NBER WORKING PAPER SERIES

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1986-1992 AND RISING RETURNS TO SKILL

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NBER Working Paper No. 7730
June 2000
JEL No. J3, J2, J0

ABSTRACT

We examine the relationship between wages and skill requirements in a sample of over 50,000 managers in 39 companies between 1986 and 1992. The data include an unusually good measure of job requirements and skills that can proxy for human capital. We find that wage inequality increased both within and between firms from 1986 and 1992. Higher returns to our measure of skill accounts for most of the increasing inequality within firms. At the same time, our measure of skill does not explain much of the cross-sectional variance in average wages between employers, and changes in returns to skill do not explain any of the time series increase in between-firm variance over time. Finally, we find only weak evidence of any declines in the rigidity of internal wage structures of large employers.

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CHANGES IN MANAGERIAL PAY STRUCTURES 1986-1992

AND RISING RETURNS TO SKILL

Earnings inequality has increased considerably in the US economy during the past 20 years. Economists have examined a number of possible explanations for the change, with an emphasis on demand-side changes that increased the returns to skills [Levy and Murnane, 1992]. We examine these important explanations for rising inequality by analyzing a data set with three unique characteristics. First, the data include a quantitative measure of the actual requirements of each job – the skills, responsibility, and accountability – that is constructed from a detailed analysis of each job. This measure has much higher validity and reliability than most measures of job-relevant skills because it captures actual job requirements. Most prior studies rely on proxies for job requirements that focus on characteristics of workers, such as years of education, or broad descriptions such as job titles. Second, the time series data report on multiple jobs (hundreds and in many cases thousands of positions) across 39 companies, allowing us to analyze inequality both within employers and between high- and low-wage employers. Finally, because these data are for managerial jobs, they allow us to extend the prior research on inequality within and between employers which focused on production workers [e.g., Davis and Haltiwanger 1991] and to contribute to the growing literature on wage structures within enterprises [e.g., Baker, Gibbs, and Holmstrom 1994, Lazear 1995].

We analyze these data to address a number of questions relating to firm-level wage inequality. We begin by describing a number of important features of wage structures at large employers. These include the magnitude and persistence of employer-specific wage levels, employer-specific returns to our measure of skill, and the sorting of employees between employers by skill. We then test explanations about inequality and firm-specific wage structures that are based on human capital theory. Among the most important of these tests is the extent to which differences in skill requirements explain apparent differences in employer wage levels. Our conclusion that differences in job characteristics do not explain differences in wage levels is so strong and surprising that we replicate the test with a second dataset, where the results were similar. We also examine the popular claim in much of the business press that wage structures at large employers have become less rigid and more responsive to markets and to individual performance in recent years [e.g., Annable, 1997; Burack and Singh, 1995; Chasman and Feldman, 1995; Manticade and Pennell, 1992]. In general we find little evidence of declining rigidities between 1986 and 1992, although use of bonuses has increased.

The basic method of this paper is to decompose inequality into two pieces: wage inequality between high- and low-wage employers (the employer wage effect), and inequality within each employer. The inequality between employers is captured in our model by estimating a separate intercept (firm effect) for each employer. We then examined each of these forms of inequality in 1986 and changes in them between 1986 and 1992. Finally, we measure how each form of inequality is related to our precise measure of skill and job requirements.

I. Human Capital Theory

The Appendix presents an illustrative model where wage differences are determined solely by differences in skill requirements. In such a world where skill levels also differ among firms and good (but imperfect) measures of skills exist, then:

> H1: Differences in employers' mean wages are primarily due to differences in mean measured skills. Empirically, the standard deviation of the coefficients on the firm effects should be substantially smaller when controlling for skills than when not controlling for skills.

Human capital theory also offers explanations about changes in wage levels and in employer wage effects that are based on returns to skill. If firms differ in their initial complements of skills and returns to skill have increased over time, then wage inequality should increase across firms:

> H2: If returns to skill have increased, then wage inequality between firms will also increase at the same pace. (This result assumes that the sorting of skills across firms is constant, which is roughly true in this dataset, as noted below.)

Other researchers have used the corollary of this argument to conclude that rising inequality among employers is due to higher returns to skill. For example, Davis and Haltiwanger estimate a rising effect of establishment size on wages within manufacturing between 1967 and 1983 [1991, pp. 156-7]. They interpret this result as consistent with a size-wage effect that results from a relationship between unmeasured skills and size coupled with rising returns to skill.

These arguments also imply that most of this rise in between-firm inequality should be eliminated empirically if one can control for skill requirements with an accurate measure of skills (as shown in the appendix):

> H3: The apparent increase in inequality between firms should be eliminated or at least sharply reduced when controlling for differences in skill levels. Empirically, the increase in the standard deviation of the coefficients on the firm effects should be much smaller when controlling for skill than when not controlling for skill.

More complex models of wage determination suggest other reasons why between-firm inequality may rise. For example, the standard deviation of firm effects will also rise if employers make greater use of company-wide profit sharing and profit levels differ across firms. Less obviously, changes in comparisons that compensation professionals use to establish pay systems can also increase inequality among employers. Consider, for example, the extreme case where employers had set pay in line with a wage survey based on other firms' pay levels. If this institutional pay-setting arrangement breaks down, then inequality among employers may rise [Levine, 1995]. Perhaps the best example of such a change has been the breakdown of pattern bargaining in unionized settings where unions set their bargaining demands based on prior settlements of other unions.

Other developments may reduce inequality among employers. If wage levels above the market level were largely due to the ability of some employers to pay more (as in rentsharing, bargaining, and some fairness theories), then increased competition from imports, deregulation, and other product market shifts should reduce wage inequality among employers by driving down the "rich" employers' ability to pay above-market wages. This pressure is reinforced if the increase in product market competition is greater for companies whose employees have the highest bargaining power and would therefore be more able to secure higher wages (Bertrand provides indirect support for this proposition [1997].) More generally, compensation practices such as internally consistent wage structures (as described in prescriptive compensation textbooks and Levine [1993]) will lead to some inequality among employers. If, as the business press claims, these institutional forces have eroded, this should reduce inequality among employers.

A. <u>Base Pay vs. Total Compensation.</u>

The analyses described above can be calculated for base pay as well as the sum of base pay and annual bonuses, and there are reasons to examine both. Base salary should be the aspect of compensation most directly related to skill requirements as employers typically describe it as the compensation for meeting the basic requirements of the job. Individual bonuses, in contrast, typically reflect performance above and beyond those base requirements. Moreover, at some employers bonuses may become an expected part of compensation and are paid even when individual performance does not exceed expected performance levels, then they should be included as part of the wage paid for stated job requirements.

To the extent that bonuses reflect pay for individual performance, inequality of total pay which includes bonuses should be larger than inequality of base pay because it includes differences attributable to variations in individual performance. To the extent that bonuses also reflect company performance (for example, due to profit sharing), between-company inequality should be higher with total pay than with base pay. Alternatively, the theory of compensating differentials suggests that higher average bonus payments may offset lower base pay because employees are ultimately interested in the risk-adjusted level of total compensation. If employers differ for some reason in the size of the bonuses they pay, then competitive labor markets that work to equalize total compensation would suggest that total pay should be more equal across firms than is base pay.

II. Changes in Internal Labor Markets over Time.

Our data cover only a relatively short time period, from 1986 to 1992. Nevertheless, this short panel permits us to test several claims about how pay structures within large employers have evolved. Numerous newspapers and magazines report massive changes in Americans' careers during this period. These discussions frequently start with a canonical "old" model of an internal labor market, one filled with numerous rigidities. For example, in the old model, companies paid similar nominal wages in different local labor markets. Large employers also had difficulty implementing meaningful merit pay and ended up giving most employees in the same job title about the same pay [see, e.g.,

Foulkes 1980]. The popular press indicates that many of these practices have declined as companies have replaced rigid rules with greater responsiveness to the external market, to individual performance, and to the employer's financial and stock market performance. The arguments below examine potential changes in wage setting practices associated with internal labor market and their empirical implications.

A. Have Local Labor Markets Become More Important?

In many classic internal labor markets, wage policies and structures were common across different locations of a company's operations, paying similar wages to similar job titles even across very different labor markets. To the extent that internal company wage structures have become less rigid, we should see local labor market conditions such as wages and unemployment having a stronger effect on wages. Belman and Levine [1998] find that wage levels and structures (e.g., returns to education) at large employers have not become more similar to those in nearby small employers from 1979 to 1993, but Bertrand [1997] finds that the sensitivity of wages to local unemployment rates has increased in companies with increasingly competitive product markets.

> H4A: Wages have become increasingly correlated with average regional wages and increasingly negatively correlated with regional unemployment.

This effect should be more pronounced at jobs that have a closer connection to the local labor market. For management jobs like those in our data, first-line supervisory positions are more closely linked to the local labor market than are senior executive positions which operate more in a national or international labor market.

> H4B: This increase in correlation should be more pronounced for lower-level than top-level positions.

B. Has Pay for Individual Merit Become More Important?

The practitioner literature on compensation advocates the use of individual-level rewards for performance and suggests that its use has increased over time. Merit pay is the term used to describe increases in base compensation attributable to individual performance. To the extent that merit pay has risen in importance, we expect:

> H5A: Inequality of base pay among employees in the same job title should have risen.

Some employers increase incentives for individual performance not by increasing merit pay but by increasing their use of short-term bonus or incentive payments that do not enter base pay in future years. If this trend is widespread we expect:

> H5B: Inequality of total pay (that is, base + bonus) within a job title should have increased faster than inequality of base pay, and

H5C: Inequality of total pay within a firm should have increased faster than inequality of base pay.

C. Has Rentsharing Become More Important?

We can also provide imperfect measures of the extent to which companies are tying more pay to company-wide performance. These measures are subject to many problems noted below; most importantly the dataset contains a limited number of employers.

First, we can decompose bonuses into a portion that is handed out to individuals and a portion that is shared company-wide. In the former, the company identifies good performers and gives them bonuses that are proportional to pay, bonuses that act much like merit pay except that they do not raise base wages. In the latter, the company distributes bonuses equally to individuals across the company. We can regress [bonus / (base + bonus)] against control variables plus a set of employer effects where the standard deviation of these estimated employer effects measures the extent of company-wide bonus; the residual measures individual merit bonuses. If company-wide gainsharing is increasingly important, we expect:

H6: The variability of firm-wide bonuses (compared to total pay) has increased.

Tests of this hypothesis are subject to a number of limitations, however. Any secular trend may be obscured by the recession in the early 1990s which should have dampened the profits that fund the bonus pool at many employers. Further, this simple decomposition cannot distinguish bonuses that are shared by a division or team. Our procedure will allocate such bonuses into individual or company-wide portions based on the size of the group sharing the bonus.

A number of arguments have been made about the rising power and influence of shareholders in corporate governance in recent decades. Much of the discussion has focused on investors' increasing ability to advance management practices designed to further their interests such as linking the pay of executives more closely to changes in shareholder value [see, e.g., Useem 1996]. We measure company performance directly using financial indicators of profits and stock market returns and estimate whether base pay and/or bonus became more tightly tied to past corporate performance over the period 1986 to 1992. (Our method follows Blanchflower, Oswald and Sanfrey [1996]. They survey the many difficulties in using correlations between pay and financial performance to measure the causal link between performance and pay. Most problematic is reverse causality: an accounting identity assures us that the direct effect of a dollar of excess wages is to lower profits by $1. Thus, even if higher product-market rents (for example) raise wages, the wage, profit correlation may be low or negative.)

H7: The correlation between recent past financial performance and pay has increased over time.

D. Have Wage Structures Converged?

Many press stories recount how competition and the reduction of product market rents have induced large U.S. firms to move closer to market levels of pay. The effect of this development on average compensation might well be obscured in practice by other developments such as increased variation in skill levels across employers or increased incentive compensation such as profit sharing that varies across employers and affects pay levels. The trend toward equalization should nevertheless appear in returns to basic units of skill. They should become more common across employers if competitive product and labor markets are reducing the ability to pay above or below market rates for equivalent units of labor.

> H8: The variation in returns to skill between-firm should decline over time.

III. Data

We analyze a proprietary data set collected by Hay Associates, the world's largest compensation consultant. The Hay system begins by identifying the skills that are needed to perform particular jobs adequately using detailed and consistent measures of job requirements. Job analyses based around detailed questionnaires are developed for each functional area such as finance, personnel, or engineering, in order to establish exactly what an incumbent does in a job. These include job duties, allocation of time, responsibility, critical tasks, customer contact, and many other tasks. The questionnaires are completed for each job title, usually by a team of managers, employees holding those jobs, and Hay consultants.

The measure of skill used by Hay measures the autonomy and complexity of jobs which are issues central to the theories of wage determination described above. The Hay measures are grouped into three categories: "Know How" measures the capabilities, knowledge, and techniques needed to do the job ranked according to their complexity. The skills captured by this measure include the kind of formal knowledge usually associated with years of education. "Problem-Solving" measures how well-defined and predictable job tasks are (less defined and predictable tasks make greater demands on employees). Finally, "Accountability" measures how much autonomy or individual discretion employees have in decision making. The three dimensions are then combined into a single index known as "Hay points" that is designed to measure the extent of job requirements that workers must perform. Hay's intention is to make these scores comparable across occupations, companies, and over time.

Hay maintains a data base on what its client companies in different industries pay for occupations with a given number of Hay points. Individual clients choose a comparison set of employers (e.g., by size, industry, and location) and decide how they would like their overall wage structure to be positioned in comparison to those paid by the comparison set -- e.g., at the median or at the 75th percentile. Clients also exercise

discretion in deciding how to position the pay of individual jobs in their organization compared to that reference set. They may decide to pay some jobs more or less than the levels prevailing in the data set, for example, in order to establish wage structures that facilitate internally consistent promotion pathways or job ladders consistent with the unique set of jobs in their company.

A. Are the Hay Measures Valid?

Data from Hay compensation surveys have been analyzed by a number of researchers [e.g., Smith and Ehrenberg 1981; Cappelli 1993; and Gibbs and Hendricks 1995]. But it is worth considering in some detail the merits and drawbacks of using these data.

An important goal of the Hay systems is that the measure of skill created by its job analysis be consistent both within and across organizations because one of the services they are effectively selling is salary comparisons based on skill across firms. Hay asserts that "compensation lines are *directly* comparable from one organization to another" (their emphasis [Hay Group, p.8]. Reliability of the measures across jobs and firms is especially important for our purposes.

The process of job analysis (defining the requirements of jobs) and attaching Hay points, the measure of skill requirements, to jobs is conducted at an employer by a team of the company's managers that is trained and led by a Hay consultant. The team begins the process with a set of "benchmark jobs," such as nurses, secretaries, or accountants, that represent common occupations easily identifiable in the labor market. The skill requirements for these benchmark jobs are reasonably constant across employers and are largely general as opposed to firm-specific. After the team has completed its analyses of the skill requirements of the benchmark jobs, the Hay consultant does another, independent evaluation of these jobs. These results are compared to the scores produced by the team in order to check for any biases in their work. After attempting to correct biases in the team's judgments and then revising the scores, the consultant does yet another comparison, this time with the average scores generated across client companies for the same benchmark jobs. A correction factor is generated from that comparison and is applied to all of the job analyses generated by the team, for benchmark and non-benchmark jobs. If, for example, the scores produced by the team for its benchmark jobs are 5 percent higher than the average across other companies, then the consultant calculates a "correlation factor" that will reduce the scores produced by the team for all of the jobs in that company by 5 percent.

As a final check on the consistency of these skill measures, the company maintains an internal Job Measurement Quality Assurance Group to check on the comparability of the scores produced across client companies. The consultants in this group are senior practitioners known as "correlators" who are certified by Hay in their ability to apply the Hay system consistently across client companies. After a consultant and the client team complete their analysis of jobs and pay, including any corrections described above, the correlators come out to the client company and assess the results for consistency with Hay practice elsewhere. And every three years after a compensation system has been

introduced, a Hay consultant returns to the client to evaluation the system and ensure its consistency.

In addition to these internal checks, external pressures also help ensure the reliability of the Hay procedures. First, the fact that Hay Associates has been using essentially the same job evaluation process for more than fifty years provides opportunities to identify and eliminate obvious sources of error. Hay Associates's success in the market over many decades implies that many employers find their job evaluation and weighting scheme to be useful. The tens of thousands of dollars that employers spend and the hundreds of hours that their managers spend working on job analyses suggests that employers consider the services Hay provides as highly valuable. Second, the fact that Hay Associates relies on repeat business from large corporations provides important incentives to maintain reliable systems: A client would immediately recognize and find it disturbing if the Hay job evaluation system generated different skill points in subsequent years for jobs that the employer knew had not changed.

Further, the Hay measures have widespread influence on how jobs are structured and evaluated in the economy as a whole and, in that sense, have good external validity. During the 1980's, for example, over 2 million employees were in jobs evaluated by Hay, and its system was used by 40 percent of the *Fortune* 1000 [Labich 1992, pp. 116-117]. Moreover, comparisons by non-Hay firms with these establishments extend the influence of the Hay system even further.

In addition to the issue of consistency or reliability, it is also important to consider explicitly whether the Hay measures are valid: Specifically, whether they do a better job at measuring the dimensions of skill than alternative measures that are available. The Hay points' measure of skills and responsibility -- as with any such measure -- is subject to several constraints. The process of writing job descriptions and determining which tasks and responsibilities should be included in them is somewhat arbitrary, and difficulties in matching actual job duties with Hay Associates' compensable factors can also introduce errors. How to weight different factors in determining an overall measure of skill is also largely arbitrary.

A potentially important concern is the extent to which clients may have an incentive to bias the decisions governing Hay points as a means of shaping pay decisions in one direction or another, despite the consistency controls noted above. For example, a powerful job incumbent involved in the job analysis process may want to justify his or her high current pay, creating reverse causality between Hay points and compensation. While such incentives no doubt exist, the clients and the individual employees in them do not need to bias the skill measures to shape those wage decisions. The process of designing compensation systems gives the client firms ample opportunity to shape wages as they wish without altering the measure of Hay points. As noted above, clients choose the comparison set for compensation data, they decide where their average compensation should be relative to the market, and they make such decisions differently across jobs. Because the relationship between pay and points is not mechanical, clients do not need to try to bias Hay points up in order to increase compensation for their positions [see Bellak

1984]. (As a further check, in many of the analyses below we control for the level of individual jobs in the management hierarchy, a key factor that may influence the ability to influence the job analysis -- top executives potentially have more power over the process than supervisors. Including these controls rarely altered the results.)

Finally, it is helpful to contrast the Hay measures and the various procedures they use to guard against biases with alternative measures of skills that are typically used in research. Job titles and education levels are the most common alternative measures. Both education and job title data are typically self-reported and come with all the associated biases -- everything from ego-enhancing reporting to simple problems remembering. Education is typically measured in years attended (sometimes years completed) with few efforts to adjust for the quality or type of education received except in some cases where the type of degree completed is included. Job titles often differ across organizations for similar positions, especially for managerial jobs. Efforts to generate consistent job titles, such as those used by the Census Bureau, confront the same type of matching analysis performed by Hay, but with far fewer quality checks than Hay has.

IV. The Sample

Our data set examines over 50,000 managerial positions per year in 39 companies in 1986 and 1992 with the number of managers employed per company ranging between 129 and 5813. The data captures the population of managerial-level jobs in each company and includes the characteristics of the jobs rather than of the incumbents. For each job, we can identify its level in the organization chart or hierarchy and the firm to which it belongs: CEO or division president; other senior executives with company or division-wide responsibilities; middle management (that is, managing other managers or supervisors); supervisors; and exempt, non-supervisors, generally professional jobs such as accountants. We also know the functional area of each job, such as marketing or finance, location (zip codes), base salary, total salary, mid-point on the salary scale for each job class, and skill points (total, and broken out into the three subscores for know-how, problem solving, and accountability skills).

The 39 companies are headquartered throughout the U.S., and the employees in each company are often dispersed throughout the country. About 200 of the locations have at least 10 managerial employees. We analyze pay data for two years for each company -- 1986 and 1992. In 1989, the midpoint in that period, the companies ranged in size from 584 to over 60,000 employees, with a mean of 16,604 and a median of roughly 9,500.

We first analyze the log of annual base wages because base wages are the component of compensation that should be most closely linked to the Hay points measures of skills and responsibility. We then present the analyses on total pay, defined as base pay plus annual bonuses. We merge into our data set information on total company employment taken from Compustat.

The dataset does not have information on stock options and other forms of long-term incentive pay. Moreover, it lacks information on stock ownership, a form of implicit

incentive that can be very important for many top executives [Hall and Leibman, 1997]. Thus, our results for the very highest levels of executives may not be representative, given that stock ownership is an important part of their total compensation. We replicate all results on a sample without top executives, however, creating a sample where stock ownership and long-term financial incentives are much less important, to produce results that can be generalized to employees for whom base and bonus payments constitute the bulk of their compensation.

V. Methods

We use an OLS regression to test the model developed above and to examine wage inequality across and within firms. We regress the log of base wages against a set of firm dummies and a composite indicator of Hay points. To control for unmeasured aspects of the jobs, we include each job's occupational level in the hierarchy (five levels) and 16 indicators of the functional area within which each job is located -- finance, marketing, engineering, and so forth.

Several analyses examine inequality within a job title. We do not directly observe job titles. To identify employees with the same job titles, we match on employer, function, level, and Hay points. In 1986, for example, there were 11,641 distinct jobs in the sample.

We used a bootstrap technique to compute the statistical significance of the changes by running the regression models 200 times on random halves of each sample and retaining the estimated returns to Hay points and/or the estimated standard deviation of the firm effects for each regression. To test for differences in a coefficient over time or across specifications, we tested whether the distributions of the 200 coefficients in each specification differed. We performed a nonparametric Wilcoxon rank test on the two distributions of coefficients and/or standard deviations. (Using a more powerful but parametric t-test produced the same results.)

Especially because many of the wage equations involve sample sizes with over 50,000 observations, even differences that are unimportant substantively can be statistically significant. In the discussion below, therefore, we emphasize those results that are large and substantive. The large sample size also implies that correcting for measurement error when, for example, computing the standard deviation of employer wage effects does not meaningfully affect our results [Haisken-DeNew and Schmidt, 1996]. As a result, we forego that extra set of computations in the results reported here.

VI. Describing Wage Structures at Large U.S. Employers

We present summary statistics and checks for representativeness of the sample as well as other descriptive decompositions of the data which may be of interest because so little few multi-employer datasets are available with measures of both skills and wages.

A. Summary Statistics.

Table I contains summary statistics about the changes in jobs in this sample between 1986 and 1992. Both base and total wages were higher in real terms in 1992 than in 1986 with most of the increase in total wages being attributable to the rise in base wages. Average skill points were slightly lower in 1992 than in 1986, a potentially interesting result given the interest in whether skill requirements in the workforce are rising. The differences in wages and in skill points are statistically significant. The standard deviation of both base and total wages increased (for example, the standard deviation of the log of base wages rose from 31.6 percent in 1986 to 34.3 percent in 1992) while the standard deviation of skill points fell slightly during this period. In results not shown, other measures of dispersion such as the Theil and Gini coefficients also indicate a similar increase in wage inequality. (These measures capture different aspects of the distribution than does the standard deviation. Amartya Sen discusses the strengths and weaknesses of these measures [1973].) Tables IF and IG present the industry breakdown of companies and the distribution of the positions by functional area.

Table I Here

B. Checks for representativeness.

An important issue in datasets such as this one is the question of sample self-selection. To test whether the firms in this sample were distinctive from employers of similar size in their industry, we used Compustat data to match each firm in the Hay dataset to the firm closest in 1986 sales within its 2-digit SIC industry. Using a Wilcoxon signed rank tests, we found no statistically significant difference between the firms in the Hay dataset and the matched firms in the level of sales, employment, or debt to equity ratios in 1992, or rate of change in sales, employment, or debt to equity ratios from 1986 to 1992. We also found no statistically significant difference in profitability (return on assets) in 1986 or 1992. Using the acquisitions line on Compustat we found no significant difference between the mean size of acquisitions over this time period and no difference in the number of acquisitions per year. In short, there is no evidence that these employers are in any way non-representative of the population of large industrial firms. (This population, of course, is not representative of all employers.)

C. Describing Wage Structures:

The employers in the Hay dataset are relatively homogeneous in terms of size and sector (they are all industrial). Because the employers in this data set pay tens of thousands of dollars to Hay to find comparable employers and use data from those comparable firms to set their own pay levels, we might expect between-employer pay variability to be much lower in this dataset than in most others. Nevertheless, the employers appear to have

distinctive approaches to setting their wage structures. For example, wage levels do differ across employers for similar jobs. Controlling for 5 job levels and 16 job functions, the standard deviation of employer effects was 12 percent in 1986 (Table III, model 1). This is somewhat lower than the standard deviation of employer effects estimated in other datasets, which range from 14 to 21 percent. (See, for example, the papers in U.S. Bureau of the Census, [1998].)

Employers also pay systematically different amounts for units of skill as measured by Hay points. In results available on request, we estimated wage equations which permitted each employer to have its own intercept and its own coefficient on Hay points. The standard deviation across employers of the return to Hay points was 0.057 in 1986, which is a substantial fraction of its mean of .239. Again, the fact that pay structures differ among employers accords qualitatively with what other researchers have found (e.g., Groshen and Levine [1998]; Leonard and van Audenrode, [1996]).

 D. **Persistence of Wage Structures**. Also, as others have found (e.g., Levine [1991]; Groshen [1991b], these employer wage effects persist over time. Controlling for level and function, the correlation of firm effects in 1986 with those estimated in 1992 is .79. Firm-specific levels of the Hay measures of skills are almost as persistent. The correlation between employer effects in 1986 and 1992 in an equation predicting skills (controlling for level and function) is .74.

Finally, other aspects of the employer wage structures besides the average are correlated over time. We permitted each employer to have its own coefficient on Hay points as well as its own intercept. The correlation between firm-specific returns to Hay points estimated in 1986 and 1992 is .69. This is somewhat higher than the autocorrelation that Groshen and Levine [1998] identify with their measure of firm-specific wage structure; they estimated 5-year autocorrelations near .45 during that time period. (Their measure is for all aspects of the firm-specific wage structure, which may include many transitory and person-specific features, while the single Hay measure may capture more about company policy.)

E. Base Pay vs. Base Pay + Bonus.

As expected, the total inequality of base+bonus is somewhat higher than that of base pay alone. In Table IV, the RMSE of an equation with only job level and function controls was 25.9 percent for base+bonus, somewhat larger than the 24.7 percent for base pay in 1986 seen in Table III. We can also conclude that virtually none of the difference in inequality between employers appears to be due to bonuses that are shared company-wide among managers and professionals. Company-wide sharing of bonuses would lead the standard deviation of firm effects to be larger for base+bonus than for base pay alone. But in fact, the reverse was true: the standard deviation of firm effects for base pay was 12.0 percent in 1986 and 11.7. percent for base+bonus.

Perhaps surprisingly, base+bonus is *more* closely related to Hay points than base alone. When regressing Hay points against base+bonus in 1986 the estimated coefficient was

.220, on base alone the coefficient was only .203. (The regressions included controls for level and function.) This result is perhaps not surprising when comparing compensation between levels. That is, top executives have on average both more bonus pay and a higher proportion bonus pay than their vice presidents. What is somewhat more surprising is that the result still holds when we include controls for job level, as in Table IV. It would be difficult to imagine that we could have this result if bonus payments were largely dependent on individual worker performance as that should vary considerably across individuals in jobs with the same Hay points. It would appear, therefore, that bonuses have at least as much to do to with one's position as does base pay.

F. Employer Wage Effects by Level.

It is also interesting to know how consistent wage policies are within a firm. Dickens and Katz, for example, present evidence that high-wage industries pay high wages to all occupations [1987]. In this data set, the firm-specific intercept estimated for each level alone are correlated .89 and above with overall employer wage effect, controlling for job function and Hay points. This suggests that these employers pursue consistent policies toward wages across different jobs, setting wages for different positions at more or less the same point in the distribution of wages for similar jobs across other employers.

VII. Results

Table III presents the main analyses. Wage inequality in this sample has increased, as indicated in the first row of Table III: the standard deviation of log (wages) has risen from 31.6 percent to 34.3 percent, that is, by about 10 percent. (For ease of exposition we refer to 100 times logs as "percent.") Inequality is lower controlling for a job level and function (RMSE = 24.7 percent in 1986). The rise in inequality between 1986 and 1992 is again almost ten percent. Controlling for job level and function ensures that the increase cannot be attributed to any changes in the composition of jobs across that period. (The R^2 of the regression with just the controls is almost unchanged between 1986 and 1992.)

Table III Here

A. Are Differences in Mean Wages between Firms Primarily Due to Differences in Skill?

The first hypothesis asserted that differences in average wages across employers were attributable to differences in average skill levels across employers. Model 1 in Table III examines base wages using only firm effects and controls for job level and function, without Hay points. The increment to the R^2 due to adding firm effects is 7.9 percent, and the standard deviation of firm effects is 12.0 percent, reinforcing the descriptive observation earlier that wages differ substantially among employers for employees with similar job titles and skills. The second model shows the results of regressing log wages against the composite Hay points score. This single measure of skill and responsibility is correlated .80 with base wages, corresponding to an R^2 of 64 percent from this single measure alone (regression not shown). By way of comparison, a standard wage equation

controlling for age, education, experience, tenure, gender, race, region and various nonlinear combinations rarely achieves an R^2 over 30 percent: A wage regression with three-digit occupational classifications -- a typical proxy for job requirements and skill in other studies -- and the above controls using the 1992 Current Population Survey produces an R2 of only 31 percent. The impressive explanatory power of Hay points implies that it is a far more complete measure of skill and job requirements than those used in the past to explain wage outcomes.

The third model includes both firm wage effects and the composite Hay points score. The standard deviation of the firm effects declines to 11.2 percent when Hay points are included, slightly less than its value of 12.0 percent when it is calculated without controlling for Hay points. The incremental R^2 of adding Hay points and controls to firm effects is 7.8 percentage points, which is almost identical to the incremental R^2 of adding firm effects and controls alone, without Hay points (7.9 percentage points). The fact that the standard deviation of the firm effects and the incremental R^2 of adding firm effects to the equation are hardly diminished when controlling for the very detailed measures of skill represented by Hay points suggests that relatively little of between-firm inequality is due to differences in mean skill levels between firms, providing little evidence in favor of hypothesis 1. Another implication of Model 3 is that Hay points are, in fact, being used consistently across firms: If they were not, then the adding firm effects should produce estimates that are substantially better than using Hay points alone. Yet the improvement is relatively modest (last row in Table III).

These results do not imply that mean wages at an employer and mean Hay points are completely uncorrelated. When we regress the mean wage residual at each firm (that is, the firm effects from Model 1 in Table III including the controls) and the mean Hay points residual at each firm (that is, the firm effects from model 2 in Table III including the controls), the R^2 is .12 in 1986 (regression not shown). This R^2 is only one-fifth as large as that obtained when we perform the regression at the individual level. Together, these results suggest that skill as measured by Hay points is a powerful predictor of wages within enterprises but a weak predictor of which employers pay high wages.

The inability of detailed skill measures to reduce the variances of employer wage effects was surprising but not entirely without precedent. Similar results were found in 1982-83 surveys that compared manufacturing establishments in the Indianapolis area in the U.S. to those in the Kanagawa prefecture in Japan (an industrial district outside of Tokyo). These surveys provided one of the few datasets in addition to our Hay data that contain both detailed measures of job characteristics and sufficient observations per employer to estimate employer wage effects. (James Lincoln and Arne Kalleberg [1990] discuss the data in detail.)

In addition to standard measures such as age, race, education, tenure, and experience, the surveys included questions on 12 (in Japan) or 13 (in the U.S.) job characteristics such as training, autonomy, complexity, and supervision that offered proxies for job and skill requirements. The job characteristics were important predictors of wages. In both countries, increasing each measure of OJT and complexity and lowering each measure of

supervision by one point each (on a four point scale) has about the same effect as raising education by four years. (Complete results are in Levine [1991], tables 2 and 3.)

As with other datasets, employers paid very different wages to employees in the same broad occupation with similar demographic characteristics and human capital. The standard deviation of employer wage effects was 18.5 percent in the U.S. and 13.7 percent in Japan. These employer effects are very large; in both countries, moving from the average plant to one paying one standard deviation above average increases wages by as much as increasing education from grade school to college.

In spite of their importance in predicting wages, however, the adding the many job characteristics to the wage equation with standard controls plus plant effects did not reduce the dispersion of establishment wages. Specifically, the standard deviation of plant wage effects in the U.S. actually *rose* slightly from 18.5 percent in the baseline equation to 19.0 percent when job characteristics are added to the regression while the Japanese figure declined only slightly from 13.7 percent to 13.5 percent. The plant effects with and without job characteristics were correlated at or above the 0.98 level in both countries.

These results are hardly definitive, but replication of this key and surprising result in the Indiana and Japanese datasets as well as the very different Hay data set raises our confidence that measures of skill and job characteristics do not, in fact, explain much of the differences in wages among employers.

B. **Changes over Time** .

Firm wage effects have grown over time in the Hay sample. The standard deviation of the firm effects alone (model 1) grew from 12.0 percent in 1986 to 14.6 percent in 1992, and the incremental R^2 of adding firm effects given the controls increased from 7.9 to 9.0 percentage points. These results support H:2, that wage inequality between employers has risen. Davis and Haltiwanger [1991] and Groshen and Levine [1998] also find rising inequality between employers during this time period. And the rise in inequality was not due to increased sorting of skills among employers.

The rise in inequality was greater between employers than within employers. Within-firm inequality of log wages (measured by the root mean square error [RMSE] of an equation including controls and firm effects) rose from 23.1 to 24.7 percentage points between 1986 and 1992, about 9 percent. In contrast, inequality between employers (the standard deviation of the firm effects) rose from 12.0 to 14.6 percentage points over the same period, a 21 percent increase that is about twice as fast as the growth of overall inequality (Table III, model 1). This result contradicts hypothesis 2, which notes that if inequality within and between firms are both proxies for human capital, then their returns should grow in tandem.

Within-firm inequality might have increased more rapidly between managers and lower-level employees, however. For example, Davis and Haltiwanger [1991] calculate that

wage inequality between manufacturing plants measured in an establishment survey (the LEED) grew more slowly than total wage inequality measured in a household survey (the CPS). Assuming the two sets of inequality measures are comparable, they then estimate that 25-40 PERCENT of the increase in wage inequality is within plants for nonproduction workers.

C. __Do Higher Returns to Skill Explain Most of the Rise in Wage Inequality__?

Model 2 in Table III regresses the composite measure of Hay points and job-level controls against wages in order to test H:3, that the increase in inequality between firms can be accounted for by changes in returns to skill. Consistent with the assumption that returns to human capital have risen over this period, the coefficient on Hay points rises about 15 percent (from 20.3 to 23.3) between 1986 and 1992.

Rising returns to this measure of skill explains only a portion of the rise in inequality between firms, however. The incremental R^2 from including Hay points (given the controls) rises from 31.4 to 32.7 percent from 1986 to 1992 while the RMSE of the regression rises from 17.3 to 18.2 percent. (In regressions not shown, without the presence of the controls, the R^2 of the equation including only Hay points actually declines slightly, from .64 in 1986 to .60 in 1992.) These increases in the inequality explained by Hay points are not significant, however, based on the bootstrap test. In model 3 we add firm effects and Hay points to a model with the standard job controls. The standard deviation of the firm effects in fact rises 2.7 percentage points, about 20%, suggesting that rising inequality between employers cannot be due to rising returns to the skills measured by Hay points and refuting H:3.

D. __Robustness Checks__.

Robustness checks (available from the first author) found the results essentially unchanged when we analyzed base pay plus bonus instead of base pay alone (Table IV); omitted the detailed controls for functions and levels within the organization; replaced average Hay points with the know-how, accountability, and problem solving subscores of Hay points along with their squares; included those employers who dropped from the sample in 1992 to perform the cross-section tests on a larger sample; added measures for SMSA mean wages and unemployment rates; corrected roughly for heteroskedasticity by weighting by 1/Hay points; ran the regression separately for each job level and for the larger job functions; and dropped the 1% of the sample with the highest and lowest Hay points and wages.

Table IV Here

VIII. Changes in Internal Labor Markets over Time

While the previous section tested results of a deductive model, this section provides evidence for hypotheses derived from more descriptive and inductive theories about the decline of internal labor markets.

A. <u>Changes in Correlations with Local Labor Market Conditions</u>.

If the compensation structures of firms over time resemble internal labor markets less and their wage setting mechanisms are more closely tied to external labor market forces, we should expect to see a stronger relationship between wages and local market characteristics over time. We test this notion by examining the differential paid to incumbents in similar jobs (same job class and skill points) across locations within the same firm in the two time periods. First we examine the variance in wages across locations. In 1986 the mean standard deviation of base salary for similar work at different locations was $3,302. This declined slightly to $3,230 in 1992 (change not statistically significant), suggesting that the geography differential has remained relatively stable over this time period.

We then calculated the percentage difference between the mean wage for each job at each company location and the overall mean wage for that job across the company and regressed it on local market wages and unemployment. In contrast to hypothesis 4A, local labor market conditions were not significant predictors of wage differentials in either 1986 or 1992. Hypothesis 4B suggests that while the overall relationship should have increased, that rise should have become most pronounced for professionals and first-line supervisors, as opposed to top managers. In fact, results were not significant for these groups, either, although the number of limitations to our analysis suggests that the lack of significant results can only be considered suggestive.

Table V here

B. Has Merit Pay Become More Important?

To the extent that individual-level rewards for performance have become more important, we should see an increase in inequality for base pay for employees in the same job title has risen as H:5A predicts. Consistent with that hypothesis, the typical (median) standard deviation in total cash compensation within job titles for jobs with four or more incumbents had a standard deviation of total pay of 7.0 percent in 1986 and 7.5 percent in 1992. All job levels experienced an increase in the standard deviation of total compensation, but it was larger for first-line supervisors (7.3 to 8.0 percent) and smaller for professionals (6.9 to 7.0 percent). The rise in inequality within a job title averaged about 8.0 percent, slightly less than the 11 percent rise in total inequality in base wages in this sample. This increase in pay inequality within jobs is consistent with the concept of "broad banding" in the practice of compensation whereby the upper and lower bounds of acceptable pay levels for any given job title are widened presumably to give more opportunity to differentiate pay according to individual performance. (Groshen and Levine [1998] also find a small but statistically significant increase in pay variation within a job title during the 1980s and 1990s.)

A second aspect of the rising importance of individualized incentives is the increased use of bonuses. Thirty-two percent of employees in our sample received a positive bonus in 1992, up from 19.6 percent in 1986, a calculation that no doubt understates the extent of bonuses because not all who were eligible for bonuses necessarily received payment. If we instead estimate the percentage of job titles (that is, positions sharing job level, job function, and Hay points) where bonuses were received, the percentage rises from 27 to 47 percent over the same period. In 1986, bonus variation within job titles was on average a small part of total pay. Considering jobs with four or more incumbents in the same firm (eliminating by definition all top executives), we calculated the variation in the percentage of bonus within job title: specifically, the standard deviation of bonus/(base+bonus) for employees with the same employer, job level, function, and Hay points. Over the entire sample, the mean standard deviations of this measure within a job cell was 0.75 percent in 1986. That is, bonuses increased pay variation only modestly among people in the same job title.

At the same time, we find some evidence for hypotheses 5B and 5C that inequality rose faster for bonus than for base pay within job titles and within firms. These hypotheses are based on arguments popular in the compensation literature that employers make greater use of bonuses to reward individual performance than in the past. The proportion of pay at risk in our data set as measured by the size of the bonus payments rose from .75 percent in 1986 to 1.03 percent in 1992. While the absolute level of these payments is low, the increase in level is particularly impressive given that 1992 was a year of low corporate profits. Assuming that bonus pools are related to corporate performance, the 1992 figures are an understatement of the true rise in the importance of bonuses.

C. Have Rentsharing / Company-wide Incentives Become More Important?

If bonuses have risen in importance, because of rent sharing or other motives, then we should expect that any increase in the standard deviation of firm effects would be larger for base+bonus than for base pay alone (Hypothesis 6). There is modest support for this hypothesis. The standard deviation of firm effects for base pay increased by 2.6 percentage points (Table III, model 1) but by 3.0 percentage points for base+bonus (Table IV, model 1). But business cycle effects that influence the level of profits of all firms, causing profits and bonuses to decline in 1992, e.g., confound this comparison. The increase in the standard deviation for base+bonus might be much greater in a more typical year.

If rent sharing with employees through incentive-based pay linked to company performance has increased, then we would expect to see a higher correlation between past financial performance and current pay in 1992 than in 1986 (Hypothesis 7). In our sample, employer wage levels are not correlated with past financial performance. We estimated the relationship using several measures of "financial performance," including a one-year lag of return on invested capital, a three-year average of lagged ROIC, and market-to-book ratio. None had a significant correlation with wage effects either in 1986 or in 1992 (Table VI).

Table VI Here

D. Have Pay Structures Converged?

Finally, if market forces have reduced an employers' ability to execute distinctive approaches to compensation, then the returns to Hay points should have become more similar over time (Hypothesis 8). The data do not support this hypothesis. The estimated standard deviation across employers of the return to Hay points was 0.057 in 1986 and 0.066 in 1992. The average coefficients were .239 in 1986 and .257 in 1992, so the coefficient of variation of the firms-specific returns to Hay points rose about 8 percent over this time period**.**

VIII. Discussion

Some of the results presented here are consistent with traditional human capital theory where higher skill requirements lead to higher wages. Most importantly, our single measure of skills and responsibility explains 64 percent of wage variation in the base year of the sample. It is interesting to see that even for management jobs, the elaborate compensation structures of large corporations are based in large measure on human capital requirements as illustrated by the fact that the correlation between wages and Hay points is even higher within firms than between them.

We find that wage inequality has risen quite substantially between 1986 and 1992. Even in this short span, inequality of log(wages) rose by about 9 percent. Inequality between firms rose faster than within firms, by 20 percent versus 8 percent. Almost all of the increase in inequality *within* firms in our data can be attributed to rising returns to Hay points. Numerous authors have found that some of the rise in inequality is due to higher returns to education, but a substantial portion of the increased inequality typically remains unexplained. Our better measure of skill and job requirements accounts for more of the rise of inequality than have other studies, consistent with the claim that omitted human capital explains the rise in inequality among people at the same employer with similar observable skills.

With respect to inequality *across* firms, we found first that companies pay workers in similar jobs quite different wages, as have previous studies. Human capital theory does poorly in explaining between-firm differences in wages. In 1986, for example, the standard deviation of firm effects was almost the same with and without controlling for Hay points. That is, very little of the differences in mean wages between high- and low-wage firms was due to differences in mean levels of skills and responsibility. This result is both strong and surprising and is replicated in similar data with information on employees, job characteristics, and employers in Indiana and Japan.

A possible explanation for the lack of effect of Hay points in explaining between-plant inequality is that high-wage employers may pay more in order to attract and retain more qualified employees than the jobs require. That is, while Hay points measure the requirements of jobs, some employers may systematically hire "over-qualified"

employees to ensure above average performance. Although this hypothesis cannot be examined with this dataset, it is worth noting that in other research, traditional measures of human capital such as tenure and education have little incremental ability to predict wages after controlling for firm and occupation-specific factors, as we have done in this study. More generally, these results echo past studies where individual-level job characteristics that might proxy human capital have had limited success in "knocking out" what appear to be wage anomalies (e.g., Krueger and Summers [1988] on industry wage effects; Groshen [1991b] on establishment wage effects; and Brown and Medoff [1989] and Kruse [1992] on size-wage effects).

While rising returns to Hay points account for out most of the rise in within-firm inequality, Hay points explain none of the rise in inequality between firms. Davis and Haltiwanger [1991] infer that the increases over time in inequality for production wages they observe between manufacturing plants, coupled with other evidence of increasing returns to measurable skills such as education, "are consistent with explanations for the gap that stress sorting by worker ability." They assert that the rise in inequality suggests that "the sorting by worker ability across plants of different size probably increased over time." Our direct test of increased sorting does not support their conclusion, at least with our sample of managerial employees. We find no consistent pattern of increased sorting of skills between employers.

Proponents of human capital theory may not be swayed by the lack of evidence in our analyses that skills are behind the rise in inequality between firms. Despite the fact that our skill measure is correlated at .80 with wages, it is possible, for example, that some aspect of skill that Hay does not measure may be increasing in importance over time and may not be evenly distributed across firms. Nevertheless, these results should give pause to researchers who are confident that differences in mean levels or increases in the differences in mean pay between employers are due to unmeasured skills.

Our results suggest mixed evidence that the administrated wage structures that characterize classic internal labor markets are giving way to arrangements where the labor market has a greater role. We find no evidence that local labor markets have much effect on the wages of these large employers, even for professional and first-line supervisory jobs which are closer to the outside labor market, either in 1986 or 1992. We do observe a small increases in pay variation within job titles, however, that would be consistent with the hypothesis that merit pay has become more important as well as large increases in the use of bonuses. We also find that the dispersion of employer-specific returns to Hay points rose slightly over this period, contradicting the hypothesis that competitive pressures are equalizing wages across otherwise similar jobs.

In considering these results, it is important to recall the limitations of the dataset – most notably, its modest number of employers and limited span of years. The sample is also fairly homogeneous in that the employers are large and relatively old. Importantly, because the employees are restricted to managers and professionals; inequality between these occupations and hourly employees cannot be examined. The sample studied by Davis and Haltiwanger [1991] examines a broader range of firm sizes and employee

occupations, workers, and some of the changes they observe may not be visible in the smaller slice of firms and employees in this sample. More recent data might also reveal greater changes in internal labor markets given that other studies are finding changes only in the mid-1990s (e.g., Neumark, Polsy, and Hansen [1998]).

Finally, these results raise new questions for future research. Perhaps the most obvious question is why do skills provide a reasonably good explanation for rising wage inequality within firms but not for the increase in inequality across firms? Perhaps individual employers are able to adjust wages to skill requirements inside their operations but firm-level wage strategies, such as efficiency wages, still differ across firms and override the tendency for wages to equalize for jobs with similar skill requirements. Although few datasets will have better measures of skills and responsibility, future research will want to examine larger samples of both employees and employers coupled with more characteristics of each in order to address questions like these.

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Table I: Summary Statistics

Table IA: Overview

	1986 Mean S.D.		1992 Mean S.D.	
Base Pay ($s)	41607	17649	43361	19593
Total Compensation ($s)	42837	21760	45277	25230
Hay points	206.6	119.9	201.4	112.4
Sample size	54,080		55,298	

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Table IB: Hay Skill Points

Mgt. Level	1986 n	1992 n	1986 Mean	S.D.	1992 Mean	S.D.	Difference of Means T-Stat
M=0	39	39	1352	838	1340	950	1.12
M=1	496	479	661	307	580	450	4.36*
M=2	4762	4102	363	127	356	116	2.36*
M=3	22695	19297	198	71	204	72	7.07**
M=4	26088	31308	171	56	168	51	7.17**
All	54080	55225	206.6	119.9	201.4	112.4	7.3***

Table IC: Base Pay

	1986 Mean S.D.		1992 Mean S.D.		Difference of Means T-Stat
M=0	220000	141982	231150	158205	2.09*
M=1	119682	58175	116369	55062	0.89
M=2	62722	18026	67884	22493	11.49***
M=3	41610	10422	44531	13183	24.23***
M=4	35970	9379	38039	11105	23.34***
All	41607	17649	43361	19593	15.5***

Table ID: Total Compensation (Base Pay + Bonus)

	1986 Mean S.D.		1992 Mean S.D.		Difference of Means T-Stat
M=0	268235	194394	310526	256258	2.17*
M=1	141669	81657	141498	85027	0.03
M=2	67242	23450	74557	29925	12.3***
M=3	42315	11424	46107	14875	28.2***
M=4	36552	9720	38969	11418	26.72***
All	42837	21760	45277	25230	17.1***

Notes: All figures expressed in 1986 dollars.

M = 0 is CEO or Division president, 1 is other senior executives with company or division-wide responsibilities, 2 is division managers (managing other managers or supervisors), 3 is supervisor, and 4 is exempt, non-supervisory positions, generally professional jobs.

Table IE: Industry breakdown of respondents

SIC	DESCRIPTION	N	SIC	DESCRIPTION	N
20	Food and Kindred Products	4	35	Industrial & Commercial Machinery & Computer Equipment	4
26	Paper and Allied Products	3	36	Electronic & Other Electric	3
27	Printing, Publishing & Allied Inds	1	37	Transportation Equipment	1
28	Chemicals & Allied Inds	2	38	Measuring, Analysis & Controlling Inst	1
29	Petroleum Refining & Related Inds	3	40	Railroad Transport	2
30	Rubber & Misc Plastics	1	49	Electric, Gas & Sanitary Services	6
32	Stone, Clay, Glass etc.	2	50	Durable Goods Trade	2
33	Primary Metals	2	51	Non-durable Goods Trade	1
34	Fabricated Metal Products	1			

Table IF: Functional breakdown of respondents

Job Function	Number of Incumbents		Mean Skill Points		Mean Base Salary	
	1986	1992	1986	1992	1986	1992
General Mgmt/Multifield	630	415	690.638	661.665	105370.5	112063.2
Strategic/Corporate Planning	128	104	339.945	313.75	61921.54	65260.56
Finance/Acctg	3768	3954	211.476	207.482	41023.2	44167.9
Info Sys/ DP	3259	4995	190.122	185.256	38803.74	39827.39
HR	2185	2331	208.05	203.616	41523.28	44421.57
Legal	504	426	305.821	303.857	55680.49	60438.94
Marketing	8604	9638	214.176	204.039	39585.22	39808.25
Public Relations	286	327	234.804	222.419	47261.31	48819.96
Facility Services	1409	1554	177.51	155.693	38711.61	37431.81
R&D	1756	1878	236.203	231.952	44202.21	50116.17
Engineering	7691	8125	203.966	195.092	42156.84	45317.06
Materials Mgmt	1979	2175	177.155	175.845	36024.76	38458.5
Purchasing/Contracting	906	938	207.422	192.788	41049.23	42737.76
Plant Engr	2015	1814	198.984	196.135	42775.41	46094.92
Mfg or Prod Engr	1314	1445	200.524	198.531	39373.31	44038.31
Quality Assurance	964	1000	194.01	191.762	39269.54	42441.18
Prod/Mfg Operations	6222	4644	184.834	191.496	38986.15	42989.94
Rail Transport Operations	2942	2197	181.673	181.675	44526.31	39645.18
Power Generation	854	525	193.987	195.796	45438.89	47716.31
Power Transmission	630	555	179.438	180.975	42661.45	43458.86
Gas Transmission	200	152	172.25	172.316	45670.52	47869.42
Utility Customer Service	503	495	159.823	153.556	36356.89	36533.89
All Others	5331	5538	203.934	224.96	40479.98	42957.59
	54080	55225				

Table II: Are Skills Increasingly Sorted between Firms? Dependent variable is log(Hay points) RMSE = Root means square error			
	1986	1992	Change (1992-1986)
s.d.(log(Hay points))	0.398	0.394	-.004
Model 1: Only firm effects.	s.d.(firm effects) = .113 RMSE= .388 R^2 = .053	s.d.(firm effects) = .121 RMSE = .384 R^2 = .049	.008 -.004 -.004
Model 2: Firm effects and controls for job level and function.	s.d.(firm effects) = .137 RMSE = 0.288 R^2 = .477	s.d.(firm effects) = .127 RMSE = 0.302 R^2 = .409	-.010 .014 -.068

Table III: Predicting Base Wages

Dependent variable is log(base wage)

RMSE = Root means square error, a measure of within-firm inequality

	1986	1992	Change (1992-1986)
Total wage inequality	s.d(log wage) = 0.316	s.d(log wage) = 0.343	.033
Controls Alone: Job Level and Job Function	RMSE= .247 R^2 = .386	RMSE= .268 R^2 = .391	.021 .005
Model 1: Only firm effects & controls.	s.d.(firm effects) = .120 RMSE= .231 R^2 = .467	s.d.(firm effects) = .146 RMSE = .247 R^2 = .481	.026 ** .016 .014
Effect of Adding Firm Effects (Model 1 - Controls Alone)	ΔRMSE = -.016 ΔR^2 = .079	ΔRMSE = -.021 ΔR^2 = .090	-.005 .011
Model 2: Only Hay points & controls	b = .203 (SE = .0008) ** RMSE = 0.173 R^2 = . 700	b = .233 (SE = .0009) ** RMSE = 0.182 R^2 = .718	.030 ** .009 .018
Effect of Adding Hay points (Model 2 - Controls Alone)	ΔRMSE = -.058 ΔR^2 = .314	ΔRMSE = -.065 ΔR^2 = .327	-.007 .013
Model 3: Firm effects, Hay points, and controls	s.d.(firm effects) = .112 **	s.d.(firm effects) = .139 **	.027 **

	b = .211 (SE = .0007)** RMSE = .149 R^2 = .778	b = .239 (SE = .0008)** RMSE = .152 R^2 = .804	.029 .003 .026
Effect of Adding Hay points, given Firm Effects, (Model 3 - Model 1)	Δs.d.(FE) = -.008 ** ΔRMSE = -.082 ΔR^2 = .311	Δs.d.(FE) = -.007 ** ΔRMSE = -.095 ΔR^2 = .323	-.001 (n.s.) .013 .012
Effect of Adding Firm Effects, given Hay points (Model 3 - Model 2)	Δb = .008 ** ΔRMSE = -.024 ΔR^2 = .078	Δb = .006 ** ΔRMSE = -.030 ΔR^2 = .086	-.002 (n.s.) -.006 .008

Note: All tests are noted as ** or (n.s.). ** implies the change is significant at the 1% level. (n.s.) implies not statistically significant at the 5% level. Tests of the statistical significance of coefficient estimates (b) and changes in coefficients (Δb) are t tests. Tests of the joint statistical significance of firm effects are F tests. Tests of changes over time (the final column) are bootstrapped, as described in the text.

Table IV: Predicting Base Pay + Bonus			
Dependent variable is log(Base Pay + Bonus)			
RMSE = Root means square error, a measure of within-firm inequality			
	1986	1992	*Change (1992-1986)
Total wage inequality	s.d(log base+bonus) = 0.333	s.d(log base+bonus) = 0.363	.033
Controls Alone: Job Level and Job Function	RMSE= .259 R^2 =.369	RMSE= .284 R^2 = .386	.025 .017
Model 1: Only firm effects & controls.	s.d.(firm effects) = .117 RMSE= .243 R^2 =.469	s.d.(firm effects) = .148 RMSE = .265 R^2 =.466	.030 .022 -.003
Effect of Adding Firm Effects (Model 1 - Controls Alone)	ΔRMSE = -.016 ΔR^2 = .079	ΔRMSE = -.021 ΔR^2 = .090	-.005 .011
Model 2: Only Hay points & controls	b = .220 (.0008) RMSE =.175 R^2 = .724	b = .255 (.0009) RMSE = .185 R^2 = .735;	.025 .010 .011
Effect of Adding Hay points (Model 2 - Controls Alone)	ΔRMSE = -.058 ΔR^2 = .314	ΔRMSE = -.065 ΔR^2 = .327	-.007 .013
Model 3: Firm effects, Hay points and controls	s.d.(firm effects) = .108 b = .227 (SE = .0007)	s.d.(firm effects) = .140 b = .261 (SE=.0008)	.022 .034 .007

	RMSE =.152 $R^2 = .793$	RMSE = .159 $R^2 =.808;$ *.804*	.015
Effect of Adding Hay points, given Firm Effects, (Model 3 - Model 1)	Δs.d.(FE) = -.008 ΔRMSE = -.082 $\Delta R^2 = .311$	Δs.d.(FE) = -.008 ΔRMSE = -.095 $\Delta R^2 = .323$	0 .013 .012
Effect of Adding Firm Effects, given Hay points (Model 3 - Model 2)	Δb = .008 ΔRMSE = -.024 $\Delta R^2 = .078$	Δb = .006 ΔRMSE = -.030 $\Delta R^2 = .086$	-.002 -.006 .008

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Table V: Effects of Local Labor Market Conditions on Wages			
Dependent variable is mean wage per job for each			
location/mean wage per job across company			
	Entire sample		Professionals and first-line supervisors, as opposed to top
	1986	1992	1986	1992
Local unemployment rate	0.048 (0.114)	-0.080 (-0.053)	0.050 (0.072)	-0.051 (-0.055)
Local wages	.111 (0.114)	0.211 (0.060)	0.112 (0.125)	0.205 (0.062)
R2	0.000	0.001	0.000	0.002
F statistic	0.96	5.31	0.94	6.49
n	11818	12458	10548	11502

Table VI: Above-Market Wages and Corporate Performance				
Dependent variable is the estimated employer wage effect from Table 3, model 1.				
Independent variables	1986		1992	
	Coefficient (SE)	R2	Coefficient (SE)	R2
One-year lag of return on invested capital	0.068 (1.838)	-0.035	0.561 (0.754)	-0.016
Three-year average of lagged ROIC	-0.41 (3.741)	-0.031	0.098 (0.087)	0.0095
Lagged market-to-book ratio	0.907 (1.73)	-0.024	1.65 (1.45)	0.010
Note: For each regression, the regression=s F statistic was not statistically significant.				

Appendix 1: An Illustrative Model of Unmeasured Skills and Firm Wage Effects

This section outlines a simple human capital model of wage determination. Although we do not expect any such simple model to be literally true, it provides a useful benchmark when we move to the data. We have designated several propositions as testable assumptions and several as testable implications from the model. While we recognize that even the testable assumptions are implications of underlying assumptions, they are sufficiently close to each other to treat them as equivalent.

Assume the true model is completely neoclassical where log(wages), w, are purely a reward for general skills (S) with a rate of return B:

$$w = B \quad S.$$

Assume further that some employers have higher average returns to skills than do other employers. Thus, employers will sort employees, leading employers to differ in their average skill levels. If we regress wages against a vector of firm-specific dummies, then the estimated coefficients on the dummies will capture the amount of sorting by skills. (We will refer to the coefficients on the dummies as the firm wage effects, or as the between-firm variation in wages.) Combined with the assumption that wages measure skills we have our first testable assumption:

TA1: Mean wages differ by firm:

1) $w = f_1 \quad firm\ effects + e_1.$

The standard deviation of the coefficients on the firm wage effects (f_1) indicate how much employers differ in their average skill levels. The standard deviation of the estimated residual e_1 measures wage and skill variation within each firm.

Assume we now have an imperfect but fairly accurate measure of skills,

$$s = S + u,$$

where u is a well-behaved error term uncorrelated with skill or firm. In this case, we can decompose the variance of the skill measure into a component due to the variance of skills, and a component due to the error:

$$V(s) = V(S) + V(u).$$

We can now correlate our measure of skills with wages, yielding a testable assumption:

TA2: The measure of skills is correlated with wages.

An important debate focuses on why we see employers paying such different wages for apparently similar workers and jobs. (Groshen, 1991a, reviews these theories and the

evidence concerning them.) We can address this debate by adding our measure of skills to the regression in equation (1), yielding:

2) $w = b_2 * s + f_2 * firm\ effects + e_2$

Now the standard deviation of the firm wage effects indicate how much employers differ in their average skill levels for those skills not measured by s. That is, the imperfect measures of skills, s, picks up some of the sorting of skills that was captured by the firm effects in equation (1). This yields hypothesis 1:

> H1: The standard deviation of the coefficients on the firm effects (f_2) will be smaller when controlling for skills in equation (2) than in equation (1) with no such controls.

To the extent that the measure of skills s is highly correlated with wages, we know the measurement error on skills (u) must be low. We will now make two further testable assumptions:

Consider the case with data from two time periods, "early" and "late." Assume similar amounts of sorting of both measured (s) and unmeasured (u) skills between employers both early and late. We can test for similar sorting of measured skills by noting that if we estimate how skills vary between employers,

$s = f_3\ firm\ effects$,

> TA3: The estimate of $V(f_3)$ should be similar early and late.

Assume further that the returns to skill (B) has increased over time. Together these imply that the variance of firm wage effects with no controls for skills (as in equation (1)) has increased proportional to the variance of log(wages).

> H2: Thus, the standard deviation of the coefficients on the firm effects in equation (1) should be proportionally larger in the later periods, and the R^2 should remain constant.

With constant measurement error of true skills, u, we have

> TA5: The estimated coefficient   from
>
> 3) $w = b\ \ s + e_3$
>
> should have risen over time. The error term in this regression, e_3, measures the returns on unmeasured skills times the amount of unmeasured skills, u.

Assume further that the measurement error in our imperfect measure of skills is constant; that is, the ratio of true variance V(S) to measured variance V(s) is constant.

(Alternatively, assume that the returns to both the measured and unmeasured components of skill both increase equally.) This yields a further testable implication that the higher estimated returns to skill explain most of the rise in the variance of log wages. Specifically, the estimated R^2 of equation (3) should not have increased over time. The standard error of the equation should have increased proportionately with the square root of the increase in the estimated returns to skill, b.

Finally, to the extent that differences in mean wages between employers (firm wage effects) are due to differences in mean human capital, controlling for observable skill (s) should eliminate most of the increase in the standard deviation of the estimated firm.

> H3: The variance of firm effects in an equation which controls for skill should have risen much less over time than the variance of firm effects in an equation with no such controls.

As discussed in the text, all of the testable assumptions (marked "TA" in this appendix) hold in this dataset.

Appendix 2: Correlations of employer effects by level

Correlations of employer effects by level	
	Correlation of employer effect at this level with mean employer effect of the other four levels.

Top executive at employer	0.31 0.39

Senior executives	0.58 0.72

Middle managers	0.89 0.91

Supervisors	0.95 0.98
Professionals	0.99 0.99

Notes: Regressions that estimate employer effects include controls for function and Hay points. Mean employer effect of the other four levels are weighted by employment.

Authors: