log wage differential (α_k) and its log tenure differential (τ_k). We use the log wage regression specification that excludes job tenure variables from the explanatory variables when calculating an establishment's log wage differential. In our U.S. data set, there is a strong positive correlation between wage and tenure differentials, holding constant worker characteristics across establishments: The correlation between α_k and τ_k is 0.301 and significantly different from zero at the 0.01 level. In contrast, in the Danish data, the across-employer relationship between wages and tenure is either insignificantly different from zero or negative. For blue-collar workers the correlation between α_k and τ_k is –0.061 and insignificantly different from zero at conventional significance levels. Among white-collar workers in Denmark, the correlation between α_k and τ_k is –0.126 and significantly different from zero at the 0.01 level. It appears that the establishments in Denmark that pay higher wages to white-collar workers have lower than average worker tenure for white-collar workers, all else equal. This somewhat puzzling result may result from higher rates of employment growth in high-wage establishments. Further research on this question is warranted.

7. Conclusion

This paper presented a detailed empirical analysis and comparison of matched employer-employee data sets in the United States and Denmark. We used identical empirical methodologies to analyze the distribution of wages and employer wage differentials across the two countries. Before we briefly summarize our findings, recall that the U.S. data set used in our analysis contains workers who are more skilled, earn more, have less dispersion in pay, and are employed by relatively larger firms than a randomly selected worker in the United States.

We find that although there are substantial differences in the wage distribution in the United States and Denmark, the dispersion in employer wage differentials is remarkably similar across the two countries and across broad occupation groups. In each country, employers that pay wages one standard deviation above the average establishment provide an 18 to 20 percent pay premium to their workers. Despite this striking similarity in the standard deviation of employer log wage differentials, there are important cross-country differences in the distribution of employer log wage differentials. The distribution of employer pay differentials has the thinnest tails for Danish blue-collar workers and the thickest tails for U.S. white-collar workers. These differences in the kurtosis of the distribution of employer wage effects closely mirror the differences in individual log wage distributions across countries.

In both countries, high-wage establishments tend to employ relatively more skilled workers, and employers that pay high wages to workers in one occupation group tend to pay high wages to workers in other occupation groups. In both the

United States and Denmark, the average observed skills of workers by occupation group are significantly positively correlated at an establishment. Employers in Denmark who tend to hire the best managers also hire the best secretaries and best production workers. These empirical findings provide strong support for the team production model. Our evidence is consistent with the notion that skill complementarities in the production process extend across white- and blue-collar workers who are unlikely to interact on a daily basis in performing their job tasks.

The primary difference we observe across countries is the inter-employer relationship between wages and tenure. Employer wage and tenure differentials are significantly positively correlated in the United States, but high-wage establishments in Denmark employ workers with the same or relatively less tenure than workers at low-wage establishments, all else equal.

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