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Wage Structure, Raises, and Mobility
An Introduction to International Comparisons of the Structure of Wages within and across Firms

Edward P. Lazear and Kathryn L. Shaw

Introduction

The variance of wages across individuals is a summary statistic that means many things. Wage variance is an indicator of income inequality: high variance suggests high income inequality. But the "wage structure" of an economy—or the mean and the variance of wages—is also an indicator of the degree to which some individuals invest in human capital, the degree to which they work hard in response to incentives, the rates of return to human capital investments, and institutional factors that shape wage determination. Thus far, economists have had data on the distribution of wages across individuals in the economy, but not on the distribution of wages across individuals within firms. Now with new matched employer-employee data sets, we can look at the structure of wages within firms as well as across firms. New questions can be raised and addressed empirically.

Every country has wage variation across individuals. Not all workers earn the same amount. Think about the following questions:

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1. Is there wage variance because workers find themselves in different firms, some of which are high-wage firms, while other firms are low-wage firms? That is, is there a high variance of mean wages across firms, or are mean wages of firms quite similar across firms?
2. Is there wage variance across individuals because within every firm, some workers are highly paid and others are less well paid?
3. Do all firms have the same wage structure, or are wage structures widely varying across firms? That is, do some firms have a wage structure that is very compressed—paying low- and high-wage workers very similar wages—while other firms have a very dispersed or high-variance structure of wages within the firm? If some wage structures within firms are more compressed than others, what factors account for differences across firms? Do most firms specialize in a narrow range of jobs, so the structure of pay looks very different across firms? Does the boundary of the firm matter? When there is pay compression, does it result in losses of the most able workers or of the retention of the least able?
4. The distribution of income is always skewed across individuals within a country—it has a long upper tail. Is this because salaries within firms are skewed, or does the skewness result from a few firms paying high wage levels? Skewness is relevant in the context of tournament theory, which suggests that there should be skewness within firms because salary jumps at the higher end of the skill hierarchy are greater than salary jumps at the lower end of the hierarchy as a reward for effort.

We can ask similar questions about wage growth rates, or pay raises, for individuals:

1. Are average pay raises very different across firms so that finding employment in a high-growth firm insures a person of high wage growth?
2. Are pay raises uniform within firms, or are some workers treated very differently from others? It is possible that workers' raises within firms are nearly identical—moving lockstep across workers when conditions change for the firm—so that differences in wage growth across workers in the economy is accounted for primarily by firm differences in mean growth rates. It is also possible that mean wage growth rates are very similar across firms, but that significant within-firm variation produces the economy's variation in wage growth rates.

Answers to these questions are revealing. For example, if wage levels are very different across firms, then firms must be sorting workers based on individual workers' levels of human capital or their effort levels, and, moreover, workers can improve their pay only by moving across firms. On the other hand, if mean wages are very similar across firms but wage variance is high within firms, then human capital development within firms and promotions within firms are predominant features of the labor market. Fur-

thermore, if pay increases are very different across workers within the same firm, then effort and skills are being heavily rewarded within firms.

Finally, do the answers to these questions vary across countries? Do wage structures appear to vary significantly across countries as a function of different institutions or human capital? Ultimately, the answers might reflect difference sources of productivity in firms. So do the patterns help explain differences in productivity across countries?

Until very recently, it would be impossible to answer these questions because the answers would require data on all of the workers in a firm for a large number of firms. Now this required data is available from a number of different countries to answer many of these questions and more. The employer-employee matched data sets, from many European countries and from the United States, either contain information on nearly all workers and firms in that country or information on all workers within a large subset of firms. As a result, it is possible to examine the worker's position in the context of his or her entire firm. Additionally, the existence of data for a large number of firms permits new questions, like those listed in the preceding, to be addressed.

This is not the first time such questions have been asked. The first economics paper on this subject is Lazear (1992). That study made use of a complete data set on one large firm and studied both wages and mobility. The work was followed by similar papers by Baker, Gibbs, and Holmstrom (1994a,b). They studied a different company and also examined the structure of promotion, ports of entry, and wages. The advantage of those analyses is that it is possible to examine the entire firm, thereby analyzing promotion paths, determinants and consequences, as well as wage determination and structure. The disadvantage is that because the studies only cover two different firms, it is difficult to generalize the results, and not all results are consistent across papers.

It is important, therefore, to have data not only on entire firms and all workers in them, but also on a large number of firms so that results can be generalized. The authors in this book have used the new style of data to ask and answer questions that cannot be answered with traditional data sets. For example, many of these data sets can be used to calculate returns to experience and tenure and can perhaps do it better because of their richness. In this book, we have steered away from some questions because they are addressed well by traditional individual-level panel data sets that use the individual as the unit of analysis and sample randomly from a large population. Those data sets have very few observations from the same firm and, in most cases, the identity of the firm is unknown. As a consequence, neither a firm's wage structure nor its hiring and promotion patterns can be gleaned from traditional data. Our focus is on exactly the questions that could not be answered historically using individual panel data.

In this introduction, we set out to do two things. First, we use the data

from all countries to address the questions, drawing out general patterns about firm wage structure, promotion, hiring, and mobility patterns to answer the questions posed in the preceding and more. Second, because this kind of analysis is new and because we are covering a large number of countries and studies in this introduction, we aim to raise as many questions as we provide answers. But the questions themselves may be useful, if for no other reason than they cast light on the kinds of issues that can be addressed with this type of data.

This study is based on the extensive empirical work done by all of the country-specific authors in this book. The authors provided to us statistics that they each constructed to be as comparable as possible across countries so that we might identify patterns across countries (though differences in the underlying data sets do not make these statistics perfectly comparable, as described in the following). However, in this introduction, we make no attempt to delve deeply into the sources of differences across countries. The individual country chapters describe the primary institutional features of the countries and the macroeconomic conditions. In addition, the country chapter authors provide much greater expertise and analysis of data that is specific to the countries (such as the occupational structures of firms or productivity information). After the following broad description of the data, we then look at the structure of wage levels and at alternative models of interpreting these structures. After that, we turn to wage growth rates and mobility.

The Data

The data come from all of the Scandinavian countries (Denmark, Finland, Norway, Sweden) and from Belgium, France, Germany, Italy, the Netherlands, as well as the United States. The sampling frames are different across countries. In a broad fashion, we can group the data of the countries into five basic sampling schemes, as shown in table I.1. The sequence of data is as follows. At the top of the list are the country data sets that cover most of the populations, and then descending in the table are data sets that cover subsets of the population covered in the data. For example, at the top of the list are Denmark, Norway, and the United States because they have data on all workers in all firms in the economy (though for a subset of states in the United States). Next, Finland, Sweden, and Belgium have data on all workers in large firms; Germany and Norway (using more matched data) have data on all workers in manufacturing. Italy and France cover all firms, but within firms they have only a sample of workers, not data on every worker.[1] Finally, additional analysis is done for Norway

1. Italy has a 1/90 sample within firms, so the Italian authors provide information on synthetic firms by taking data from similar industries and locations and blending them into cells, which they treat as firms. France has a 1/25 sample, so we correct statistics for this sampling.

Table I.1 Country classifications by type of data

Data type	Country details
All private firms, all employees	United States—all firms, all employees, wages plus bonuses, quarterly data annualized Denmark—all firms, all employees, wages plus bonuses, annual (November) The Netherlands—all firms (including nonprofit, government), all employees, wage plus bonuses, annual (September)
Firms in employer associations, all employees	Finland—employer association (TT; large firms), all employees, wages plus bonuses, annual Belgium—random sample of firms, all employees, 1995, wages plus bonuses, annual Sweden (plants)—all industries, plants only, all employees, annual
Employer associations, some industries, all employees	Germany—manufacturing and services (IAB; large firms), plants only, top-coded wages are input, annual (June) Norway—heavy manufacturing (industry 38), all employees
All private firms, sample of employees	Italy—private sector, large employers, permanent employees, 1/90 sample of workers, annual (May) France—all firms, 1/25 sample of workers in firms, wages plus bonuses
Firms in employer associations, all employees, but only white- or blue-collar	Norway—white-collar, employer association (NHO), manufacturing and services (more manufacturing), all employees, but only employees, wage plus bonuses Sweden (firm)—white-collar, employer association (SAF); blue-collar, employer association (SAF)

Note: TT = Confederation of Finnish Industry;
IAB = Institute for Employment Research;
NHO = Confederation of Norwegian Business and Industry; and
SAF = Swedish Employer's Federation.

and Sweden for white- and blue-collar workers because additional detailed matched data is available for these groups.

Table I.1 also provides a brief summary of the key wage variables and the age or time restrictions on the data, but for more detailed analysis of the country-specific differences, see appendix table I.A.1. Inevitably, variables differ, as in how wages are measured (with or without bonuses, hourly or salary, monthly or annual), and these differences naturally enter the statistical comparisons that we make. In addition to the descriptions in appendix table I.A.1, each chapter describes its own data in detail.

Appendix tables I.A.2 and I.A.3 contain basic descriptive statistics for all the countries for the key variables that are used in the following figures.

The key to constituting an employer-employee matched data set is that there is substantial information on a cross section of workers within each firm spanning many firms. This is essential to drawing inferences about wage structure, worker mobility, and promotion and hiring patterns within and across firms.

Primary Findings

The main finding is that countries are remarkably similar in their structures of wage levels and of wage changes. Given the similarity of the wage structures across countries, we reach some general conclusions based on the data. The discussion section at the end of the chapter introduces more policy conclusions on why these empirical regularities matter.

1. There is a striking amount of wage variation within firms: the within firm wage variation is about 60 to 80 percent of the wage dispersion across all individuals in the economy. There is also variation across firms in the mean wages they pay: the standard deviation of the mean wages of firms is about 60 percent of the standard deviation across all individuals. However, when we scale the mean wages firms pay relative to the average worker's wage in the economy, one standard deviation in firm means is only 15 to 20 percent of the average wage: firms don't differ that much in what they pay. Overall, despite very different labor institutions across countries, the evidence favoring high within-firm wage dispersion appears across countries.
2. The across- (or between-) firm differences in wages appears to be growing over time. That is, for a significant number of countries, the firm-specific fixed effects are explaining a larger percent of the distribution of wages across firms. This may be because firms are increasingly segregated according to the skills that they require. Or it may be that firms that pay high-level efficiency wages (in exchange for skills or low turnover) are increasingly diverging from those that are pushed to low-level market clearing wages in lower-skilled or highly competitive industries. Or it may also reflect the boundaries of the firm associated with outsourcing: the high-skill firms now use more outsourcing for their low-skill jobs.
3. With respect to wage growth, although firms differ in the average raises they give in a particular year, firms do not tie all workers to the same percentage point raise within the firm. The standard deviation of raises within firm is between 10 and 20 percentage points, even when the average wage increase for the firm is close to zero. This is most consistent with the view that firms respond to outside pressure (either market or governmental) to raise workers' wages commensurate with some occupational or skill standard; firms are not raising all workers' wages equally in response to the conditions within the firm.
4. Mobility levels differ across countries, but even here, mobility patterns seem relatively consistent. High-wage firms have low turnover. Large firms are higher wage and lower entry.

Decomposing Wage Variance

Return to the question raised at the outset, how much do firms differ? Figure I.1 depicts the two extremes views of the variance of wage levels

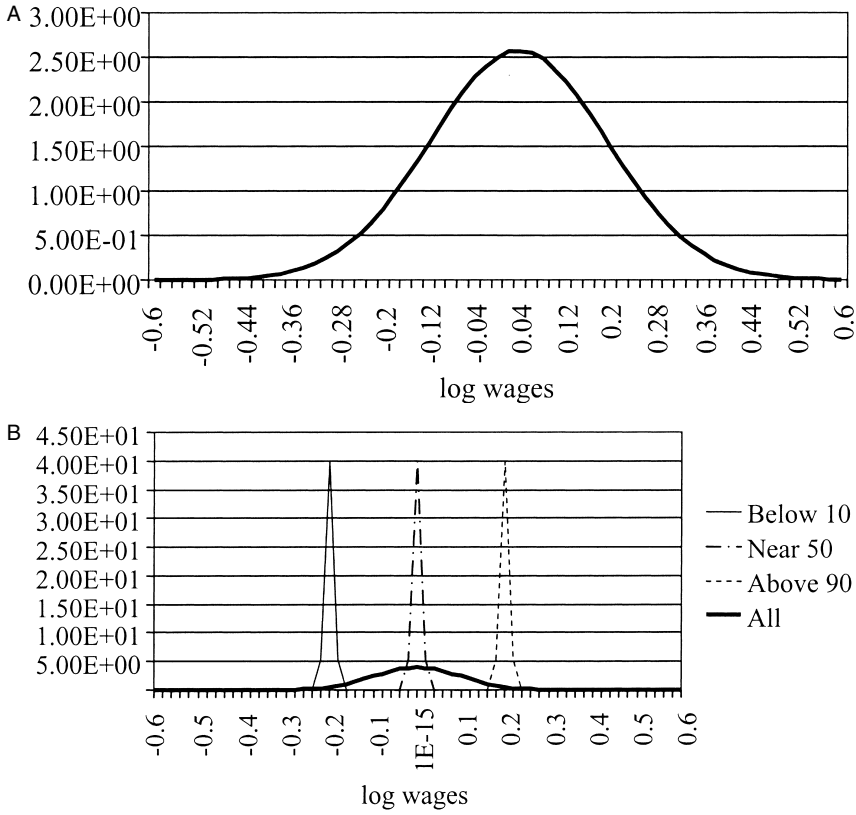

Fig. I.1 Wage distributions within and between firms: *A*, All firms have identical wage distributions: Firms have the same within-firm wage variation and no between-firm variation. The probability density function for the country is the same as that for the median firm and extreme firms. *B*, All firms have similar within-firm wage distributions and different between-firm wage distributions.

within and across firms. In panel A of figure I.1, all firms are identical, so the variance of wages for each firm is the same as the variance of wages for the country. At the other extreme, in panel B of figure I.1, all firms differ, so the variance of wages within firms is very narrow, and the variance of wages for the country arises from differences in the variance of mean wages across firms.

The different sources of wage variation in figure I.1 can be decomposed more systematically, which is useful later in interpreting the sources of wage variation. Decompose the variance of wages across individuals into the contribution of firms:

$$\sigma^2 = \sum_{j=1}^{J} p_j \sigma_j^2 + \sum_{j=1}^{J} p_j (\overline{w}_j - \overline{\overline{w}}_\cdot)^2, \tag{1}$$

where p_j is the share of workers in the economy who are working in firm j, σ_j^2 is the variance of wages in firm j, $\overline{w}_j$ is the mean wage for firm j (across its workers), $\overline{\overline{w}}$ is the mean wage for the entire economy (across its workers and firms). Thus, the variance of wages for the economy will be high if (1) mean wages differ across firms, so $|\overline{w}_j - \overline{\overline{w}}|$ is large (as in panel B of figure I.1) or if (2) the within-firm variance of wages, σ_j^2, is large (as in panel A of figure I.1), or if both are true (not drawn in a figure).

The wage structure underlying figure I.1 assumes that firms have identical wage variance within each firm. Figure I.2 depicts a more likely structure. In that figure, the variance of wages is not only different across firms, but also rises with the mean wage of the firm. There are numerous reasons for the positive correlation between wage level and variance, such as rising levels of human capital in firms, that are introduced later.

The Structure of Wages: Wage Levels

To get started, let us point out some initial observations. There are two (among many) ways in which data have been displayed by the authors of this book. The first is to use the individual as the unit of analysis. The second, and way most unique to this structure, is to use the firm as the unit of analysis. Table I.A1 does the comparison. Here, the average level of wages, the standard deviations, and 90th and 10th percentile are displayed. The units are own-country currencies, so comparisons cannot be made across countries without conversions to ratios or other unit-free numbers. The mean level of average wages in the firm-based data is always lower than that of the mean for the individual-based data, although there is some variation in ratios across countries (see tables in the country chapters). This reflects

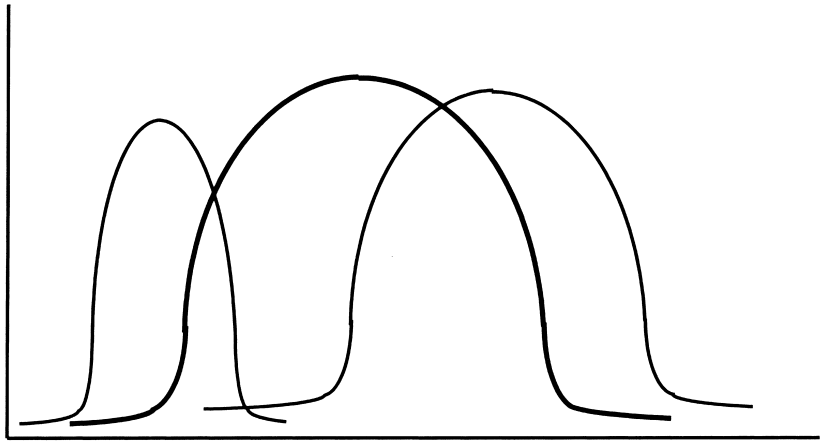

Fig. I.2 Positive correlation in within-firm mean wages and variance

weighting. If all firms were of identical size, then the firm average would equal the individual average. The fact that the firm mean is below the individual mean implies that the largest firms, which account for disproportionately more workers, have higher average wages than the smaller firms. The firm average, which does not weight by firm size, puts relatively more emphasis on the small firms and pulls the average wage down. That firm size and average wage are correlated is not a new result (Brown and Medoff 1989; Fox 2007).

The key question raised in the preceding is, how does the variation in wages within and across firms contribute to the variation in wages for the country? First, if all firms were alike, then their wage distributions would be identical to the distribution for the country as a whole as shown in panel A of figure I.1. At the other extreme, firms might treat their workers very similarly within the firm, and the variation in wages throughout the country could be accounted for by differences in the mean value of wages between firms, as shown in panel B of figure I.1.

We begin by displaying wage distributions for some typical countries. Consider the patterns illustrated by Norway, France, and Denmark (as typical countries) in figure I.3. In figure I.3, there are wage distributions displayed for three typical firms. The Low Wage Below 10th percentile distribution represents the wage distribution for firms in the sample that have mean wages below the 10th percentile of the wage distribution of firms' mean wages.[2] The other two firm types are the firms Around Median Wage (in the 45th to 55th percentile of the firm mean wage distribution) and the High Wage Above 90th percentile. The bold line is the distribution for all individuals in the data.

Norway's situation is typical and is a compromise between panels A and B of figure I.1. Firms have very considerable wage dispersion within them, though not as high as the wage dispersion across all individuals in the economy. The typical firm is not the almost spiked distribution as shown in panel B of figure I.1. However, the wage distribution for the typical firm that is below the 10th percentile is tighter than that for the country as a whole. The same is true for the wage distribution of the typical firm around the median and for the firm with mean wages in the top 10 percent of firms.[3] While wage dispersion within firms is very high, firms have many different jobs within the firm. As a result of differences in the means, the wage distributions of high-wage and low-wage firms are by and large disjoint. At the mean, some of these firms have low pay, low skill; some have

2. In these figures, each distribution is a graph of the normal distribution given the mean wage and standard deviation for that subsample.

3. The typical firm was constructed by averaging the mean log wage and the within-firm standard deviation of log wages for firms in the 0 to 10th percentile, the 45th to 55th percentile, and the 90th and above percentile. The distributions were constructed assuming that wages are distributed log normally.

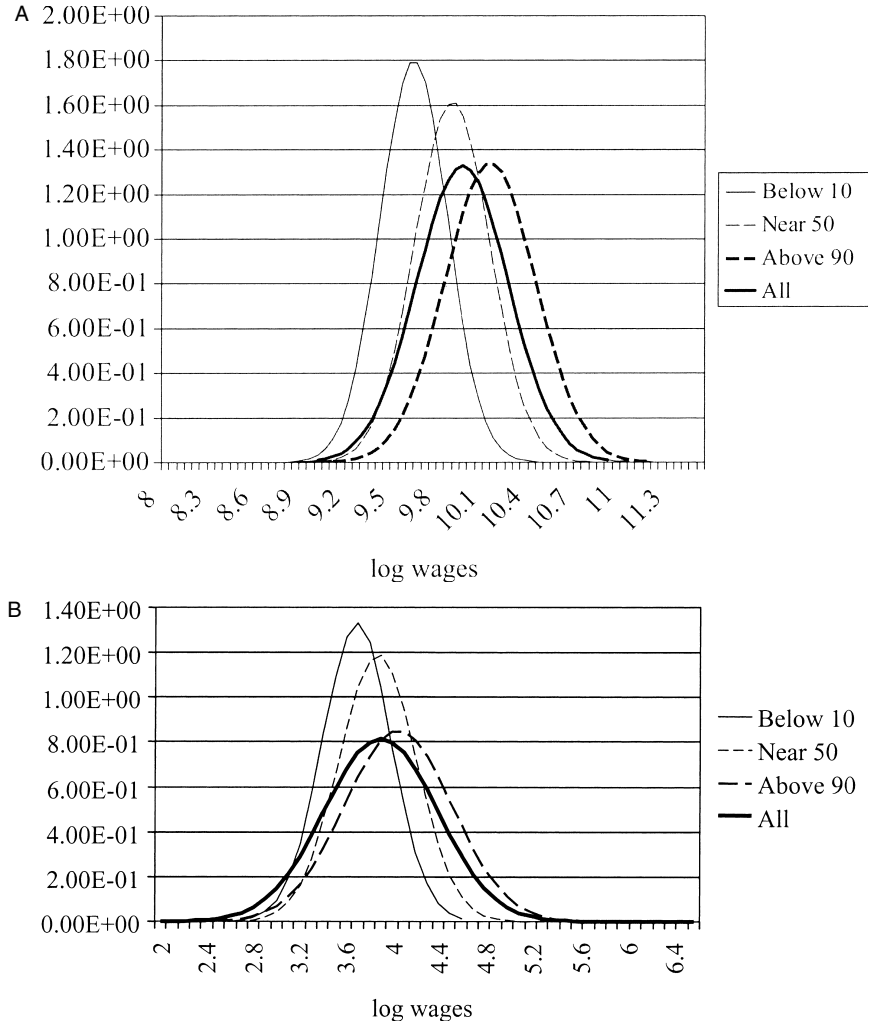

Fig. I.3 Wage distributions for some typical countries: *A*, Norway 1997; *B*, France 1996; *C*, Denmark 2000

Notes: Below 10 refers to the subsample of firms for which each firm has its mean wage of the firm below the 10th percentile of the mean wages of all firms. Near 50 refers to the subsample of firms for which each firm has its mean wage of the firm near the 50th percentile of the mean wages of all firms. Above 90 refers to the subsample of firms for which each firm has its mean wage of the firm above the 90th percentile of the mean wages of all firms. All refers to all firms.

high pay, high skill (or high variance). But the high variance of wages within firms causes wage distributions of firms with very different means to overlap.

Figures I.4 through I.6 summarize these primary results across countries on the structure of wages. Figure I.4 graphs the ratio of the average of the

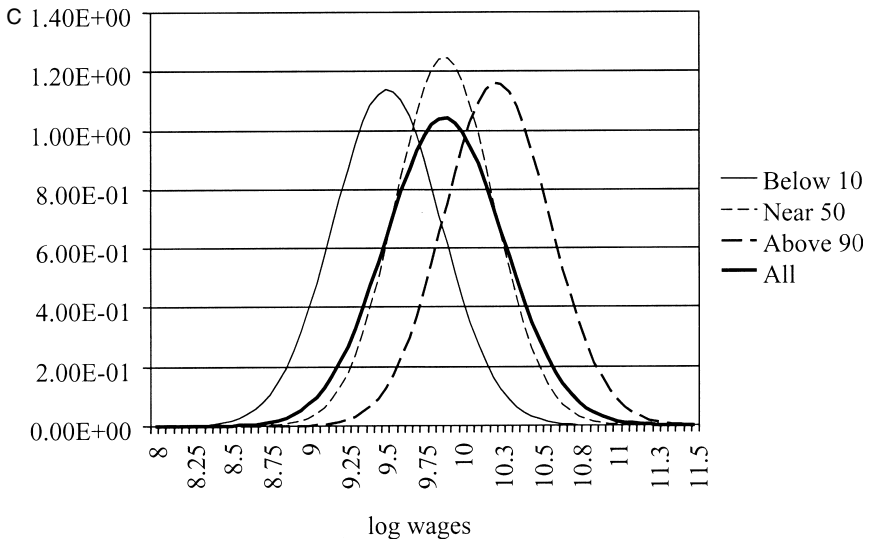

Fig. I.3 (cont.)

within-firm standard deviation of wages divided by the country's standard deviation of wages. Figure I.4 shows that, on average, the dispersion of wages within firms is about 60 percent to 80 percent of the total wage dispersion for the country (across individuals). Figure I.5 graphs the ratio of the standard deviation of the mean wages of the firms divided by the country's mean wage. By this measure, it appears that firms don't differ much in their mean wages—the standard deviation is only 10 percent to 20 percent of the average wage for the country. However, the dispersion of mean wages for firms is high relative to the overall dispersion of means: the standard deviation of mean wages of the firms is about 60 percent of the total wage dispersion for the country (figure I.6).

Thus, these figures show that—across all countries—the structure of wages is a compromise between panels A and B of figure I.1. There is very high wage dispersion within firms. But the mean wages of firms also differ considerably: there are high-wage firms and there are low-wage firms. The figure for Norway, figure I.3, is very representative of the structure of wages across countries.

What is especially striking about these results is that it is true across all countries.[4] Figure I.7 expands upon these two points by providing the average coefficients of variation for within firms across all countries. Countries are remarkably similar: for the average firm, the standard deviation of wages is about 25 percent of the mean wage. For example, Finland has

4. The low number belongs to Italy and the Italian data contain synthetic firms that are closer to a random draw from the overall population. This reduces reported dispersion below the amount that would be present in real firms.

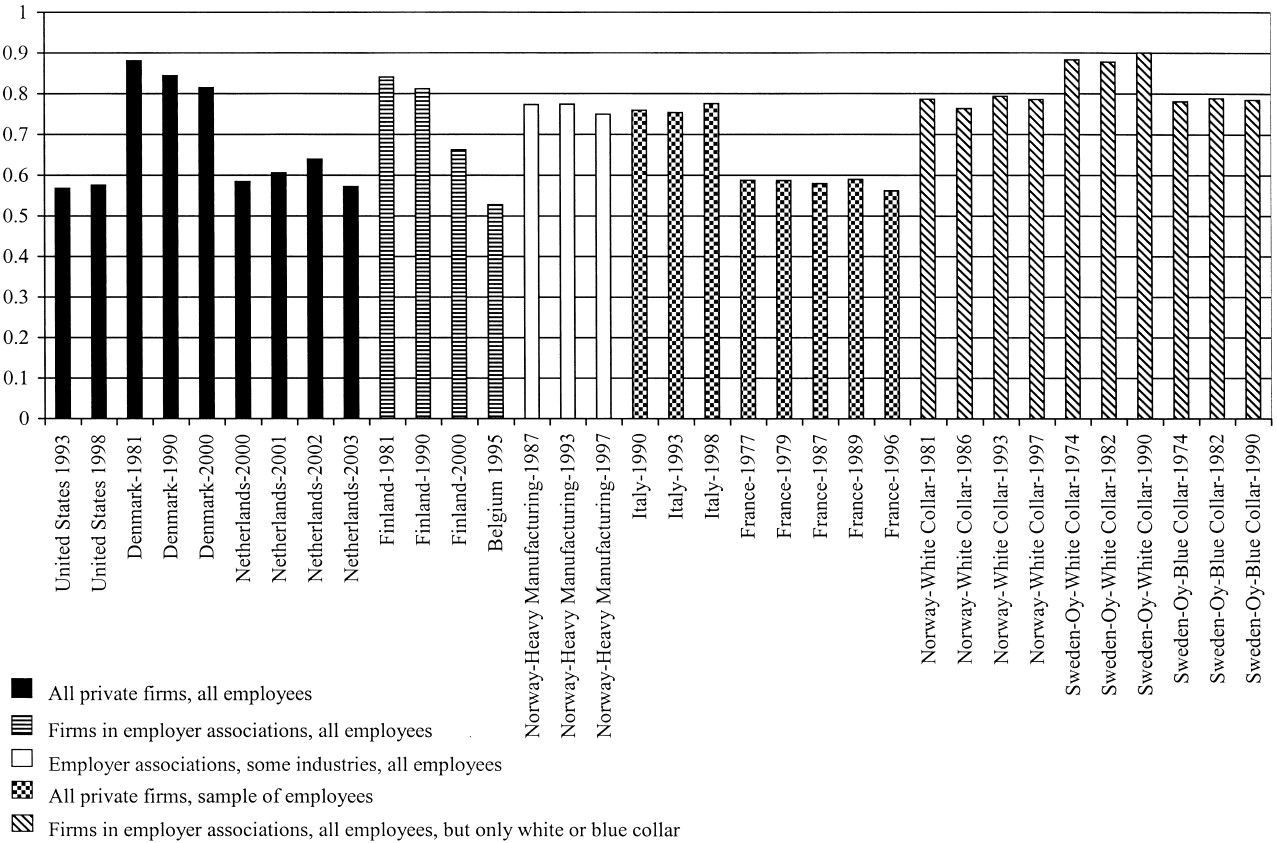

Fig. I.4 Ratio of the average within-firm standard deviation of wages to the standard deviation of wages (across all individuals)

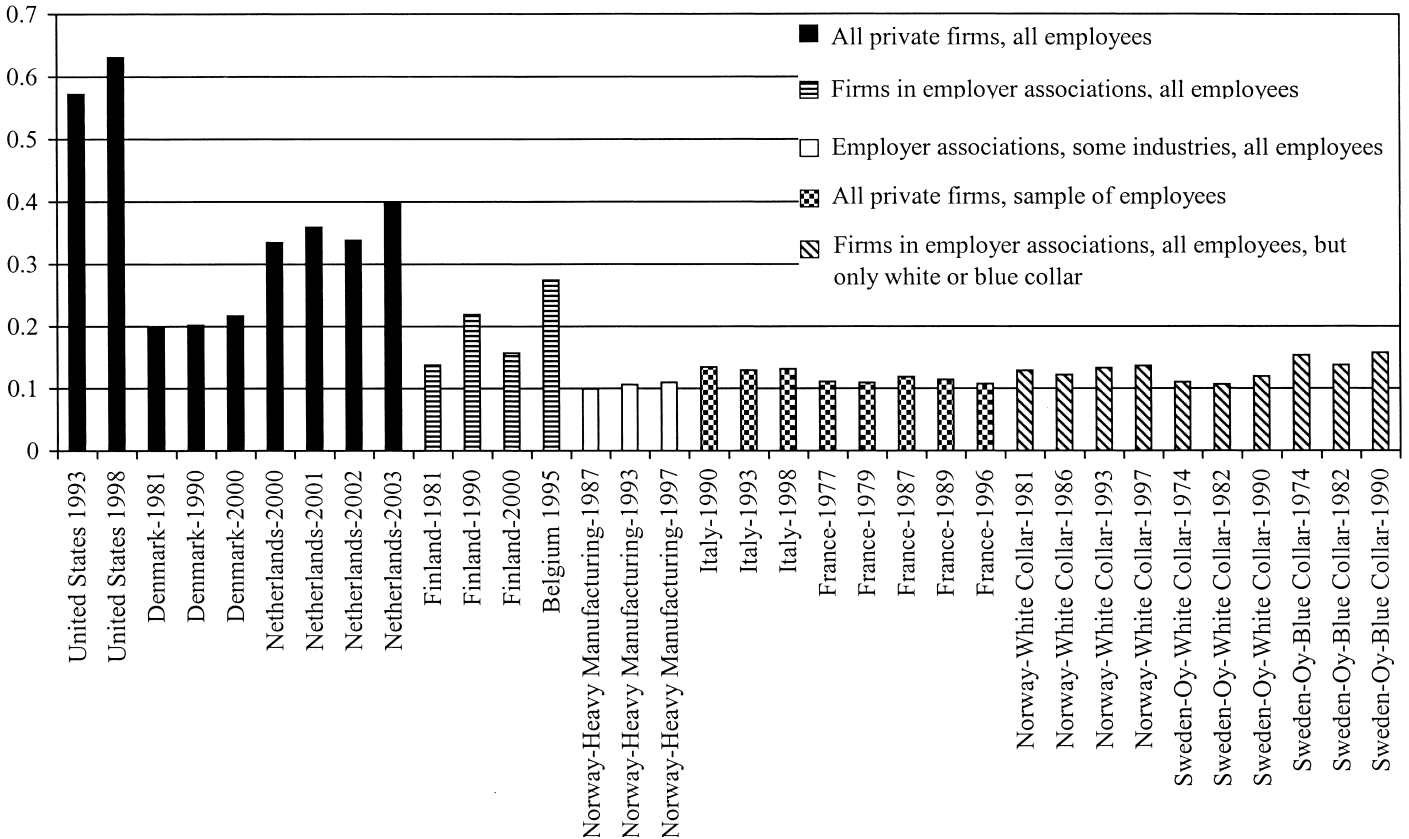

Fig. I.5 Ratio of the standard deviation of the mean wages of firms to the mean wage for the country (across all individuals)

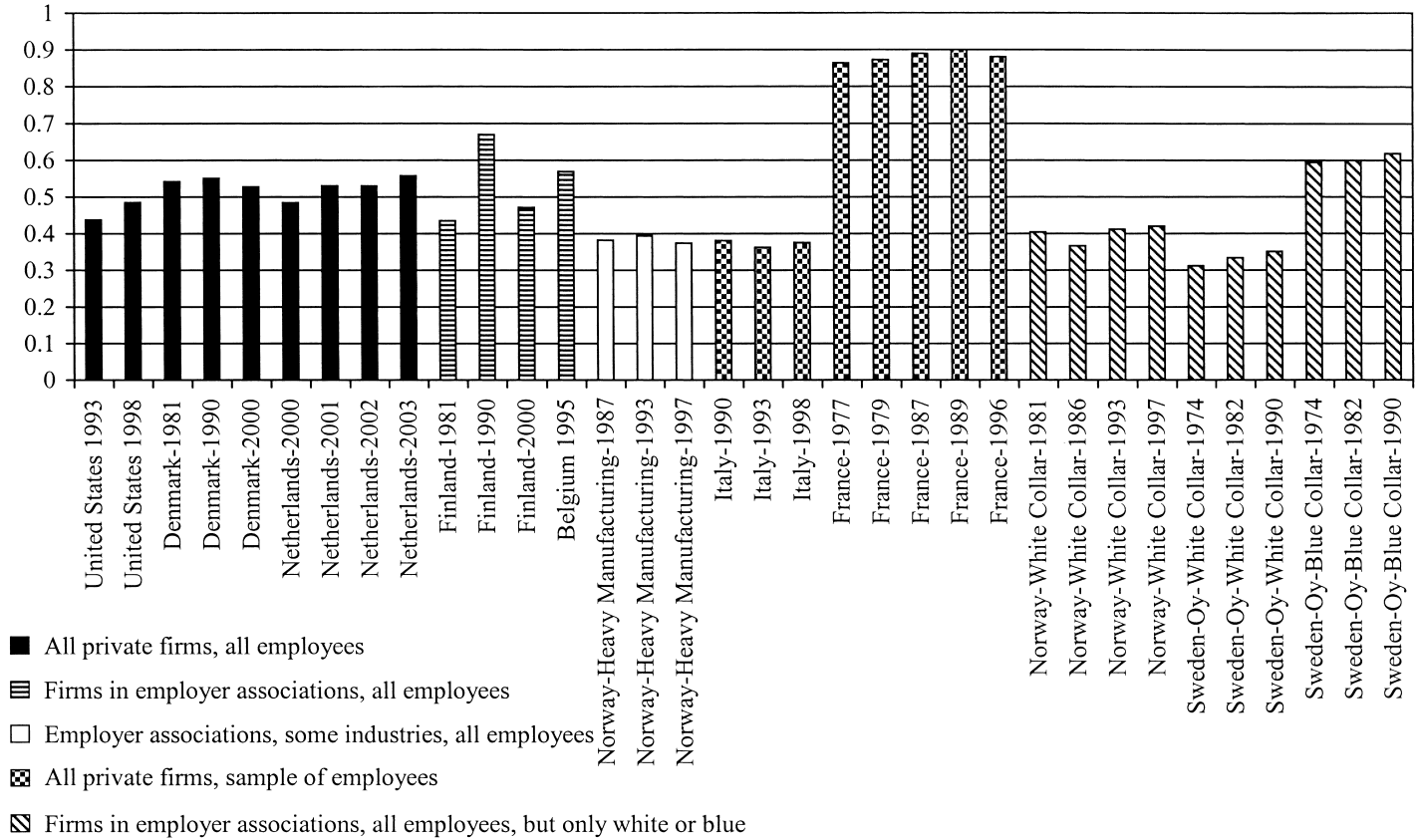

Fig. I.6 Ratio of the standard deviation of the mean wages of firms to the standard deviation of wages for the country (across all individuals)

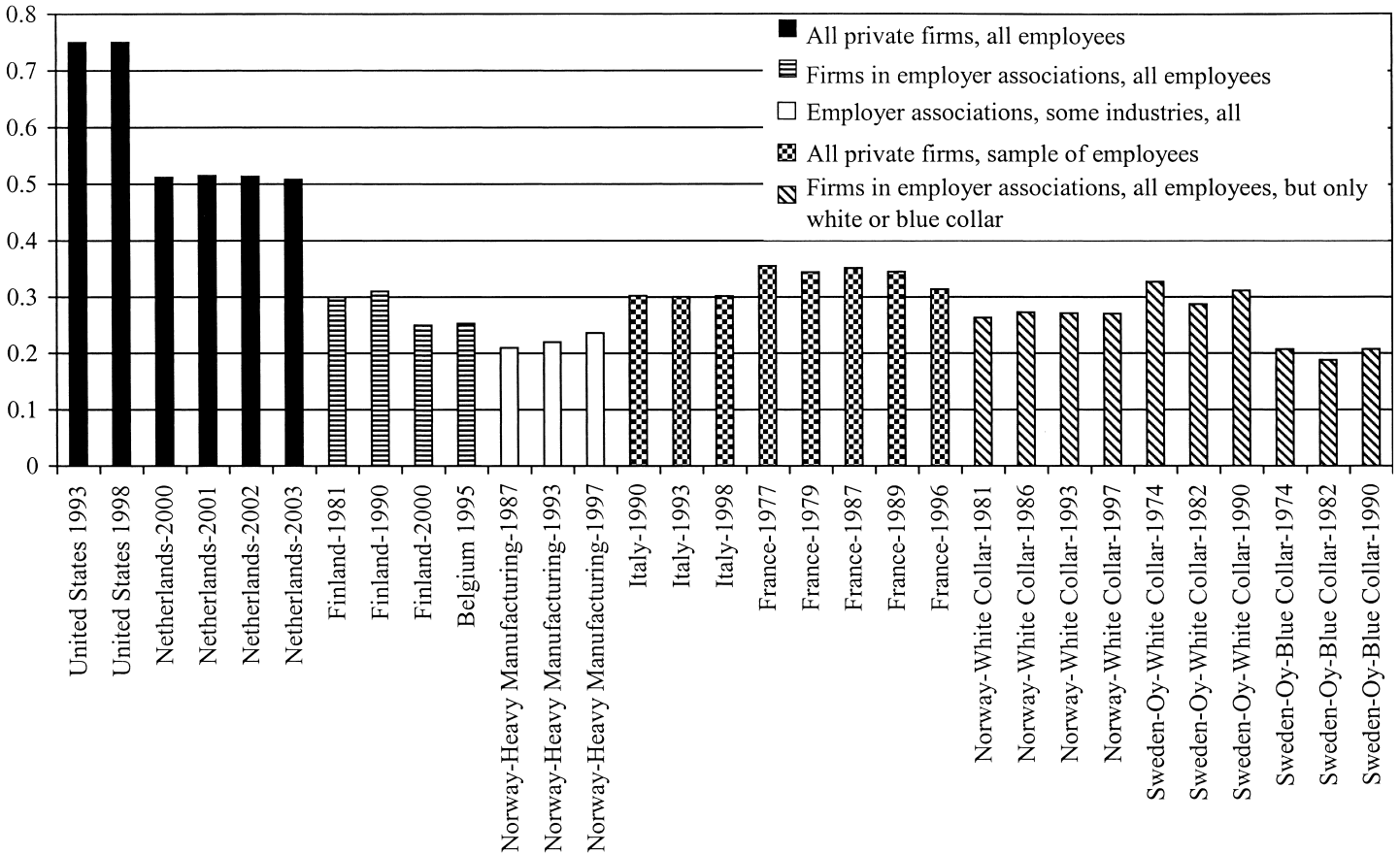

Fig. I.7 Within-firm coefficient of variation of wages

considerably different firms in that the firms with larger internal wage dispersion have coefficients of variation equal to about .35, whereas those with little internal wage dispersion have coefficients of around .15. But the average is around .25, which is about the same value as the average value for almost all countries. The average firm across Europe has a standard deviation of wages that is about one-fourth the wage of that firm. This is slightly higher in some countries and slightly lower in others, but the variation is small relative to the within-country differences in coefficients of variation for wages. Whether this reflects some kind of universal constant remains to be determined.

Thus, despite different labor market institutions, countries do not differ dramatically in their wage patterns. Does it imply that there is a typical skill distribution for all countries and these are reflected in the coefficient of variation that is seen for the country as a whole? Or does it imply that wage policies vary across firms, but tend to average out at the country level because firms adopt the same distribution of wage polices irrespective of country? These questions remain open ones, but we turn to themes that describe the wage patterns.

The Structure of Wages: Some Themes

What do these results tell us about our basic models of the determination of wages and productivity across workers? To answer, we begin by identifying three different models of wage setting that permeate the literature. Given these models, we then ask, why do workers differ within firms, and why do firms differ?

The best known theory of wage setting is human capital theory, which states in its most basic form that workers are paid on the basis of their general skills and that these skills can be measured as a scaler, meaning that there is one skill, and everything can be expressed in efficiency units of that skill. The wage equation for individual wages is:

$$w_{ijt} = \beta_0 + \beta_1 \text{Educ}_{ijt} + \beta_2 \text{Exper}_{ijt}, \tag{2}$$

where wages for person i in firm j at time t are a function of his or her education and experience. Were human capital the only determinant of wages, then it would not matter at all in which firm a worker finds him- or herself. The competitive labor market would require that all firms pay the worker exactly the same thing, irrespective of the firm in which he or she works. Otherwise, other firms could easily steal him or her away by paying a slightly higher wage and capturing the profits. This is most easily described as a spot market view of the labor market, where competition forces workers to be paid on the basis of the productivity, which is in turn reflected perfectly in measurable skills. The β_1 and β_2 in equation (2) measure the rates of return to skills.

Table I.2 Models of wage setting that would produce figures I.1

	Wages vary within firms: Broad dispersion of skill or effort within the firm.	Wages vary across firms: Workers sort into firms based on their skill or effort levels.
	Panel A of figure I.1: All firms alike, but high within-firm wage dispersion $\overline{w}_j = \overline{\overline{w}}_.; \sigma_{\overline{w}l} = 0$	Panel B of figure I.1: All workers paid same within firm; Panel firms differ in mean wages. $\overline{w}_j \neq \overline{\overline{w}}_.; \sigma_{\overline{w}l} > 0; \sigma_{wl}$, *low*;
Wage setting based on occupation (human capital skills)	All firms have a broad distribution of occupations within the firm (same distribution of human capital).	Wage structures differ across firms because there is one occupation per firm. Workers sort into firms by occupation or by skill level.
Wage setting based on wage policy aimed incentive pay (e.g., piece rates or tournaments) or at wage compression	Workers identical skills; tournament or piece rates create pay dispersion. Or workers differ in ambition, but distribution of types identical in every firm.	Workers sort across firms according to preferences for piece rate pay. Narrow wage dispersion implies no tournaments; there is pay compression within the firm.
Institutional wage setting (such as unions) for sharing rents between worker and firm	All firms have a broad distribution of occupations or job titles on which wages are based, or a steep seniority structure on which wages are based.	Wage structures differ across because workers sort by firms occupation, or because pay is a function of the profitability of the firm.

The human capital model of wage setting does not tell us why wages differ within or across firms because firms are irrelevant. Firms matter if we add a model of worker sorting across firms and thus of differences in the underlying production functions of firms. Table I.2 lays out the alternatives. In column (1), there is large wage dispersion within firms, and all firms are identical (mimicking panel A of figure I.1). There is high wage dispersion within firms if the within-firm production function requires a combination of workers with different skills to optimally produce output. The appropriate model of the firm would be one in which workers within the firm have complementary skills, as in models of teamwork or of hierarchy.[5] In contrast, if firms differ by occupation, then workers are likely to be sorted by occupation or skill: the within-firm wage dispersion is low, but there are large differences in mean wages across firms (as in column [2] of table I.2). Last, it is likely that mean wages and the variance of wages are positively correlated: high-human-capital firms (like law firms or large businesses) are more likely to have teams or hierarchies that produce higher wage variance than low-wage, low-human-capital firms. A law firm will

5. See Lazear (1999) for a model of complementary team workers and Hubbard (2000) for a model of complementary workers within a hierarchy.

have high-wage lawyers and lower-wage assistants and janitors, but a janitorial service firm will have few high-paid managers. This theoretical positive correlation between the mean wage and variance is displayed in figure I.2.

An alternative model of wage setting, a purely institutional theory of wage determination, also has the implication that a worker's wage is independent of the firm in which he or she is employed. Suppose that wages were set by a central authority and the authority set the wage based on the worker's occupational title, where his or her occupational title was determined by his or her worker characteristics. For example, a particular level of experience and educational background could be used to determine occupational status using some index, such as

$$w_{ijt} = \beta_0 + b\,\mathrm{Educ}_{ijt} + c\,\mathrm{Exper}_{ijt}. \tag{3}$$

Although the index might look similar to a human capital wage function, there need be no direct relation of the coefficients b and c to anything having to do with productivity. The central authority, such as a union, might simply determine that the selected weights b and c are appropriate in some sense, based on equity or any other consideration. In the institutional model, the sharing of rents between the worker and firm is determined by institutional rules (such as those set by union negotiations).

As in the human capital model, the institutional model predicts wage dispersion within firms if firms contain many occupations, or, alternatively, predicts very different mean wages across firms if firms are organized by occupation or industry (comparing the predictions of columns [1] and [2] of row [2] in table I.2). The institutional model differs from the human capital model in that the underlying model of wage setting is quite different despite similar predictions. In an institutional model of wage setting, pay dispersion may arise within the firm if pay rises with seniority, even if all workers have the same level of human capital. Alternatively, workers may have very different levels of human capital, but the same wages within the firm, if unions compress all wages to be equal. Firm profitability also enters. If negotiated pay is a function of the profitability of the firm, there will be little wage dispersion within the firm, but very different mean wages across firms as a function of profits. In this case, "a rising tide lifts all boats": rising profits raise the pay for all workers in the firm, and there is no wage dispersion within the firm.

Finally, firms can have "wage policies" that are aimed at incentives for effort or at optimal sorting and that thereby affect wage dispersion. Most wage policies that are aimed at pay for performance will increase wage dispersion within firms. That is true of piece-rate policies or of implicit contract theories that create divergence between wages and productivity. Consider first the piece-rate model, in which a firm pays a piece rate that is given by

$$\text{Pay}_{ijt} = a + b\,\text{Output}_{ijt}. \tag{4}$$

The higher is b, the greater is the amount of effort that a worker puts into a job.[6] Thus, if workers differ in skills or in effort, then piece-rate pay accentuates the variance of pay within firms. Similarly, tournament models increase within-firm pay variance as well. Tournament models (Lazear and Rosen 1981), which are most applicable to white-collar workers, suggest that wage structures within firms serve incentive purposes and that it is the hierarchical structure of accelerating wages at each level, rather than the current wage, that determines the strength of the incentives. In tournament theories, workers at higher levels of the firm's hierarchy receive pay that has impacts on those below them. Lower-level workers want to become higher-level workers, and their desire to climb the internal job ladder depends on the raise that workers receive when they are promoted (nonmonetary as well as monetary). Because the optimal size of the raise depends on internal conditions like the riskiness of the activity and the shape of the firm's hierarchy and the firm's production function, tournament theory suggests that workers will be treated differently in different types of firms, even when the workers have the same basic characteristics. Overall, tournaments increase pay dispersion within firms, holding fixed the level of human capital.

Wage policies, such as forms of incentive pay, can also cause striking differences in mean wages across firms due to worker sorting.[7] Firms offering incentive pay are also the high-wage, high-effort firms. Those firms without incentive pay are low wage, low effort, and thus there is variance of mean wages across firms when workers preferring the high effort firm sort to those and others do not (as summarized in column [2] of table I.2). These differences in mean wages and incentives reflect differences in the production environment that determines the value of incentive pay.

In sum, these models suggest at least two possible reasons why firms might have significant within-firm variation in wages. First, and most obvious, is that workers are different. The workers that firms employ within are not identical, and, as a result, wages reflect the skill heterogeneity of the workers within the firm. Those wages might be determined completely externally, either by a competitive labor market process, in the extreme by a spot market, or by a centralized wage setter, like a government or tripartite (labor, management, government) body. If worker skills are different within firms and wages are set externally, then wages within firms will reflect the underlying skill distributions within them.

6. The worker maximizes $a + b$ (output) – C(output), where C(output) is the effort cost of producing a given output level and where $C' > 0$. The first order condition is C'(output) = b. Because $C' > 0$, increasing b increases the amount of effort.

7. For example, see McLeod and Malcolmson (1989) and Stole and Zweibel (1996) for models of bargaining theories, where the outside alternatives as well as the worker's value to the firm affect the actual wage level, and thus create differences in what firms pay.

Alternatively, the wage variance within the firm might reflect wage policy, not skill heterogeneity. Even if all workers were identical ex ante, a wage policy could result in paying different wages to different people. This happens in a tournament, for example, where pay is more dispersed than ex ante talent and where the relation of pay to ex post output is positive, but with a correlation far from 1. In the other direction is that wages may be more compressed than ex ante ability. Pay compression might simply reflect wage policy of the firm. It is well known, for example, that certain institutions, like labor unions, compress wages relative to nonunion firms. It is also possible that wage setting in a centralized or negotiated environment might result in wage compression that brings up the wages of the least skilled and cuts the wages of the most skilled. There is no reason why this pattern would necessarily be uniform across firms, industries, or occupations. Thus, pay policy is another variable that lies behind the within-firm wage distribution.

It is key to try to disentangle these alternative explanations. That takes us beyond this introductory analysis, but in the next sections, we will describe evidence that speaks to these differences and will try to suggest additional questions or lines of research that might assist in obtaining answers.

The Structure of Wages: Disentangling the Themes

The data show that across all countries there is very significant wage dispersion within firms. However, firms are different: mean wages vary considerably.

We cannot identify whether the wage dispersion within firms is due to the heterogeneity of skills within firms or due to wage policies of incentive pay that increase pay variance. However, some forms of wage policies can be rejected. We have two pieces of evidence rejecting the possibility that firms compress pay within the firm (relative to market-level wage rates). The first is the correlation between firms' mean wages and firms' spread in wages within each firm. Second is the correlation between the wage spread in the firm and worker mobility.

Wage Level and Wage Variance

There is a positive correlation between the log wage and the within-firm variance of the log wage (figure I.8). The correlation ranges between .1 and .3 across countries. There are a number of interpretations of this finding. Two are worth mentioning. The first is causal; the second is statistical.

One causal explanation is the human capital story: firms that have high levels of human capital are more likely to have a high within-firm variance of human capital. The second causal explanation is more subtle, regarding wage policy. Apparently, firms are rejecting policies of pay compression in favor of policies of within-firm incentives and human capital growth. A

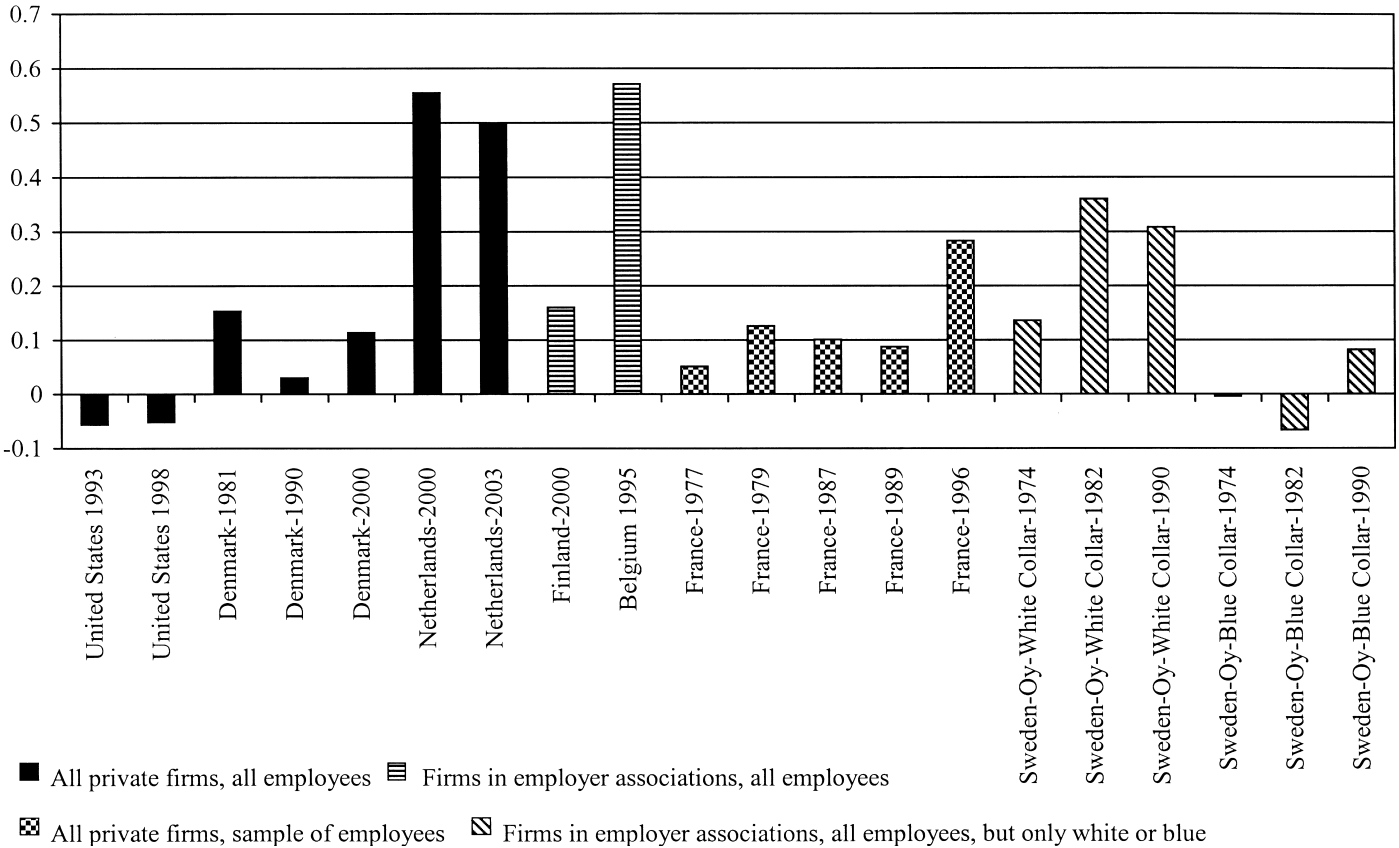

Fig. I.8 Correlation of the within-firm standard deviation of log (wages) and the within-firm mean log (wage)

policy of pay compression—or egalitarian pay and compressed incentives—could arise in large firms with high mean wages. Such a policy of pay compression could increase performance if it enhances teamwork and workers are very complementary (or have high amounts of firm-specific human capital). However, such a policy could be harmful to productivity—it would induce adverse sorting and adverse incentives: the top performers would sort out of the firm and would work less hard if the firm lacks tournaments or piece-rate pay.[8] The data rejects pay compression: high-wage firms are also high-incentive, high human capital firms. In the next subsection, we provide evidence on mobility that also rejects the pay compression model.

A second explanation for the correlation between average wage and its standard deviation is purely statistical. It is well known that the distribution of wages is positively skewed: there is significant positive skew in worker ability. Suppose that firms are partitions of the overall income distribution. A positive correlation between average and standard deviation of wage would result. For example, suppose that wage distribution is partitioned into two firms: the bottom 50 percent of wage earners work for the low-wage firm, and the top 50 percent worked for the high-wage firm. The high-wage firm would have higher variance due to the positive skew of the overall income distribution. Thus, if there are low- and high-wage firms due to people sorting by human capital levels across firms, the skewness of the wage distribution will produce a positive correlation between wages levels and variance.[9]

Finally, the basic results—of positively correlated mean and wage variance—rule out the "extreme sorting" of workers into firms according to either their occupation, skill, or effort level. Even within the high-wage firms, there are lower-wage workers: high-wage firms are not just firms of lawyers or high-tech programmers. Law firms must have janitors, but building cleaning contracting firms need not have lawyers.

8. The sorting mechanism is more important at the firm level than at the country level. Between country there is less sorting than between firms within a country. Workers who do not like pay compression in Sweden might choose to move to Denmark, but less readily than those at Volvo move to Saab. As a result, the correlation between average wage and variance in wage might be expected to be stronger within county than between. (It is difficult to compare wages across countries because of exchange rates, purchasing power parity [PPP] issues of nontradeable goods, etc.)

9. The positive skew could be due to luck or effort, or both. Assume the firm has a wage policy of incentive pay. When the firm gets "lucky," the incentive pay rewards all those within the firm, but it rewards the highest paid the most. An extreme example of this would be stock options. For example, Microsoft was a high wage and a high wage variance firm due to options and incentive pay. When Microsoft got lucky, many within Microsoft did well. Because greater amounts of stock options and incentives are given out to those at the highest pay levels, there is a positive correlation between pay level and variance. Researchers could examine the role of luck by looking more closely at the role of individual fixed effects versus firm effects in contributing to high variance income.

Wage Level and Worker Mobility

A key determinant of whether within-firm wage variation reflects wage policy or underlying characteristics is the pattern of mobility. For example, consider a firm that has a small standard deviation of the log of wages. This could reflect a policy of pay compression, or it could reflect a homogeneous workforce. If it is pay compression that hurts the top relative to the bottom, then the top workers should be more likely to leave the firm than the bottom workers. If we find a pattern where firms with tight wage distributions also have disproportionate exit of the highest paid workers, then the inference that we would draw is that the pay compression is policy. Conversely, if low-wage workers have their pay increased relative to the market in such firms, then they should be less likely to leave. There would be no reason for top workers to leave disproportionately nor for bottom workers to stay disproportionately if all were paid their competitive wage.

Figure I.9 provides some evidence. The exit rates of workers who are highly paid but work in compressed pay firms are lower than the exit rates of top workers in noncompressed firms. If these findings hold up, they would suggest that the pattern observed reflects worker heterogeneity more than it does wage policy. That is, firms that have more compressed wages have a more homogeneous workforce, and within that workforce there is less difference between the top workers and the median workers. As a result, top workers are less likely to be underpaid in that environment and less likely to exit. Overall, we do not find evidence that pay compression in firms is pushing out more skilled workers. We leave it to future research to disentangle the relationship between compression and mobility.[10]

In sum, firms that allow high wage spread also have higher wages. This pushes a productivity interpretation: firms that allow disparate wage treatment also reap the benefit through incentive and selection effects of higher productivity. Firms that compress wages drive out their best workers and stifle incentives to produce. However, workers don't exit more in compressed wage firms. Apparently, firms with compressed wages also have higher wage levels or lower skill levels. But across all countries, we find no evidence that policies of pay compression are reducing productivity.

The general conclusion from this section is that there is considerable within-firm variance in wages in all countries. Although firms differ considerably within a country, both in terms of average wage and in terms of wage spread, there is a significant amount of variation within each firm.

10. Why is pay compression and exit rate negatively correlated? It could be because large firms have high exit rates and have high but compressed wages. In these data, exit rates are lower in large firms that have compressed wage structures. It could also be because highly skilled workers avoid compressed pay firms. Or it could be that unions compress wages and raise wages.

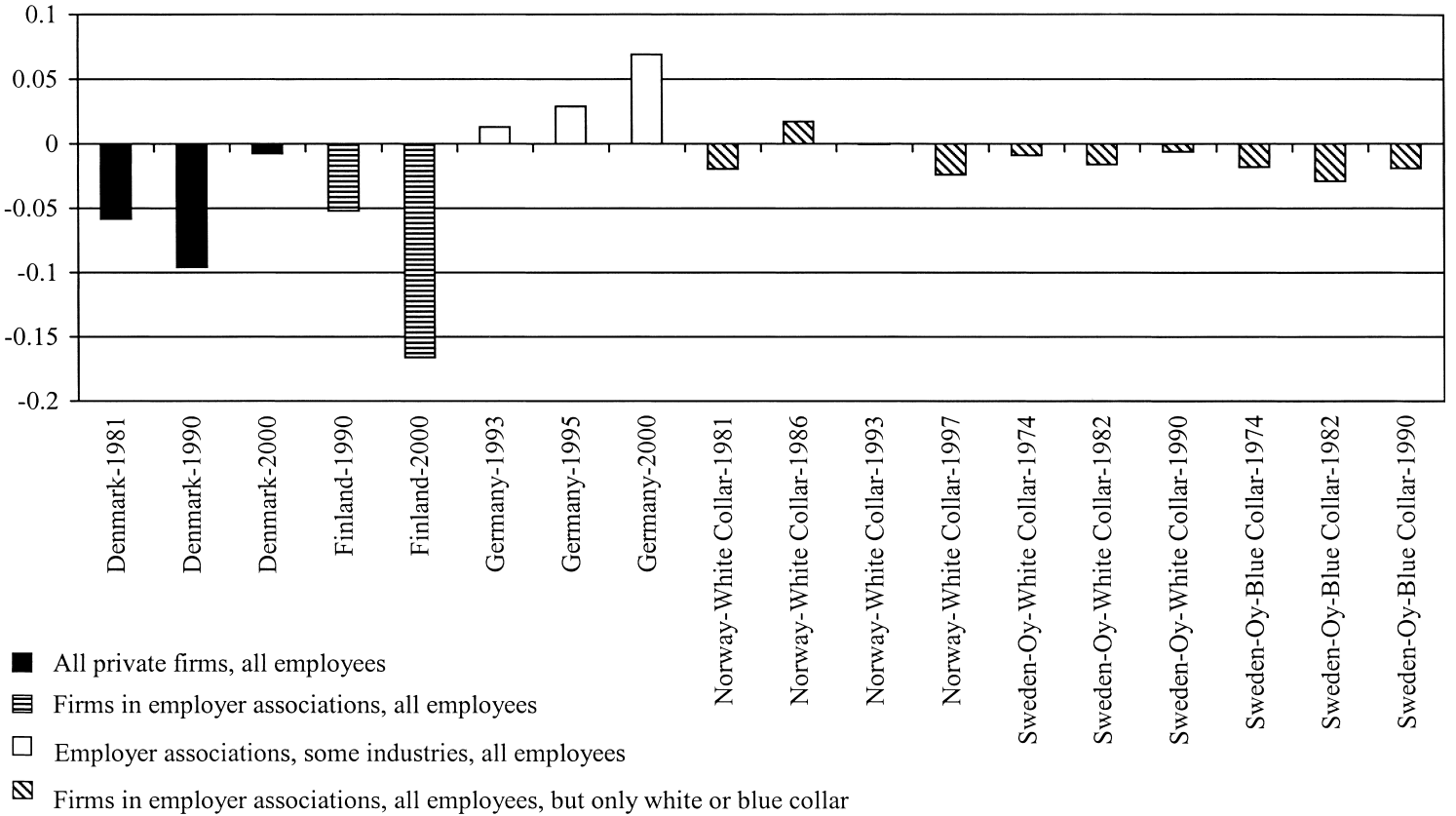

Fig. I.9 Difference between exit rate of workers whose wages are in the 90th percentile of wages within the firm for workers in firms with compressed wages, minus the exit rate for workers in the 90th percentile in firms with noncompressed wages

Notes: "Compressed wages" means the firm's wage variance is below the median. "Noncompressed" means the firm's wage variance is above the median.

Some of this reflects differences in workers within each firm, but some may reflect wage policy. At this point, it is difficult to distinguish, but the wage compression evidence points more to heterogeneity than to wage policy.

Wage Growth

Alternative views of the sources of wage growth build directly from the themes developed in the preceding in studying the variation in wage levels across and within firms. Imagine figure I.1 as a picture of the distribution of wage growth rates rather than wage levels. At one extreme is panel B of figure I.1, in which firms have very different mean pay raises. Firm-specific differences in pay raises would arise: when occupational segregation or skill heterogeneity within firms causes some firms to pay high raises in response to hot occupational labor markets; when some firms with a policy of pay compression pay lower raises due to lower performance; or when the profitability of the firm translates into pay differences through institutions or union bargaining. At the other extreme is panel A of figure I.1, in which firms have extreme heterogeneity of wage growth rates within the firm. These within-firm differences in wage growth would arise when workers build human capital at different rates within their careers in the firm; when firms respond to the external labor market pressures for wage growth that vary across the occupations within the firm; when tournaments or incentive structures introduce pay raises for effort; or when institutional seniority-based pay structures vary across occupations.

Raises within and across Firms

The data reveal extensive heterogeneity of wage growth both within each economy and within most firms. Within the economy, workers experience very different outcomes: the standard deviation of the growth of log wages is much larger than the average level of wage growth for most countries (figure I.10). In most economies, the average growth of wages is 2 to 5 percent, but the standard deviation of wages is about 10 to 30 percentage points. Workers in the 90th percentile of wage increases obtained increases in the range of 15 to 20 percent in most countries (figure I.A.1). Even when wages were not growing that rapidly, on average, some workers experienced very high wage increases. This is an interesting fact and one that could have been learned from standard panel data sources. The advantage of the new data is they enable us to look next at how the firm influences these wage changes.

Within the firm, wage dispersion is also very high. The within-firm standard deviation in wage increases is always larger than the mean wage change and, in many countries, very much larger: mean wage dispersion ranges from 5 to 15 percentage points (figure I.11). The within-firm dispersion of wage growth is often about 50 percent of the dispersion of wage

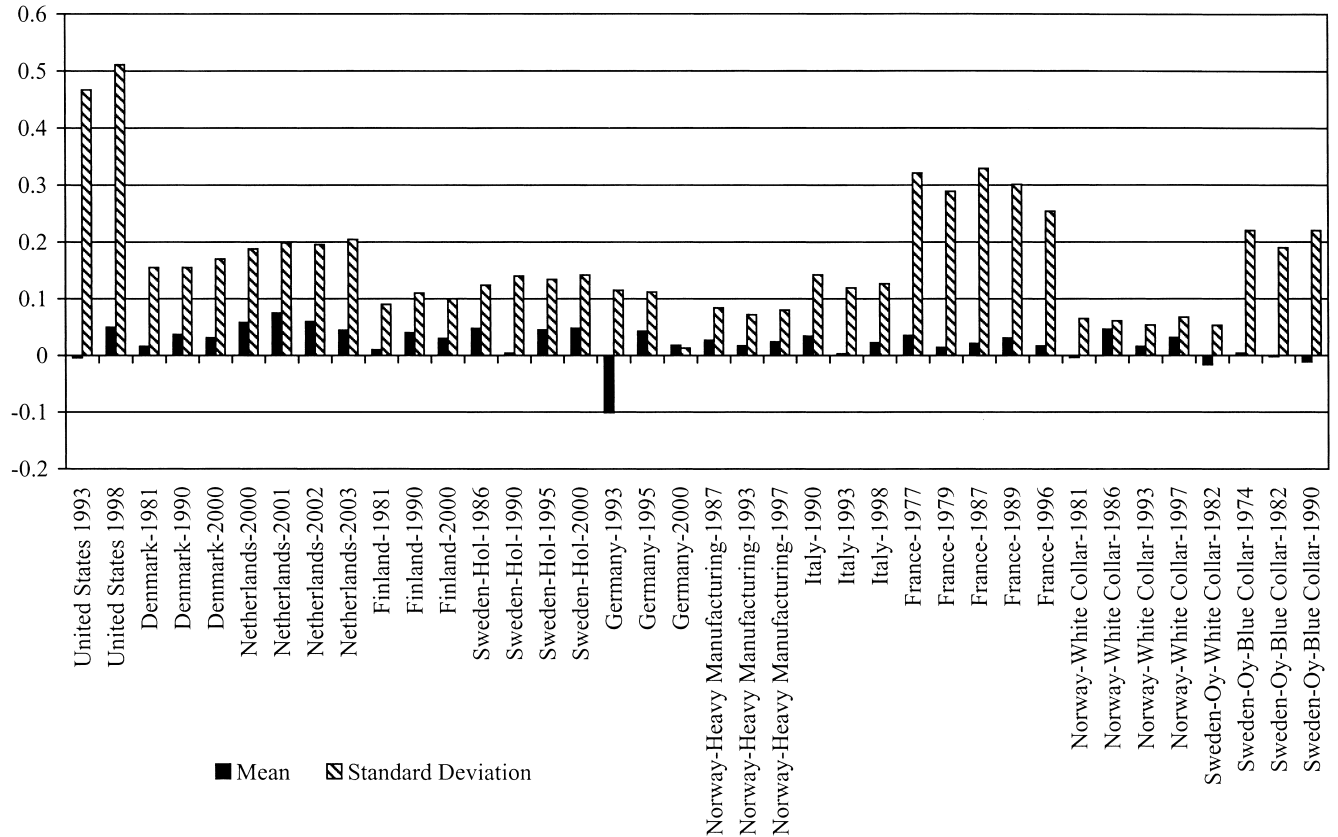

Fig. I.10 Mean and standard deviation of wage growth (across all individuals)

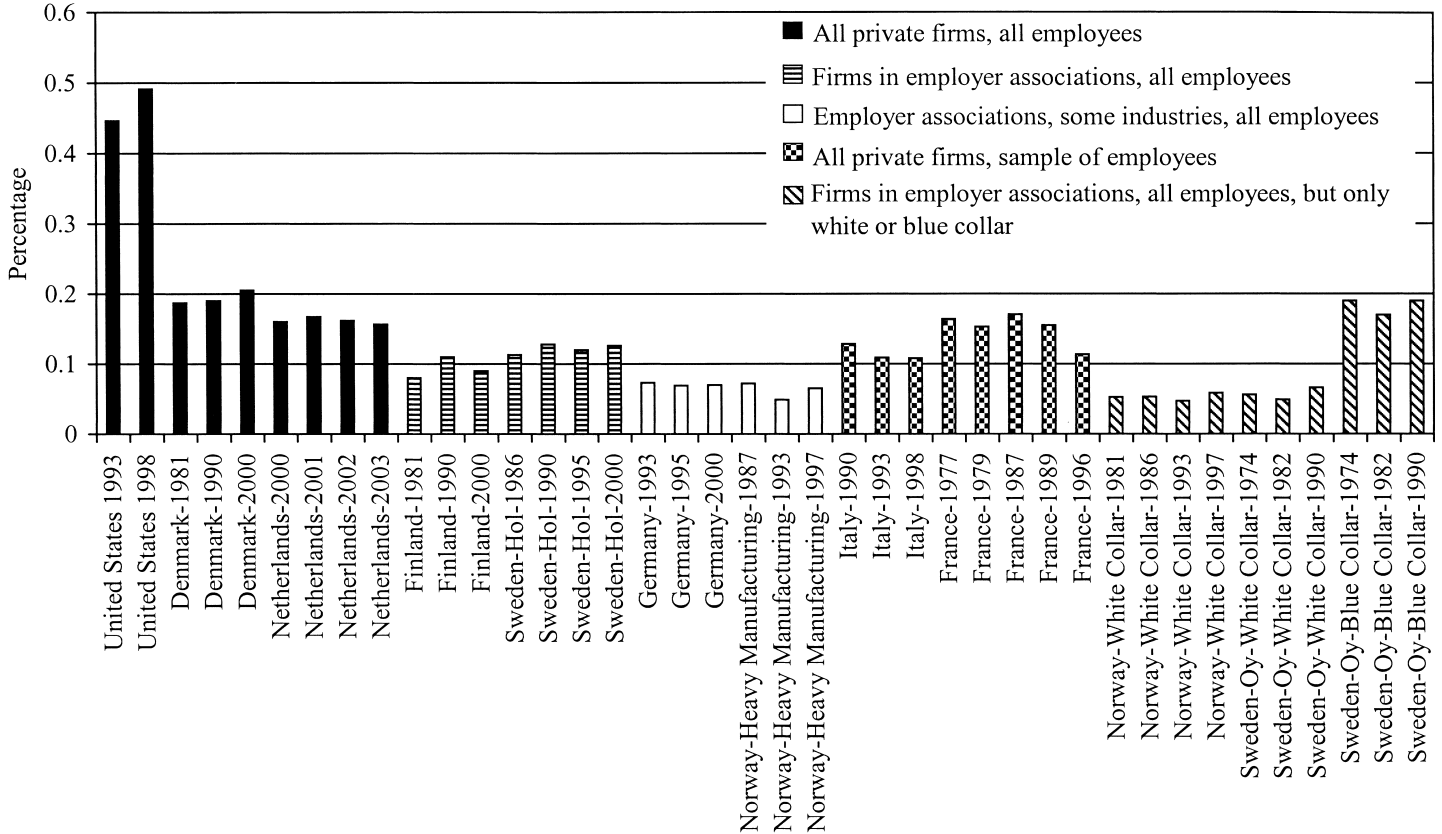

Fig. I.11 Average standard deviation of the wage growth for workers within the firm

Note: Wage growth = log (wage$_t$) – log (wage$_{t-1}$), annual change.

growth for the country. But it is often more than twice the mean wage growth for the firm. For example, in Denmark, in 2000, average wage growth for the firm was 3.4 percent. The within-firm standard deviation of growth rates was 8 percent.

Overall, a very interesting pattern emerges. The picture for wage levels is mirrored and amplified in wage growth. Figure I.12 is the wage growth counterpart to figure I.3 for wage levels. Figure I.12 shows wage growth distributions for low-wage-growth firms and high-wage-growth firms. France has higher wage growth dispersion than does Norway (according to these measures). But for all three countries, the firm is a "microcosm" of

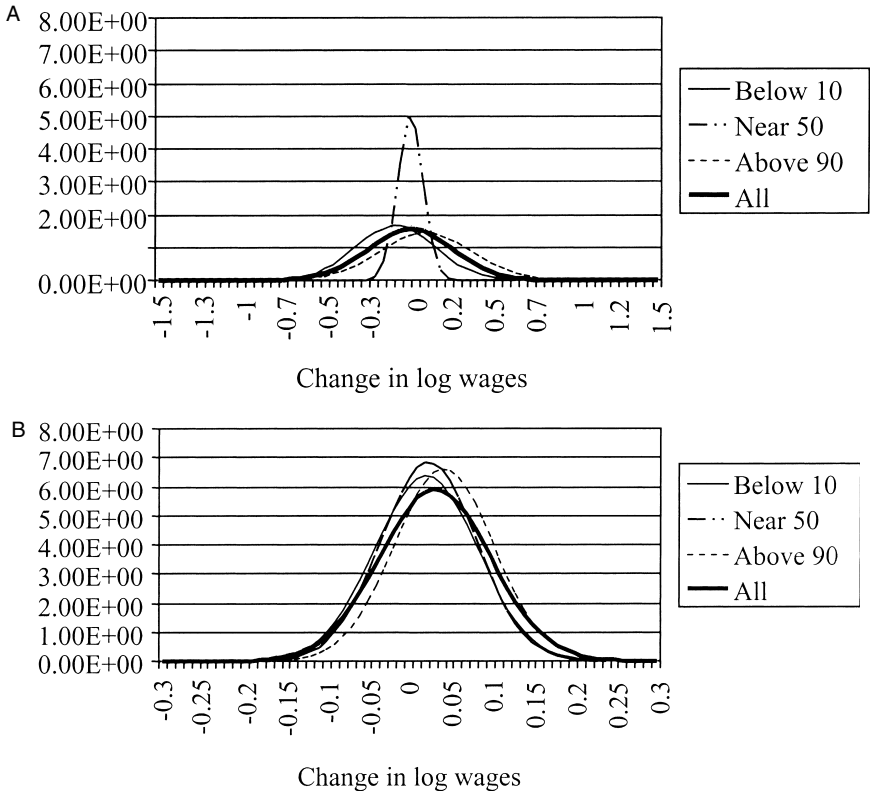

Fig. I.12 Wage growth distributions for low-wage-growth firms, median-wage-growth firms and high-wage-growth firms for some typical countries: *A*, France 1996; *B*, Norway 1997

Notes: Below 10 refers to the subsample of firms for which each firm has its mean wage growth rate of the firm below the 10th percentile of the mean wage growth rate of all firms. Near 50 refers to the subsample of firms for which each firm has its mean wage growth rate of the firm near the 50th percentile of the mean wage growth rate of all firms. Above 90 refers to the subsample of firms for which each firm has its mean wage growth rate of the firm above the 90th percentile of the mean wage growth rate of all firms. All refers to all firms.

the economy—the dispersion of wage growth within the firm is strikingly similar to wage growth across firms and individuals.

Modeling wage growth introduces a role for business cycles. One common view of business cycles and economic growth is that when things are good for some, they are good for all. When the economy is good, wages grow for the economy as a whole, and every firm and every worker experience the same increase in wage growth. In this extreme view, firms change wages in lockstep: wages rise or fall at the same rate and same time for all firms. At the other extreme, the relevant unit of analysis is the worker and the state of the economy has little effect on wage growth. Each worker's annual wage increase is an independent draw from some distribution that is a function of skills or effort. The firm wage increase is then an aggregation of its workers' increases and the economy as a whole an aggregation of the firms' increases. Of course, neither extreme will be true. But what our data shows us is that even though mean wage growth varies over time with the state of the economy, most workers' wage increases do not move in lockstep with the state of the economy, but vary widely in every year regardless of the state of the economy.

The fact that within-firm variation in wage growth is high suggests a number of things. First, a rising tide does not lift all boats, at least to the same extent. Second, the fact that wage growth is quite varied within the firm suggests that raises are tied to some other factor, like the outside labor market. Lazear and Oyer (2004) find that occupation is a much more important determinant of wage growth than is the firm. At least in Sweden, workers' wages are more closely related to their skill set than to their firms' fortunes. The same appears to be true of other countries, because the within-firm variation in wage growth is so high. High variance of wage growth within the firm also suggests high variation in human capital growth or effort across workers within the firm.

Firms are different, however, in that some firms have much more of a lockstep approach to raises than others. Figure I.13 plots the standard deviation of the change in log wage for firms that have very high within-firm variation, specifically are in the 90th percentile of firms' standard deviations of the change in the log wage. It does the same for firms in the 10th percentile. For example, in 2000 in Finland, the firms that treated workers most disparately with respect to raises had a standard deviation of Δ log wage equal to .15, whereas those that treated workers most similarly with respect to raises had a standard deviation of .05. Some firms have a lockstep raise policy. What one worker gets as a raise, the other workers get as well. Other firms do not have much within-firm conformity.

One key area for future investigation is whether the standard deviation of wage changes within the firm is fairly stable over time. Figure I.13 shows that it is remarkably constant over time for the country as a whole. Whether and why the within-firm standard deviation of raises is stable is an area for

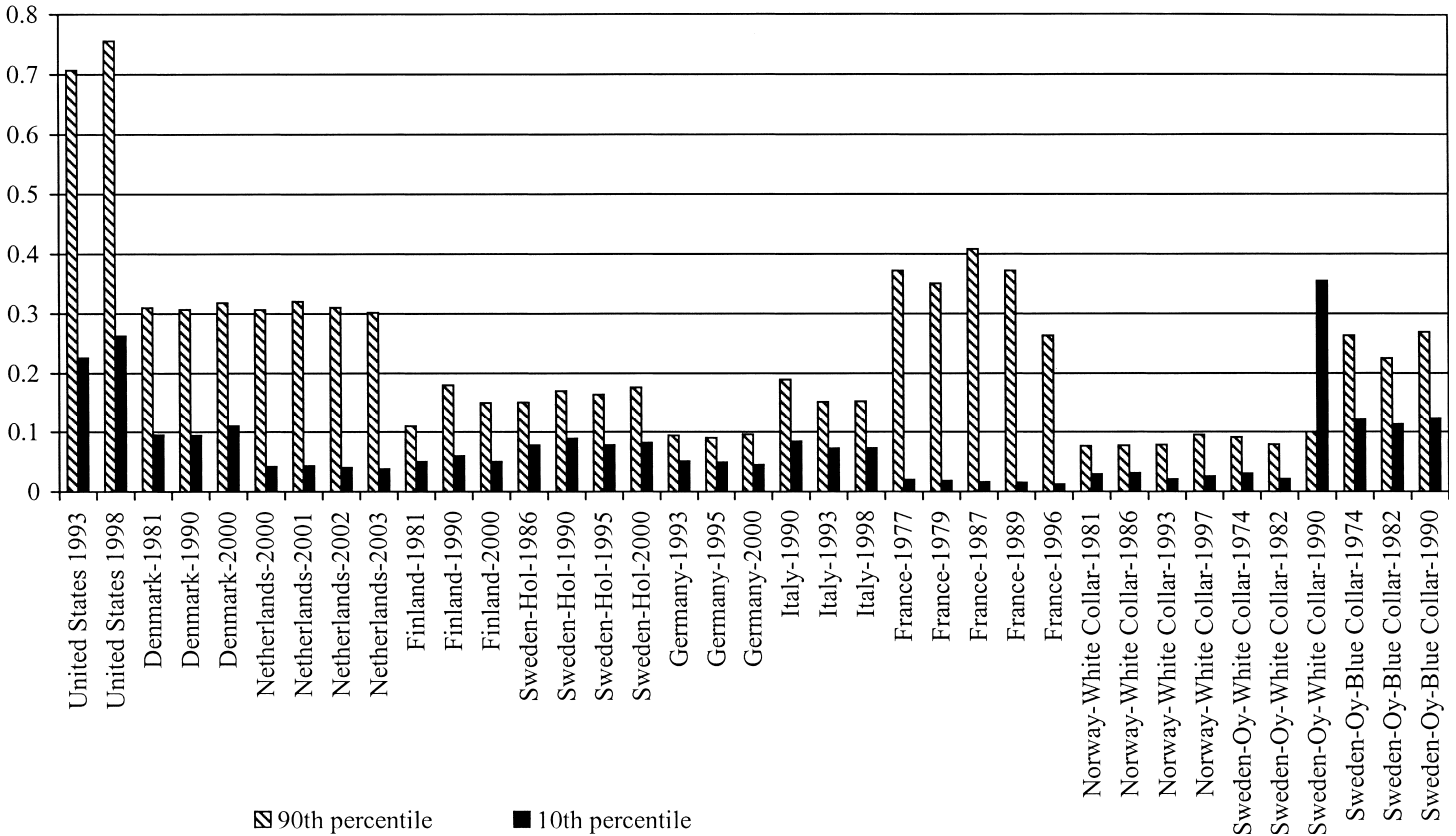

Fig. I.13 The 90th percentile and the 10th percentile of the distribution of the standard deviation of within-firm wage growth rates

future research, but a conjecture is that the structure of the firm remains relatively constant over time.[11] One way of examining this would be to estimate firm fixed effects in the wage growth equation and see if these firm effects are fixed over time and whether they contribute equally to the variance of firm growth over time.[12]

Raises and Tenure

Standard in the literature on human capital is that wage growth is more rapid during the early years of career than during the later years. The average wage increase is larger for young workers than older workers. This can come about through a variety of mechanisms. One is that young workers move across more firms than old workers. The other is that within firms, there is a policy to give larger wage increases to young workers than to older ones. That policy could reflect incentive rewards for early effort or human capital growth. Most academics experience this firsthand: academic deans invariably send out a letter each year bemoaning the small pool available for raises and justifying small senior professor raises by stating that the pool must be reserved to increase the wages of more junior professors. Is this a valid characterization of the typical firm, and how general is this policy across firms and countries?

Figure I.14 shows the difference between the wage growth rate of high-tenure workers and low-tenure workers within the firm, averaged across firms in the economy. The difference is almost always positive, and in some country years, it is large. Of course, this is wage growth for those who stay in the firm. Much of the difference in wage growth at the individual level that occurs over the life cycle may work through mobility across firms.

Young workers who are "stars" also receive considerably higher raises than older workers who are the stars within the firm. Taking the difference in the wage growth rate among the 90th percentile raises among low-tenure workers from that of the 90th percentile of high-tenure workers within the firm, this difference is positive and often 2 to 8 percentage points. This suggests more positive skew in the distribution of raises among the young than among the senior. Some young workers do very well and may be on a fast track. To ascertain that, it would be necessary to examine the pattern of

11. Wage growth dispersion within the firm should reflect the fact that some occupations enjoy relatively large increases in demand during some years, whereas other occupations enjoy large demand increases in other years. Although it is not the same occupation that experiences high wage growth over time, it is true that firms with many occupations are more likely to have more disparate wage growth than firms with few occupations. If so, there will be relative stability in the within-firm variance in wage growth, even if occupations switch places in terms of which are treated well or poorly in a given year.

12. Another question is whether firms that have little wage change also have small variance in wage change. It has long been known that at the national level, inflation and cross-sectional variation in prices are positively correlated; there is a higher variance of wage growth during periods of high inflation. We have not yet investigated this phenomenon, but it is possible to do so with these data.

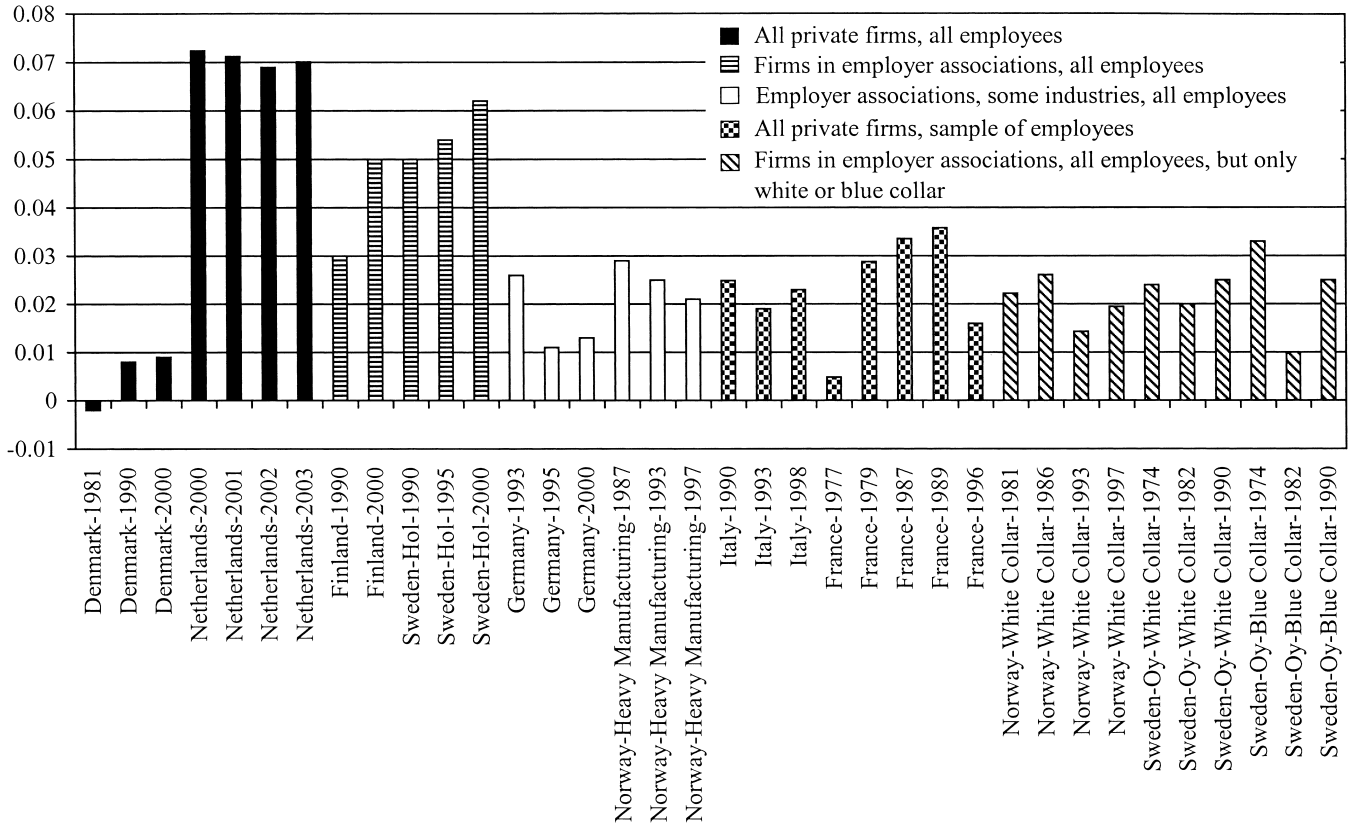

Fig. I.14 Difference in wage growth by tenure group: Low-tenure (< 3 years) wage growth rate minus high-tenure (≥ 3 years) wage growth rate

serial correlation of raises for a given worker over time, which is possible in these data but left for another study.

Mobility

Exit rates vary substantially across firms and countries. The typical firm's exit rate varies from lows of around 15 percent in Norway, Sweden, Finland, and early observations for Germany, to highs of 35 percent in France. However, we caution against comparing exit-rate levels across countries for these data. Because the different data sets measure exit over different time intervals and types of jobs, exit levels are not comparable.[13] Instead, we focus on within-country correlations. For example, in countries where exit rates are high, entry rates are also high (figure I.15). This must be true to provide an equilibrium where approximately the same number of workers are employed over time.[14]

Mobility and Wage Levels

There is a negative correlation between both exit and entry rates and wage levels (figure I.16). Firms that are high-wage firms are also low-turnover firms. This could reflect one of two phenomena. First, high-wage firms may pay above the market. Workers queue for jobs in those firms. When they finally land a job in a high-wage firm, they keep it because their alternatives are rarely better. Low-wage firms scrape for workers, lose them whenever something better comes along, and must have high hiring rates to compensate for the high quit rates.

An alternative explanation is that high-wage firms have more skilled workers, and the turnover rates for the less skilled are higher than those for the more highly skilled. Work experience could account for this alone. A firm with many high-tenure workers would be expected to have lower turnover rates than those with low-tenure workers.

A very interesting new fact comes from figure I.17. Growing firms tend to be low-wage firms. The firms with the high entry rates also have the lowest average wages. The pattern holds across countries and over all years but is stronger in some cases than others. This finding makes sense. New firms are likely to be growing more rapidly than older firms, and new firms are also likely to be smaller than mature firms. It is also interesting that the pattern holds across countries.

13. For example, exit rates based on monthly data will be much higher than those based on annual data because one job can have many workers turn over in that job within one year.

14. There are some notable exceptions. Germany, during the early 1990s, had exit rates that far exceeded entry rates. This invariably reflects the reunification and fundamental changes in the labor market that occurred during that period.

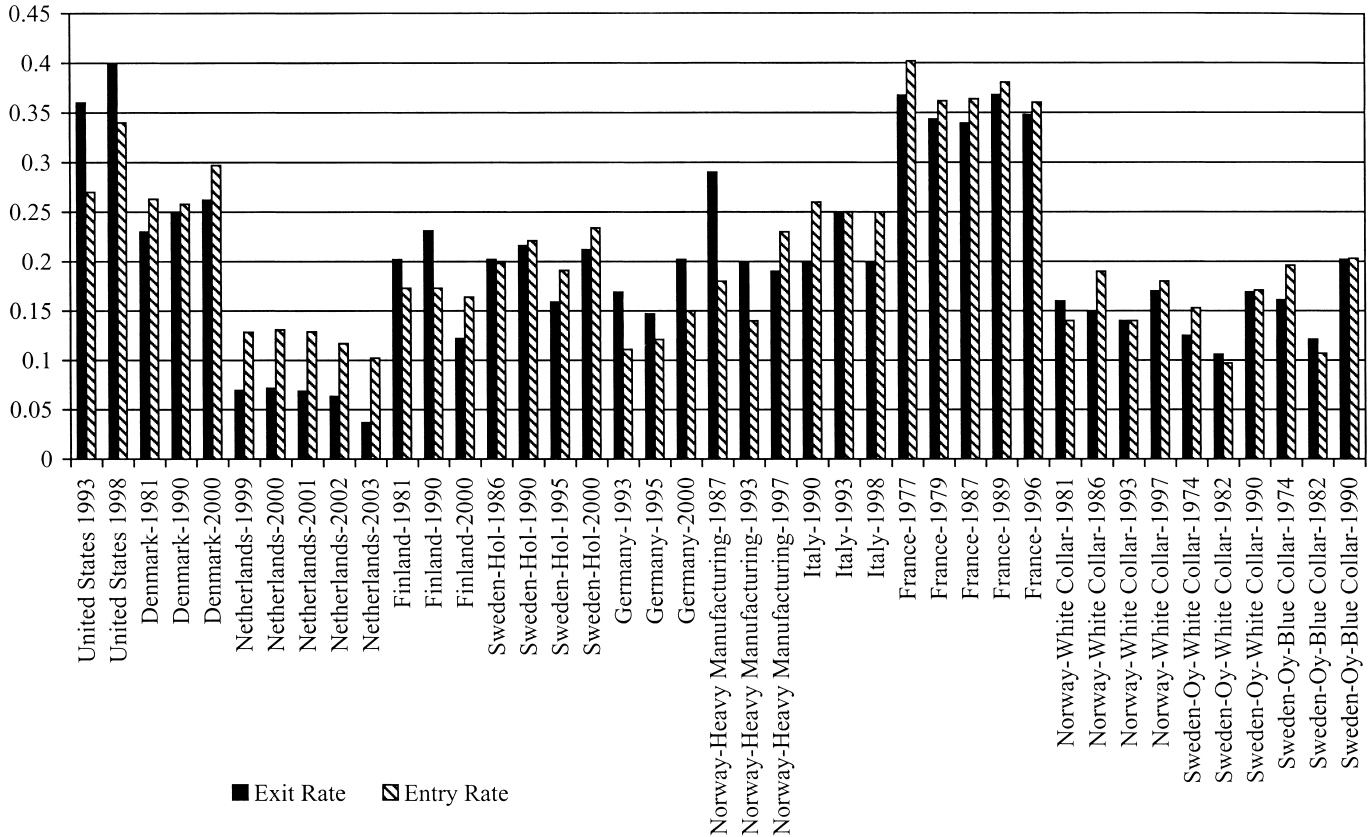

Fig. I.15 Entry and exit rates

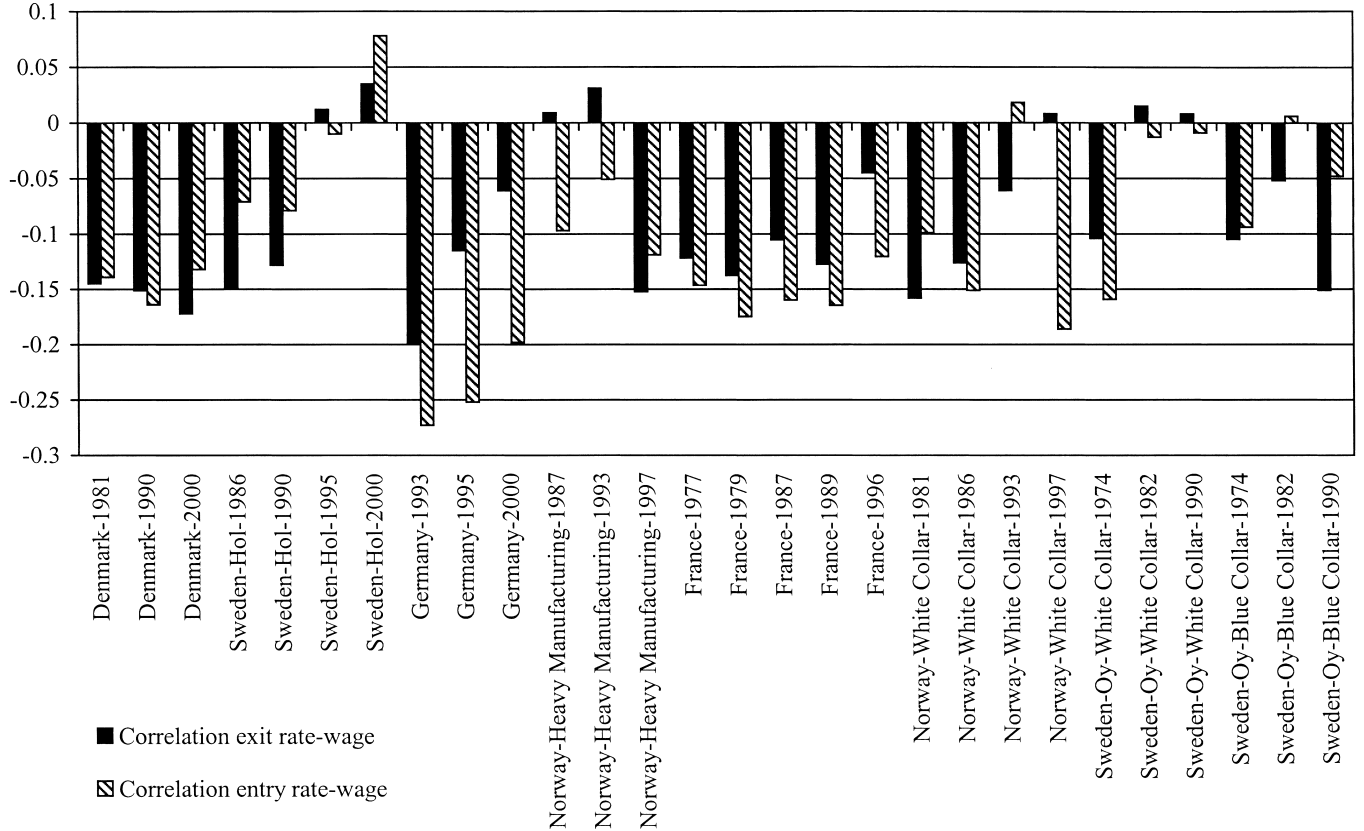

Fig. I.16 Correlation of firms' entry and exit rates with firms' average wage rate

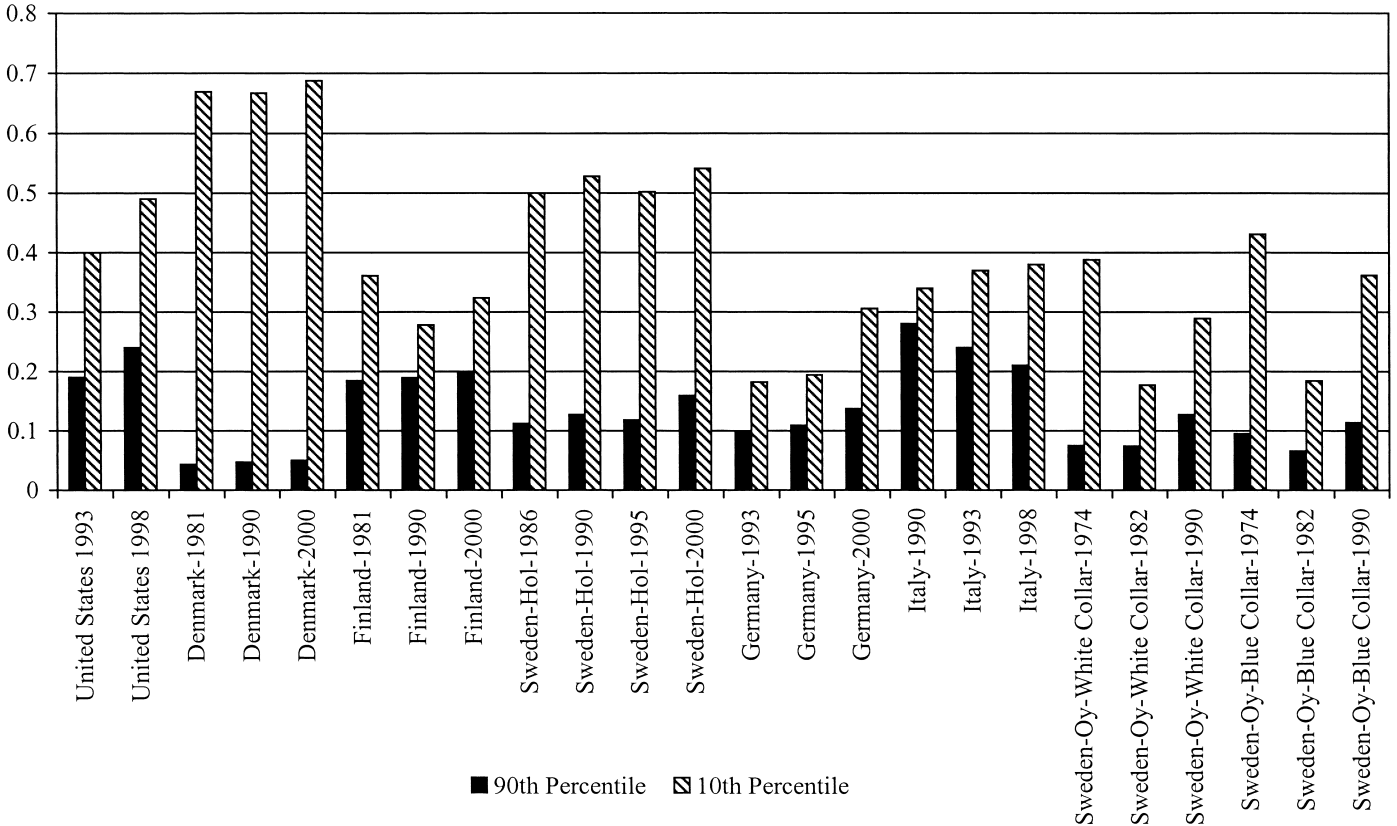

Fig. I.17 Entry rate for workers in the firm for those workers in the top 90th percentile of wages in the firm and entry rate for workers in the bottom 10th percentile of wages within the firm

Mobility and Firm Size

Another related and new fact is that exit rates and entry rates in big firms are lower than the exit and entry rates in the average firms. Figure I.18 shows that the exit rates at big firms are about 80 to 90 percent of the exit rates at average firms. The pattern is strikingly consistent across countries (with a few exceptions). The same is true of entry rates; there is less hiring at big firms and more hiring at small firms relative to the size of the firms. Figure I.19 shows the net entry rate (entry-exit rates) and then taking the difference between all firms and big firms. There is no consistent pattern. This neither supports nor rejects Gibrat's law. In some country years, there is a pattern of growth being lower in large firms. In other country years, the reverse is true. But the difference is rarely zero, which would be the prediction of Gibrat's Law. (Given the number of firms in each subsample, the differences shown in figure I.19 are most likely significant in almost all cases.) Apparently other factors are important in determining the size distribution of growth rates, and the statement that growth is independent of firm size seems to be inaccurate. A more accurate statement is that growth rates vary with firm size across time and location. The causal nature remains unknown at least for this study.

The determinants of firm turnover rates (industry, occupation, wage, skill, average tenure, etc.) could be investigated. Although we present no evidence on those factors here, it is possible to perform an analysis of this sort using the countrywide data sets used in this book.

Firm Mobility and Wage Growth

If the typical labor market allows for some rent sharing between capital and labor, worker wages should rise when firm profits rise. It is also reasonable to expect that profits and employment would be positively related. Firms that are profitable are likely to be doing more net hiring than firms that are unprofitable. When profits are down, firms typically cut the size of their labor force. As a result, good times might be accompanied by supernormal wage growth and also by supernormal employment growth. The cross-country data provide evidence on the correlation between wage and employment policy, and we believe that this is the first evidence of this sort that cuts across many firms.

Figure I.20 reports that the correlation between wage change and entry rates tends to be positive. In a given country year, firms that are raising wages are also likely to have higher than average entry rates. But firms that are raising wages do not consistently (across country years) have lower exit rates. In the most open countries, like Denmark, the finding is strong. High wage growth and low exit rates move together. But in Sweden, the results are weak and in the opposite direction. This might reflect the "dot.com boom" phenomenon. During the dot.com boom, the typical view was that

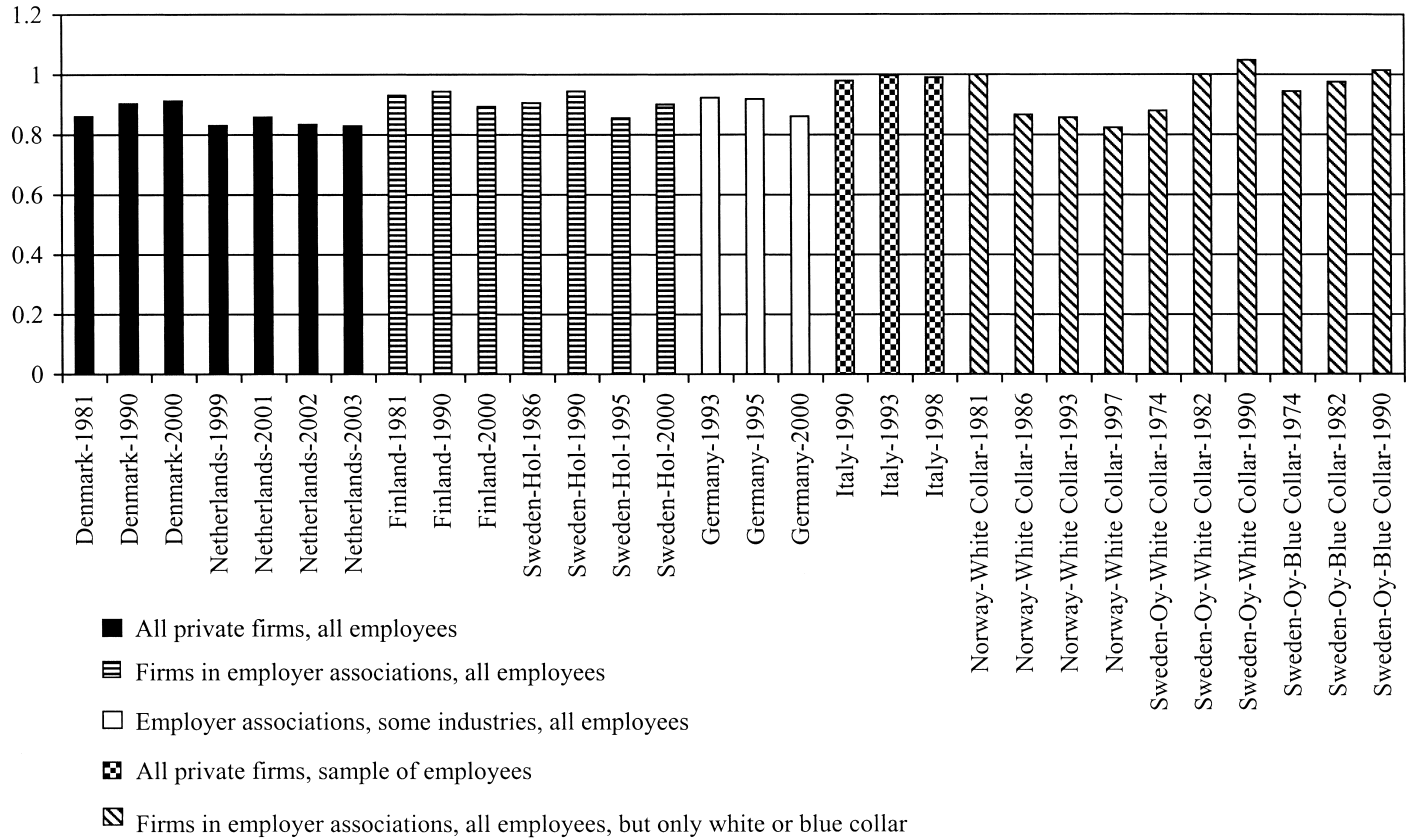

Fig. I.18 Exit rates of workers from big firms (employees ≥ 100) divided by exit rates of all firms

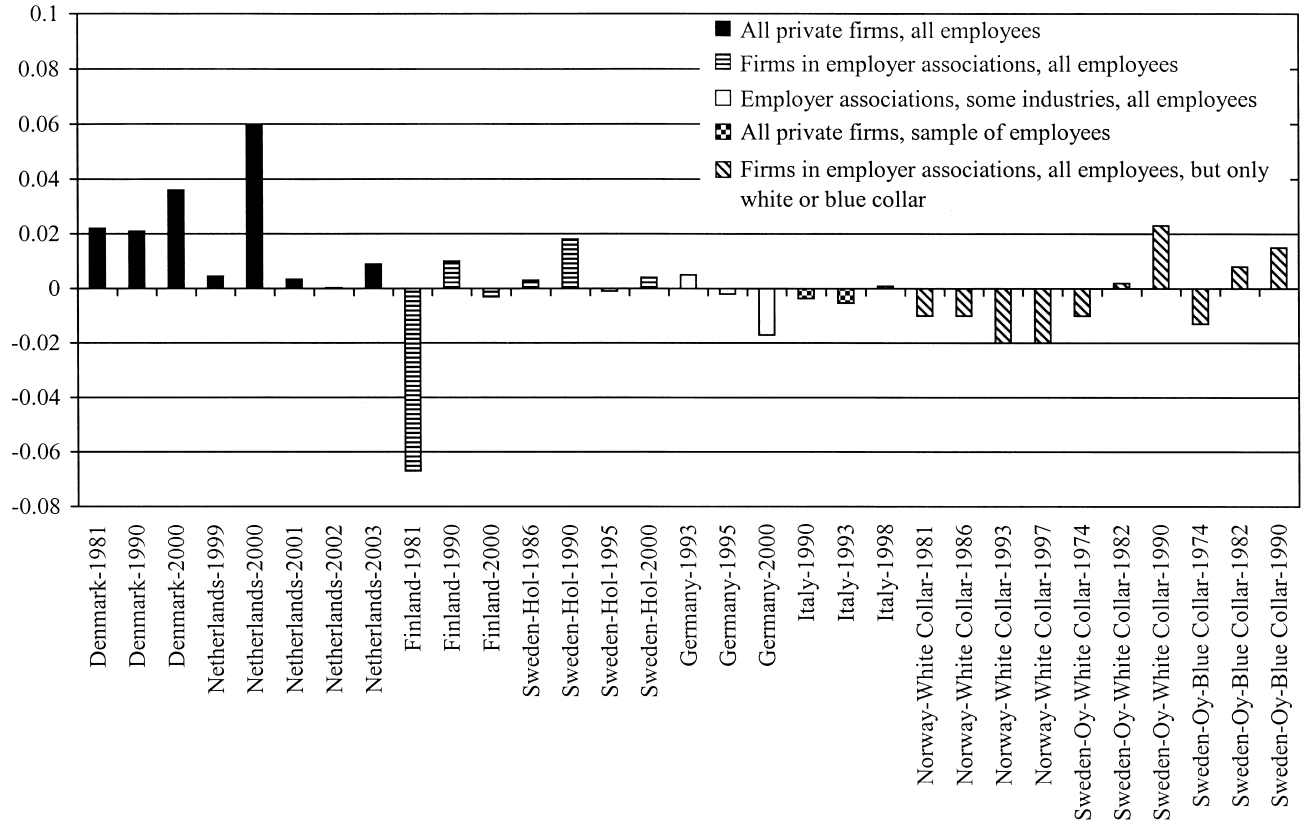

Fig. I.19 Entry rate minus exit rate of workers in all firms minus entry rate minus exit rate of workers in big firms (employees ≥ 100)

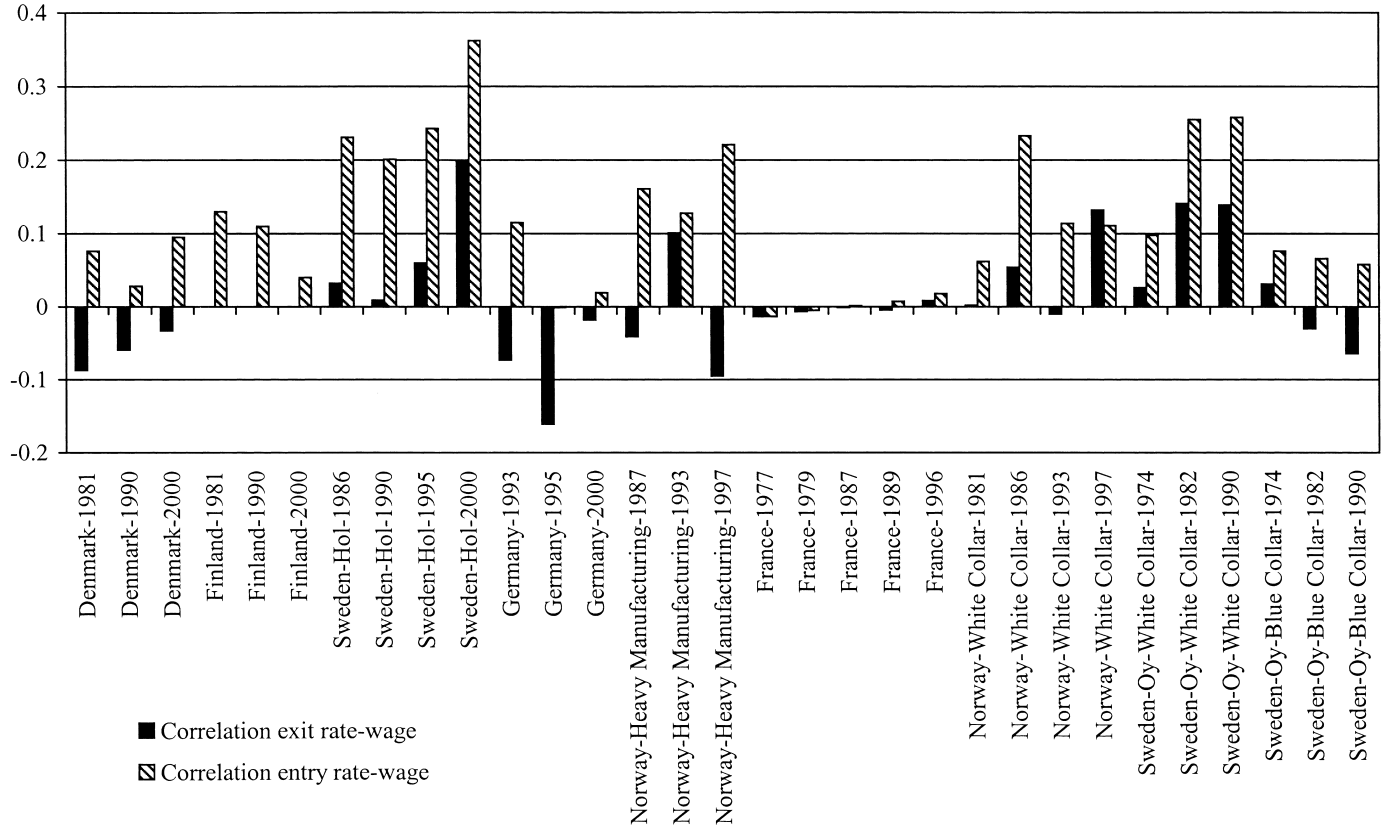

Fig. I.20 Correlation of the firms' exit rate and wage change and correlation of the firm's entry rate and wage change

the Silicon Valley labor market was in a talent war. Programmers and other skilled technical workers moved from firm to firm frequently, as demand shifted to reflect the fortunes of one company or another. Firms with rapidly growing wages hired many workers, but also lost them to other firms with rapidly growing wages because of the nature of industrial structure. Turnover rates were lower and wages were increasing less rapidly in more traditional parts of the economy, where the situation was closer to stable. So exit rates and high wage growth might go together if they characterize firms that are in industries that are undergoing rapid change. Again, this is a question that requires additional evidence, obtainable in these data sets, but not presented here.

The Structure of Wages: Why Care? Discussion and Summary

Several results in these data have revealed key features of the employment and wage structure of firms that were not previously known.

- The general structure of wages is remarkably similar across all countries. No previous study has had the data on employees within firms to assess wage structures across countries.
- The wage dispersion within firms is nearly as high as the wage dispersion overall. The standard deviation of wages within the firm is about 80 percent of the standard deviation across all workers in the economy (figure I.4). In addition, the variance in wage growth rates across individuals within the firm is very high. Even when the average raise is 4 percent within the firm, the top 10 percent of workers will typically receive increases of 8 percent. Wage levels and raises vary considerably across workers within the firm.
- Firms are more similar than they are dissimilar. The standard deviation of mean wages across firms is only about 20 percent of the average worker's wage for the economy (figure I.5). But firms are not identical: the standard deviation of mean wages is about 60 percent of the standard deviation of all individual wages (figure I.6).

In sum, most firms have many different jobs within the firm; wage variance is high within firms. But the jobs differ across firms. Janitorial firms have lawyers, but few. Law firms have janitors, but few. Consequently, mean wages differ across firms. Firms are not microcosms of the entire economy, and yet most firms do reflect a subsample of many of the jobs done in the economy. Figure I.2 is the more accurate depiction of the sources of wage variance from within and across firms; the extremes of panels A and B of figure I.1 are not evident in the data. Recalling equation (1), the variance of wages for the economy combines a high within-firm variance and significant gaps in mean wages across firms.

What do we learn about wage-setting policies and worker sorting across firms? First, there is no evidence of extreme sorting of workers across firms. That is, most firms contain a broad mixture of workers' skills or effort levels within the firm: wage levels vary greatly within the firm, and wage growth rates vary greatly within the firm. Moreover, an average worker moving from a low-wage firm to a high-wage firm would increase his or her wages by only about 20 percent. Having said this, one can look at the same data and reach a different conclusion. There are differences in mean wages across firms: law firms do not pay the same as cleaning-service firms, and people do sort by occupation or industry.

Second, there is sorting within the firm. High-effort or high-skilled workers are sorted into jobs that pay more within the firm. High-effort workers are rewarded with pay increases and are thus sorted into the jobs where they are the most productive. Again we know this to be true because there is a high variance of pay levels and pay increases within firms: firms do not have policies of equal pay for all. Instead, what they have is some combination of heterogeneous teamwork within the firm, systems of incentive pay that reward for effort, and sensitivity of wages to outside market conditions for each occupation or individual. Firms are more hierarchical than homogeneous. Of course, a law firm would not be expected to have the same average wage as a cleaning-service firm. The differences in skill between these two firms is obvious. There is also likely to be a difference in wage policy: law firms may by choice introduce tournament models; cleaning-service firms may have compressed wages from unionized bargaining. It may be possible to distinguish skill heterogeneity if we estimate models with individual specific and firm effects; given individual effects, the residual wage variation across firms represents policy. We leave it to future researchers to work on the underlying wage-setting models (extending the work of Abowd, Kramartz, and Margolis 1989). Why does all this matter? We highlight three reasons.

One reason to care about within-firm variation in wages and even more to the point, worker characteristics, is that it may help us learn about the nature of the firm's production function. One possibility (as shown in panel B of figure I.1) is that workers are almost identical within firm, both in wages and in characteristics. The need for different skills to produce a product might be handled by the market, say, where low-skilled workers sell the commodity that they produce to more highly skilled workers who know how to market and distribute the product. Alternatively, team production may make it essential to have many different types of workers within the same firm. It may be difficult to use the discipline of the market to supervise workers within one firm by workers in another firm. The evidence here is that firms comprise workers that are more heterogeneous than homogeneous, but further work should be done.

Some analysis suggests that firms are becoming more dissimilar over time. That is, firms that specialize in high-end skills are increasingly different from firms that specialize in low-end skills (Kremer and Maskin 1995). The evidence for this is from regressions with firm fixed effects. In the chapters that estimated wage regressions with firm fixed effects, the firm fixed effects are contributing more to the *R*-squared of the wage regression over time. Thus, increasingly the firm matters more: high-wage firms are selecting or rewarding the highest skill. This is an interesting technological change. Kremer and Maskin (1996b) posit that in recent years firms require more skill segregation across firms as a response to skill-biased technological change. In all the countries that study this, we have evidence lending support to this hypothesis. In general, a deeper understanding of the wage distribution within firms might give us a clue as to the labor ingredients required to produce—how those ingredients vary over time and among industries—and might shed some light on the nature of team production.

The ultimate question is whether wage policy specifically and labor policy in general has an effect on productivity. It is conceivable that data of this type might allow investigation of this issue within countries and among countries. Within a country, firms that (randomly) adopt different policies with respect to the types of workers they hire and how they pay them might experience different levels of productivity. For example, some have suggested that firms that limit the levels of top salaries relative to its median levels are less productive. Because the unit of analysis is the pay policy of the firm, only these employer-employee data can address issues such as this. By attaching measures of firm productivity or profitability, or in the absence of profitability, firm survival, we may get some hints as to the effects of various policies. For example, if it were found that firms with either a too compressed or too disparate wage policy were more likely than firms in the middle to go out of business, this would be a starting point. Then an examination of the detailed nature of turnover at those firms might shed additional light.

Finally, these data shed new light on workers' careers. The fact that there is considerable wage variation within firm means that, at least potentially, workers are not locked into a particular wage slot as a function of their first job assignment. If wages were compressed within firms, mobility would be necessary to change one's position, both over the life cycle and relative to other workers. Luck might play an important role. If a worker landed in a low-wage firm like the one pictured at the far left of panel B of figure I.1, he or she would have no hope of changing his or her income without leaving the firm. In an economy where mobility is costly (either as a result of market forces or government mandated severance pay that makes firms reluctant to hire), young workers who begin in low-wage firms suffer signifi-

cant lifetime losses on their human capital. On the other end, those who start in high-wage firms experience a windfall. Thus, if firm effects dominated the market (as in panel B of figure I.1), then a bad initial "draw" of one's firm has a huge income effect for the rest of the worker's career.

In this context, if all of the variation in wages within firms were accounted for by person effects, then there would be constancy over time in a worker's position in the firm, given his or her initial position. Workers care that their position can improve in the firm as a result of experience and promotion. If there is no within-firm residual variation, then the only way for a worker to improve his or her relative position is to move. Given our evidence on the high levels of variance of individual wage growth rates within firms, the data suggests significant promotions and little evidence of getting stuck in one position, but further work expanding on these points would be highly valuable.[15]

15. One interesting extension is to estimate wage growth models as a function of individual specific fixed effects in wage growth rates.

Appendix

Table IA.1 Data sources and criteria

	United States	Denmark	The Netherlands
Source Surveys	All employees in the population for a subsample of states, based on unemployment insurance (UI) records filed quarterly with every state.	IDA—database kept by Statistics Denmark. This is a longitudinal database from 1980–2001. Register data supplemented with data from the 1970 Census and reports from all educational institutions (educational register).	Social Statistical Database of jobs (SSB Banen) kept by Statistics Netherlands. This is an event history database of all employment relationships bringing together information from tax and social security authorities combined with demographic information about Dutch inhabitants and their households from the joint register of Dutch municipalities.
Population	Workers are included in analysis if real monthly earnings exceed $100 and are less than $100,000.	All workers 18–66 years of age and all workplaces and enterprises. The link between workers and employer is established every year on a day in November. Data used are only on primary employment.	All firms (incl. nonprofit and government), all employed workers.
Variables	For each person: gender, age, compensation. For each establishment can calculate wage and entry and exit given all person-level data for the establishment.	Demographics, education, labor market experience, tenure, and earnings.	Demographics, tenure, and earnings.
Years	1993, 1998	1980–2001	1999–2003
Wage definitions and parameters	Earnings are from UI wage records. UI wage records measure "gross wages and salaries, bonuses, stock options, tips, and other gratuities, and the value of meals and lodging, where supplied" (Bureau of Labor Statistics 1997, 44). They do not include Old Age, Survivors, and Disability Insurance (OASDI), health insurance, workers compensation, unemployment insurance, and private pension and welfare funds.	Gross hourly wages, with bonuses and overtime. Register data containing tax-based information on the total earnings paid to each individual worker during the year (considered high quality data). Earnings are for the employer in November. Wage records constitute deductible labor costs for the employers (what makes information more reliable). Working hours: IDA computes annual number of working hours from employer's contributions to the pension scheme (contributions to the pension scheme are proportional to the number of hours worked). Hourly wage rates are calculated by dividing the earnings at a particular employer with the estimated annual hours at the employer.	Gross monthly wages including bonuses. Data contains contains tax-based information on total earnings per individual and firm combination. Earnings are calculated for the most important employer only, if multiple employers exist. Monthly wages have been calculated on the basis of the annual salary multiplied with fraction of months worked.

(*continued*)

Table IA.1 (continued)

	United States	Denmark	The Netherlands
Mobility			
Entry rate	Entry (accession) and Exit (separation) rates reflect links across years for unit of observations defined as PIK SEIN year observations (persons linked to a state unemployment insurance account number [SEIN] in a given year). Entry refers to workers who have zero earnings with SEIN in prior year ($t-1$) and have positive earnings in current year (t). Workers are only counted for purposes of computing rates if they satisfy above earnings thresholds. Note, however, that a worker who has positive earnings in year $t-1$ and t but in one year earnings do not satisfy thresholds is not counted as an entrant.	Entry rate calculated as the proportion of new employees in the firm in the end-of-November year t as compared to mean employment in firm over the year.	Entry rate calculated as the proportion of new employees in the firm during the calendar year (t) compared to previous year ($t-1$).
Tenure	No measure.	Tenure is calculated as contiguous time employed at workplace, firm, and industry.	Tenure is calculated based on the first day of employment (as observed by the fiscal authorities) relative to the third Thursday in September of a year (cut date for annual data).
Exit rate	Exit refers to workers who have positive earnings in year t at SEIN and zero earnings in year $t+1$. Workers are counted for purposes of computing rates if they satisfy above earnings thresholds. Note, however, that a worker who has positive earnings in year $t-1$ and t but in one year earnings do not satisfy thresholds is not counted as an exit. Note the timing difference—entry refers to flow into firm from $t-q$ to t; exit refers to flow out of firm from t to $t+1$. Hence, inappropriate to compute net flow from entry and exit given timing differences.	Exit rates are calculated as the proportion of employees who have exited from the firm over the year (since the comparisons are between end-of-Novembers, and this will neglect intermittent short-term jobs, the entry rate and exit rates are downward biased).	Exit rate calculated as the proportion of employees leaving a firm during the calendar year (t) compared to previous year ($t-1$)
			.
	Finland	Belgium	Sweden—Edin, Holmlund, Nordström-Skans's chapter
Source Surveys	Wage survey of the Confederation of Finnish Industry (TT)—about 30% of private-sector employees. Complete wage records on blue- and white-collar workers are available from 1980–2002.Excludes top management.	Two surveys conducted by Statistics Belgium and merged using the form social security number: • 1995 Structure of Earnings Survey (SES) • 1995 Structure of Business Survey (SBS) October 1995.	Registered Manufacturing Data (RAMS), provided by Statistics Sweden, contains data on all individual workers that were employed at each plant sometime during the year.

Population	All employees in all large TT member firms, excludes small firms with less than 25 employees. Most TT firms are in manufacturing and construction. Excludes top management and trainees. Workers whose usual weekly hours exceed 30. All persons aged greater than 15.	All firms with 10+ workers. Economic activity in mining and quarrying; manufacturing; electricity and water supply; construction; wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods; hotels and restaurants; transport, storage, and communication; financial intermediation; and real estate, renting, and business activities. Final sample = 34,969 individuals in 1,498 firms.	16–65 years of age residing in Sweden sometime between 1990 and 2000, ages 16–60 in 1985, and ages 16–64 in 1989. This chapter is focused on the corporate sector, including only establishments with at least 25 employees. Annual data (November). Workers employed full time, in job with person's highest wage.
Variables	Worker demographics and details on all forms of compensation. Annual data (December).	SES: firm characteristics and individual employee demographics. SBS: (firm-level survey) sales, value added, production value, gross operating surplus, and value of purchased goods and services.	Total annual earnings, first and last salaried month for each employee. Year of birth, gender, education, and immigration status for each individual. Sector and industry for each establishment.
Years	1980–2002; data analyzed was mainly from 1981, 1990, and 2000.	1995 only.	1985–2000, more detailed for 1986, 1990, 1995, and 2000.
Wage definitions and parameters	Gross hourly wages, with bonuses and overtime, and real wage 2000. Payroll records. Blue-collar workers (hourly wage) from the last quarter of each year, and white-collar workers (monthly salary) from each December. Wage is calculated with all wage components (bonuses, overtime, etc.) and dividing the total wages by total hours. White-collar worker wages: hourly wages are calculated based on monthly wages and usual weekly hours. All wages are deflated to year 2000 euros using the consumer price index. Wage dynamics obtained by calculating the firm averages in year t and $t-1$, taking the difference, and then the across-firm average of these differences. This calculation does not necessarily have the same employees in both years.	Gross hourly wages (without bonuses) calculated by dividing total gross earnings (including overtime and premiums) in the reference period by the corresponding number of total paid hours (including paid overtime). Gross hourly wage (with bonus) calculated by adding to the gross hourly wages (without bonuses) the annual bonuses dived by: 1) the number of months to which the bonuses correspond, and 2) the number of total paid hours in the reference period, respectively. Thus, *average wage, observation = a person* the individual grossly hourly wages (in EUR) include overtime paid, premiums for shift work, night work, or weekend work.	Monthly wage is calculated by dividing total earnings during the year by the number of remunerated months, including only employment spells that cover November of each year. Employment definition: a person is employed if and only if the wage for November exceeds 75% of the mean wage of a janitor employed by a local municipality according to Statistics Sweden's information on monthly wages. An individual is only allowed to be employed by one plant each year, and priority is given to the observation generating the highest wage. Data set is based on information collected to calculate taxes. Data contains earnings of all employees including CEOs(possible outliers). Wages of the top earners (see table I.2) have a large impact on the standard deviation of monthly wages, while the mean hardly is affected at all (see text).
Tenure	Wage growth and entry rates calculated from year $t-1$ to t. Wage growth for the workers that enter the firm as well as the wage growth by tenure are calculated using the information on the date when the employee was hired to the current firm.	Not available.	When calculating wage change or plant change, they only counted those who switched between firms that were 25+ employees (if the firm size was less, the subject was dropped).

(*continued*)

Table IA.1 (continued)

	Finland	Belgium	Sweden—Edin, Holmlund, Nordström-Skans's chapter
	Current year – entry year.	Not available.	Tenure is calculated within the sample (tenure = the number of consecutive years a person has his or her main employment at the same plant). Thus, the fraction on long-tenured workers may be lower than if calculated from the year of hiring as tenure is broken by absence and only the main employer is used.
	Calculated from the year t to the year $t + 1$. Any restrictions on the firm size (25 employees) will refer to the base year. Therefore, it is not required that a firm would have had at least 25 employees or even that a firm would have existed in year $t - 1$ or year $t + 1$.	Not available.	Calculated exit rates will not include plant closings because the authors require that establishments have at least 25 employees in both years.
	Germany	Norway	Italy
Source Surveys	Plants: IAB Establishment Panel conducted by the Institute for Employment Research (since 1993; annual survey sample based on a register of the Federal Employment Service—entry, exits, and wages are all mandatory reports for the social security system) Employees: all employees in Germany covered by the social insurance and who work at least one day in a plant of the IAB Establishment Panel in the respective year.	Data sets are linked employer-employee from administrative files from Statistics Norway. Plant-level information is from the annual census for manufacturing. White-collar data sets are from the Confederation of Norwegian Business and Industry (NHO). Blue-collar data sets from the Federation of Norwegian Manufacturing Industries (TBL) .	WHIP data set (Workers Histories Italian Panel) by LABORatorio R. Revelli. It is built from a randomized sample drawn from INPS (Italian National Social Security Institute). More information available at www.laboratoriorevelli.it/whip. Administrative data set on employees.
Population	The register covers more than 90% of all employees in the manufacturing and 75% in the service sector. Excluded: civil servants, self-employed, and those not eligible for social security; apprentices; switchers from part to full ftime and opposite. All employees in plants with a valid interview in the respective years and at least 25 full-time workers. Number of observations varies from year to year. Workers are age 15–65.	White-collar sample: all workers in all NHO member firms; N = 97,000 white-collar workers per year in different industries during the period 1980–1997. Restrictions on white-collar sample: the number of hours worker per week is 30+ (full-time only); the number of full-time employed white-collar workers (ages 16+) in each firm is at least 25 in year t and in year $t - 1$. Blue collar sample: N = 34,000 blue-collar workers per quarter. Data managed much the same way as white-collar workers.	Employees ages 14–75. INPS archives: employee population: all dependent workers in the nonagricultural private sector. Firms population: all firms in the nonagricultural private sector with at least one dependent. WHIP data set: a sample is drawn selecting all employees born in four fixed dates of the year (sample rate ~1:90) and matching them with all firms where they have been employed. As a result, there are ~130,000 individuals, ~90,000 firms per year. Inclusion criteria here: individuals reported to have a job spell during the month of May of the year of interest, blue- and white-collars working full-time only; thus a cross section of workers for each referred years.

Variables	Primary job in June. Employees: demographics, entries and exits, occupation (3-digit), gross daily precise wages (including all bonus payments), a unique plant identifier and the industry code, since 1999: regional information. Nominal wages are deflated by the consumer price index and are written as euros in 2000. Employers: detailed information about total employment (also for different skills), standard and overtime hours, wage recognition, output, exports, investment, urbanicity, and ownership.	White-collar workers: organized hierarchically with 22 different combinations of groups and levels. Both plant and firm identifiers are available. See the section "Defining Plant and Firm" in the Norwegian chapter for details. The person identification number is used as merging variable when adding in plant and firm information from the employer-employee register.	Annual data (May), full-time jobs. Employee: register—employee ID; date of birth; gender; place of birth. For every year and every job: employee ID; place of work; months paid; number of salaried weeks/days; job start/end date; salary year; wage supplements paid by employer; status full time/part time/temporary; code of contractual agreement and position in contractual ladder; wage supplements on behave of INPS (1989–). Employer (firm): register—employer ID; economic activity (NACE rev. 2, 3 digit), dates of registration and termination; for every month—number of employees, salaries paid, contributions paid, total days for which salary was paid, wage supplements paid for social security, and rebates on contributions.
Years	The survey is conducted annually since 1993 to present. In the text only the years 1993, 1995, and 2000 are observed (meanwhile worker data are applicable until 2002).	1980–1997: specifically 1981, 1986, 1993, and 1997.	1985–1998.
Wage definitions and parameters	All wages are gross wages. The information about wages wages is censored because payments for the social security system are limited to a certain amount. This threshold varies from year to year. Thus, the observed wage at the threshold are imputed with predicted values using a Mincerian earnings function augmented by ten sector and ten occupation dummies and adding an error term. Varying from year to year 10–15% of all observations are imputed. In the group of employees with a university degree, 50% of all observations are censored.	White-collar: monthly salary (per Sept. 1st) including the value of fringe benefits and exclusive of overtime and bonuses. Indirect costs to the firm such as employers' fee, pensions, etc. are not included. Nominal wages were transformed to real wages using the Consumer Price Index (CPI) with base year 1990.	Defined as the total amount of the earnings paid to the worker: basic wage, cost-of-living allowance, residual fees, overtime plus back pay, bonuses, supplement holiday pay, and sick pay. Wages reported in the tables are defined as average daily retributions, referring to a single job spell/year. This is computed as the total annual wage earned in the firm divided by the number of paid working days. Nominal daily wages are deflated by the CPI index and are expressed in 1990 Italian liras (1 euro = 1936.27 Italian liras).
Mobility Entry		For each firm in year t, how many of the workers were not present in year $t-1$? This number is then divided by firm size in year t.	
Tenure	Job tenure was computed by checking the appearance of the employee identifier in $t, t-n\,(n \in N)$ with the condition of the duration equal 365 (366) days. With larger n they have less plant observations because of panel attrition. Therefore, they calculated the job tenures only up to 3 years. Also, to be in the group job tenure >3 years, there must be full time employment in t and $t-1$, and the individual identifier in the plant must be observed in all 3 years. In addition, there has to be an annual job duration in these 3 years of 365 (366) days.	Tenure is based on the variable "job start date" (i.e., the date when the worker was first employed with his current employer). Note: there is some censoring with the year 1978 as the censoring point.	Job start and job end are imputed by a procedure that identifies continuing work spells of a worker within the same firm, taking into account possible brief interruptions due to suspensions, illness, and maternity leaves, temporary layoffs. The procedure starts from the first year of the panel so that tenure is left-censored at 1985.

(*continued*)

Table IA.1 (continued)

	Germany	Norway	Italy
Exit rate	They look at each firm in year $t-1$ and ask how many workers in the firm leave the firm by year t. This number is then divided by firm size in year $t-1$.		
	France	Sweden—Oyer's chapter	
Source Surveys	DADS (Déclaration Annuelles de Données Sociales): longitudinal employee-firm matched data collected by National Institute for Statistics and Economic Studies (NSEE). Tax-based employer mandatory reports.	Swedish Employer's Federation (SAF) provided employment data.	
Population	All statutory employed persons. Final sample = 13,770,082 observations, corresponding to 1,682,080 individuals and 515,557 firms. Sample selection procedure: persons born in October of even-numbered years.	White- and blue-collar data is on separate databases—there is no way to match the two groups. There are more blue-collar firms than white-collar firms. Firms = every private-sector industry. Firm = white-collar workers at a company or the blue-collar workers at a company.	
Variables	Demographics for each person: number of days worked in the firm, employment status (full time, part time, intermittent), gender, date of birth plus place, occupation, total net earnings year, year, gross nominal earnings. Nominal values were deflated by the CPI.	GDP data presented in dollar terms. Data set variables include occupation, age, and wages. "Levels within firms" white-collar worker occupation codes used to observe hierarchy within firm.	
Years	1977, 1979, 1989, 1996. 1987 only used when it was useful to compute 10-year-long differences.	1970–1990. Mainly 3 points: 1974, 1982, and 1990.	
Wage definitions and parameters	Minimum wage: since 1951, indexed to the rate of change in consumer prices and to the average blue-collar wage rate. Total annualized net real wage (excluding employer and employee taxes, but including bonuses). French CPI used, base year = 1980.	Actual wages paid in monthly units.	
Mobility			
Entry			
Tenure	Based on observed firm identifier for all jobs starting after 1976 (first year of data). For jobs already started in 1976, imputation is based on the wage structure survey of 1978 (see Abowd, Kramarz, and Margolis 1999, data appendix).	Tenure calculations are limited by the entry of individual firms.	
Exit rate			

Table I.A.2 The structure of wage levels within and between firms

	United States (1998)	Denmark (2000)	The Netherlands (2003)	Finland (2000)	Belgium (1995)	Sweden-Hol (2000)	Germany (2000)
Average wage, observation = a person	3,253	21,097	2,767	10	15	17,843	3,314
Standard deviation	4,230	8,674.6	1,986	3.46	7.056	7,040	1,144.24
90th percentile	5,925	31,858.6	4,211	14.82	22.274	26,716	4,844.97
10th percentile	855	12,456.	1,485	5.95	9.055	11,208	2,175.74
No. of workers	40,110,897	1,081,555	4,600,000	380,644	31,788	860,581	
Average of firm average wage, observation = a firm (weights observations differently from previous row)	3,020	20,473	2,206	9.01	13.1851		
Standard deviation	2,051	4,572.9	1,107	1.63	4.018		
90th percentile	5,070	26,584.2	3,066	11.13	18.037		
10th percentile	1,336	15,336.2	1,249	7.01	9.317		
No. of firms	202,528	13,999	71,445	1,863	1,445		
Average of Standard deviation of wage, observation = a firm	2,434	7,065	1,135	2.29	3.7197		
Standard deviation	2,452	2,736.6	1,764	.94	3.382		
90th percentile	4,888	10,764.	1,799	3.6	7.503		
10th percentile	732	3,980.4	535.6	1.15	.802		
No. of firms	202,528	13,995	70,736	1,863	1,445		
Average coefficient of variation of wages, observation = a firm	0.75		0.5081	0.25	0.2531		
Standard deviation	.37		.21	.08	.154		
90th percentile	1.2		.758	.36	.461		
10th percentile	.42		.282	.15	.083		
No. of firms	202,528		70,736	1,863	1,445		
Correlation (average wage, Standard deviation of wage), observation = a firm	0.7856	0.672	0.7299	0.53	0.831		
Average of firm average wage, observation = a plant						17,245	2,861.15
Standard deviation						3,663	677.69
90th percentile						22,497	3,806.67
10th percentile						13,413	2,007.83
No. of plants						9,067	1,569

(*continued*)

Table I.A.2 (continued)

	United States (1998)	Denmark (2000)	The Netherlands (2003)	Finland (2000)	Belgium (1995)	Sweden-Hol (2000)	Germany (2000)
Average of Standard deviation of wage, observation = a plant						5484	818.24
Standard deviation						2,222	226.69
90th percentile						8,635	1,113.54
10th percentile						2,936	522.29
No. of plants						9,067	1,565
Average coefficient of variation of wages, observation = a plant						0.312	0.293
Standard deviation						.088	.071
90th percentile						.429	.387
10th percentile						.2	.196
No. of plants						9,067	1,565
Correlation (average wage, Standard deviation of wage), observation = a plant						0.768	0.616
Average wage for workers between 25 and 30, observation = a person	2,618	19,556		9.77	12.6091	16,258	2,832
Standard deviation	4,325	6,334.9		3.08	3.768	4,929	740.02
90th percentile	6,822	27,067.9		13.72	17.113	22,121	3,688.77
10th percentile	891	12,935.1		5.82	8.901	11,009	2,062.87
No. of workers	6,589,276	169,120		51,046	7,004	138,219	
Average wage for workers between 45 and 50, observation = a person	3,932	23,044		10.68	16.811	19,169	3,438.98
Standard deviation	9,164	8,796.8		3.56	8.7	7,772	1,204.48
90th percentile	6,989	34,613.3		15.24	26.779	29,579	5,048.48
10th percentile	1,037	14,731.6		6.13	9.98	12,108	2,211.54
No. of workers	5,306,977	132,563		70.212	4.873	116,080	105

	Norway—Heavy Manufacturing (1997)	Italy (1998)	France (1996)	Norway White collar (1997) (1990)	Sweden—Oy White collar (1990)	Sweden—Oy Blue collar
Average wage, observation = a person	18,311	95	56	21,838	15,990	10,571
Standard deviation	5,374	33.359	34.28	7,084	5,435	2,690
90th percentile		140.307	92.1	31,958.9	23,475	14,041
10th percentile		61.751	29.9	14,625	10,400	7,223
No. of workers	25,446	47,173	639,671	79,259	296,782	372,621

Average of firm average wage, observation = a firm (weights observations differently from previous row)	16,877	85.53	50.6	20,395	15,660	10,176
Standard deviation	2,010	12.52	30.2	2,977.008	1,908	1,664
90th percentile		99.774	81.3	24,359.63	17,970	12,400
10th percentile		70.903	28.7	16,685.75	13,329	8,140
No. of firms	139	775	213,493	565	2,493	3,931
Average of Standard deviation of wage, observation = a firm	4,026	25.87	19.3	5,566	4,895	2,112
Standard deviation		7.117	21.868	1,640.82	1,164	656
90th percentile		34.762	44.9	7,421.265	6,335	3,012
10th percentile		16.772	2	3,743.561	3,393	1,366
No. of firms	139	731	68,997	565	2,493	3,930
Average coefficient of variation of wages, observation = a firm)	0.236	0.30	0.314	0.2703342	0.311	0.207
Standard deviation	.054	.001	.235	.057	.058	.054
90th percentile		.397	.647	.334	.382	.276
10th percentile		.221	.051	.204	.235	.145
No. of firms	139	731	68,997	565	2,493	3,930
Correlation (average wage, Standard deviation of wage), observation = a firm		0.59	0.744	0.72	0.657	0.561
Average of firm average wage, observation = a plant					15,714	10,192
Standard deviation					2,020	1,706
90th percentile						
10th percentile						
No. of plants					2,956	4,866
Average of Standard deviation of wage, observation = a plant					4,926	2,103
Standard deviation					1,205	663
90th percentile						
10th percentile						
No. of plants					2,956	4,865

(*continued*)

Table I.A.2 (continued)

	Norway—Heavy Manufacturing (1997)	Italy (1998)	France (1996)	Norway White collar (1997) (1990)	Sweden—Oy White collar (1990)	Sweden—Oy Blue collar
Average coefficient of variation of wages, observation = a plant					0.31	0.21
Standard deviation					.061	.053
90th percentile						
10th percentile						
No. of plants					2,956	4,865
Correlation (average wage, Standard deviation of wage), observation = a plant					0.623	0.582
Average wage for workers between 25 and 30, observation = a person	16,571	83.74	48.0	17,630	13,244	10,642
Standard deviation	2,999	23.969	22.819	3,546.809	2,813	2,671
90th percentile		115.076		22,202.05	16,787	14,143
10th percentile		59.756		13,386.13	10,100	7,373
No. of workers	3,781	9,318	117,395	9,123	37,423	54,590
Average wage for workers between 45 and 50, observation = a person	19,338	105.80	67.3	23,262	17,699	11,020
Standard deviation	5,959	35.541	39.133	7,844.934	5,949	2,707
90th percentile		154.642		34,460.62	26,395	14,511
10th percentile		67.378		15,250	11,500	7,639
No. of workers	3,988	7,489	95,650	13,962	46,722	39,175

Note: See country chapters for detailed discussion of these data and variables.

Table IA.3 **Change in log wages [(log wage in year *t*) – (log wage in year *t* – 1)]**

	United States (1998)	Denmark (2000)	The Netherlands (2003)	Finland (2000)	Sweden—Hol (2000)	Germany (2000)	Norway—Heavy manufacturing (1997)	Italy (1998)	France (1996)	Norway—white collar (1997)	Sweden—Oy-White collar (1990)	Sweden—Oy-Blue collar (1990)
Average change in wage observation = a person	.0496	0.031	0.04464	0.03	0.048	0.018	0.024	0.02	0.017	0.031724	–0.004	–0.011
Standard deviation	.511	.17	.204	.1	.142	.013	.08	.127	.254	.068	.7	.22
90th percentile	.495	.2	.175	.16	.207	.131		.136	.198	.093	.07	.26
10th percentile	–.379	–.125	–.063	–.1	–.085	–.089		–.081	–.142	–.007	–.06	–.27
No. of workers	35,607,319	799,463	3,800,000	312,968	704,360		19,489	43,377	519,770	69,210		
Average of firm average change in wage, observation = a firm	0.0558	0.034	0.04726	0.03	0.053	0.021	0.022	0.02	0.022	0.0298882	0.001	–0.011
Standard deviation	.191	.08	.143	.06	.059	.034	.026	.025	.217	.023	.031	.12
90th percentile	.215	.109	.148	.08	.114	.055		.051	.185	.057	.04	.124
10th percentile	–.112	–.036	–.039	–.02	.001	–.012		–.011	–.113	.006	–.031	–.139
No. of firms	202,335	11,383	90,709	1,321	9,063		139	734	148,995	565		
Average of Standard deviation of change in wage, observation = a person	0.4917	0.205	0.1567	0.09	0.126	0.07	0.065	0.11	0.114	0.0585112	0.066	0.19
Standard deviation	.206	.093	.125	.05	.039	.024	.031	.035	.136	.037	.029	.061
90th percentile	.755	.318	.302	.15	.176	.096		.153	.263	.095	.355	.269
10th percentile	.262	.11	.038	.05	.082	.045		.073	.012	.026	.1	.124
No. of workers	202,335	11,366	85,396	1,307	9,054		139	687	46,573	565		
Average change in wage for people who change firms, observation = a person	0.1031	0.043		0.05	0.053	n.a.	0.023	0.06	–0.004		0.02	–0.003
Standard deviation	.786	.313		.16	.213	n.a.	.14	.244	.441		.097	.267
90th percentile	.997	.376		.26	.319	n.a.		.327	.477		.14	.319
10th percentile	–.799	–.296		–.16	–.218	n.a.		–.209	–.487		–.055	–.324
No. of firms	10,522,612	240,362		14,473	40,217	n.a.	697	3,496	68,164			

Note: See country chapters for detailed discussion of these data and variables.

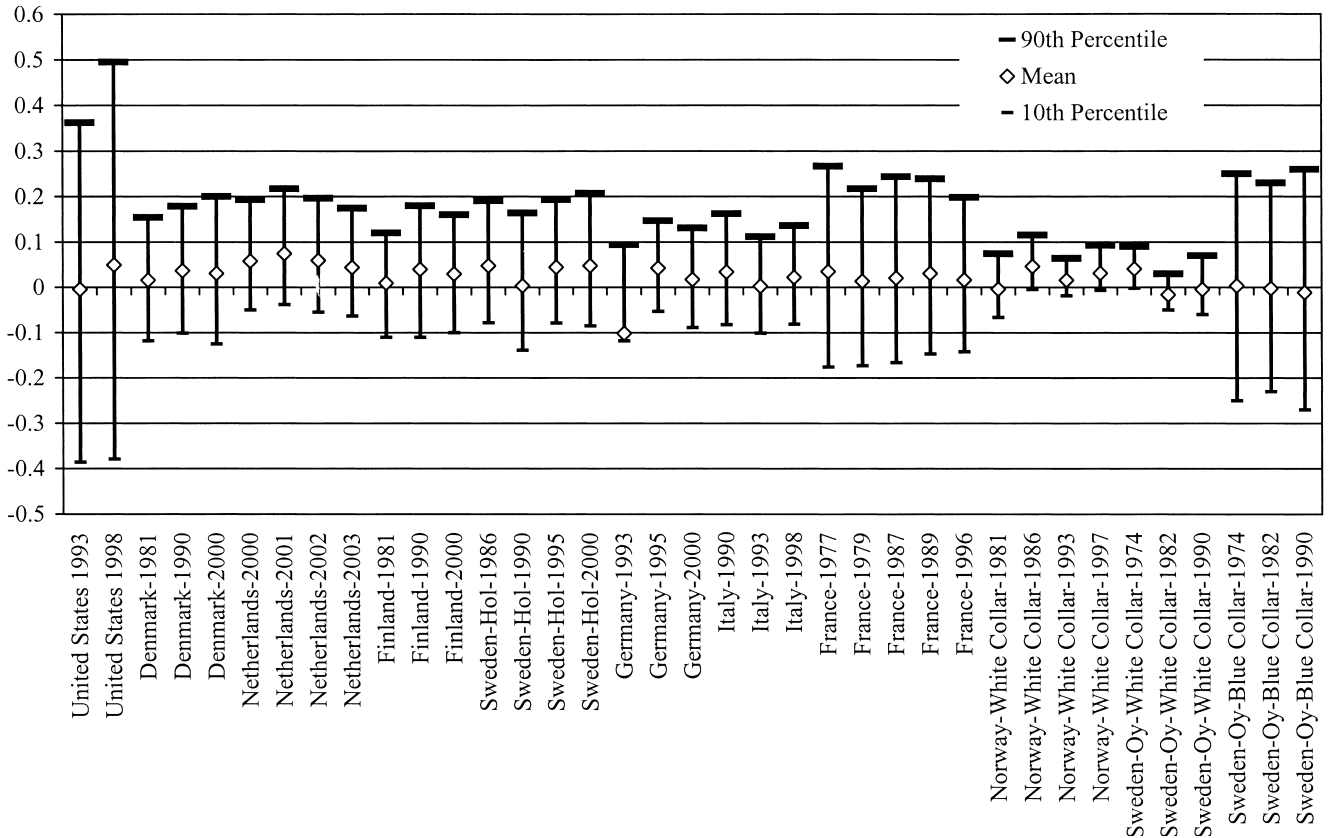

Fig. IA.1 Distribution of mean wage growth (across all individuals)

Note: Wage Growth = log (wage$_t$) – log (wage$_{t-1}$), annual change.

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