This section presents the empirical results summarized in Table 4. The results indicate a significant positive relationship between the growth rate of firm value and the growth rate of hourly compensation of average employees. The coefficients are indistinguishable from those published in the executive compensation literature, and small firms tie pay more closely to performance than large firms. These results are surprisingly large, and they demonstrate that firms use wages, salaries, and bonuses to create incentives for average employees to maximize firm value.

A. Average Employee Results

The average employee of an average firm has a performance elasticity of compensation equal to 0.102. A one percent increase in firm value results in a 0.102 percent increase in compensation over two years. This estimate of the pay-performance elasticity of the average employee is small, but the estimate is consistent with the elasticities reported for CEOs. For example, Coughlan and Schmidt (1985) report a performance elasticity for CEO pay of 0.1.

The relationship between CEO and average employee performance elasticities is surprising. It seems reasonable that the pay of CEOs should be more sensitive to performance than the pay of other employees because CEOs have more control over firm value. Differential use of other incentive mechanisms may explain this incongruity. Firms may use tools not contained in the Compustat data (such as stock options) to compensate CEOs, while these tools are not used (or are used less) to compensate average employees. The influence of these unobserved tools will not contribute to point estimates based on the Compustat data. This paper is only capable of addressing the link between Compustat's compensation variable and firm performance.

Even without information on other forms of incentive alignment tools, these coefficient estimates represent a significant amount of compensation that firms devote to aligning employee and shareholder incentives. Application of these point estimates to the average firm in the sample indicates that a one percent increase in value results in over $1.24 million in performance-based

Table 1 through Table 3 present the means and medians of relevant variables. These tables demonstrate several features of the data. The Compustat database tends to over-sample large firms. Voluntary reporting of the labor variable exacerbates this bias. As a result, I am not surprised that the median firm in the regression sample employs 18,000 employees and has total assets valued at over $1.7 billion. Such measures of size demonstrate the skewness of the sample. The value of the average firm is over $2.9 billion. The value of the median firm is just under $1 billion.

For consistency with Jensen and Murphy (1990), I base the separation of large and small firms on market value. The separation criterion classifies firms larger than the median size of other firms in the same industry as large firms. This avoids separation of the sample based exclusively on industry-specific characteristics. There are technological reasons to expect differences in the market values of firms in different industries. The sub-samples in this paper contain roughly equal numbers of firms from each industry, and this means industry-specific factors can not explain differences in coefficient magnitudes. This also mitigates rent-sharing explanations for average employee performance elasticities because these effects are equal across the size classes if the extent of rent-sharing is industry-specific. The size hypothesis should be harder to verify if rent-sharing behavior is an increasing function of union density because employees in large firms are more likely to be unionized than employees in small firms.[11]

Median hourly compensation is $13.69, and median total compensation is $30,715. These compensation figures reflect the sample's bias toward large firms.[12] Not only is the average level of compensation high in the entire sample, but median hourly compensation in large firms is about 8.4 percent higher than median hourly compensation in small firms.

VI. Empirical Results

[11] Rayton (1996) examines the link between rent-sharing and incentive explanations for the link between pay and performance in more detail.

[12] See Oi (1990) for several explanations of the size-wage premium.

if changes in hours and overtime have industry-specific determinants. Omission of the BLS data from the estimation does not affect the results in this paper.

C. Returns to Common Stock

I define the growth rate of firm value as the rate of return on common stock. The regression equation includes contemporaneous and lagged values of this growth rate. This lag structure is consistent with Jensen and Murphy (1990), and it allows current changes in compensation to depend on past information. Current pay may depend on past performance if there is some delay in the observation of performance, or if there is some structural factor requiring a delay. For example, salary levels cannot reflect performance changes until the following year.

D. Other Data Issues

This paper uses an unbalanced panel because Compustat increased its coverage in the 1980's. Balancing requires either rejecting all firms not covered (or not reporting the relevant variables) in previous years, or restricting the length of the panel. I admit firms to the dataset that contribute at least five contiguous observations. This allows at least one year of data to work completely through the regression equations for each firm. This approach is consistent with Bhargava (1994). I remove outliers from the data using a simple algorithm employed in Carpenter, Fazzari, and Petersen (1994) to protect against results driven by a few extreme observations. This algorithm entails removal of observations in the one percent tails for each regression variable. All regressions have been run with outlier cutoffs ranging from 0.5 to 3.0 percent. The results are not significantly changed by these variations in the severity of the outlier removal algorithm, or by the use of a balanced panel. After creation of lags and removal of outliers there are 292 surviving firms contributing over 3,000 firm-years from 1974-1992.

V. Descriptive Statistics

digit level, and is available for all industries at the two-digit level of disaggregation. The data is constructed from a mail survey of approximately 375,000 employer units with over forty percent of total payroll employment. The sample contains about 300,000 employer units for the construction of hours and earnings data for production and non-supervisory workers in private, non-agricultural industries.

I use the measurements of average weekly hours and average weekly overtime hours for production and non-supervisory workers to control compensation data for non-numeric changes in the workforce. It is important to correct for changes in hours because firms change the workload of current employees over the business cycle. Failure to correct for changes in hours and overtime over the business cycle could induce spurious correlation between compensation expenses and firm value, both of which vary procyclically. An expanding economy increases both firm value and the overtime of existing employees. This can raise compensation expenditures for reasons unrelated to incentives.

The BLS data can not control for all changes in workforce composition. For example, when unionized firms lay off workers in recessions they begin with the least experienced, and thus the lowest paid, employees. This induces a countercyclical component to average hourly pay. Countercyclical average pay generates a negative bias in the point estimates because increases in average hourly pay accompany recessionary decreases in firm value. The data is insufficient to control for these kinds of non-numeric fluctuations in the labor force, but the biases introduced make it harder to accept the hypotheses of this paper.

I impute BLS industry numbers to all firms in that industry. When four-digit industry data is available I use it, and when it is not available I use the two-digit industry data. This approach to controlling for changes in the number of hours worked is obviously imperfect, but the confidentiality of BLS data prohibits more detailed analysis. This data should serve as an adequate proxy for firm-level data on annual changes in employee hours. This is particularly true

definition of compensation and firm performance does not rule out the conclusion that firms tie the pay of average employees to performance, but any significant relation between Compustat's measure of compensation and firm performance strengthens the argument that compensation contracts throughout the firm reward employees for good performance.

Reporting of the labor variable is purely voluntary, and only twelve percent of Compustat firms choose to report this variable during the sample period. This represents the most severe constraint on the size of the final dataset.[8] Firms that report the labor variable tend to report it each year, and I have discerned only one obvious criterion differentiating reporting and non-reporting firms. Reporting firms tend to be larger than non-reporting firms. For example, the median value for real total assets in the full Compustat database is approximately $46 million.[9] The median value of total assets among those firms who report the labor variable is $1.674 billion. Not only are firms in the Compustat database larger than average firms in the economy, but the firms admitted to the regression data are large in comparison with the average firm in Compustat. Selection bias is a potential problem, but Rayton (1995) finds no evidence of selection biases introduced by the decision to report the labor and related expenses variable.[10]

B. Total Hours and Overtime Hours Worked

The Current Employment Statistics Program provides data on employment, hours, and earnings from a broad sample of firms in considerable industrial detail. The Bureau of Labor Statistics (BLS) cooperates with state agencies to collect monthly data from a sample of establishments involved in all non-farm activities. This data is publicly available for most industries at the four-

[8] Twenty-nine percent of the observations otherwise eligible for admission to the regression sample do not report the labor and related expenses variable.

[9] All dollar values in this paper are reported in 1987 dollars.

[10] Selection bias is investigated using Heckman's two-stage method. This method uses the inverse Mill's ratio (calculated from a probit on the reporting status of the firms) as an explanatory variable in the two-stage least-squares procedure used to generate the baseline results. The inverse Mill's ratio is *never* found to be significant. This approach is suggested by Hsiao (1986, pp. 198-200) for use with panel data.

alternative instruments, but the exclusive use of sales growth possesses the dual advantages of simplicity and defensibility based on previous work.

IV. Data

One distinguishing feature of this paper is the data. Other work on the incentives of average employees uses cross-sectional data or data from a small number of firms. Data for this paper is drawn from the Standard and Poor's Compustat database and the Bureau of Labor Statistics Current Employment Statistics program. Compustat reports a twenty year window of annual data for publicly traded firms, and the compilation of three editions of this data provides 22 years of annual data for over 6,000 firms. Limitations on data availability within Compustat and the removal of outliers limits the final dataset to 3,014 firm-years of data from 292 firms.

A. Compensation Data

I use Compustat's labor and related expenditures variable to measure total compensation. Compustat also reports the number of employees for each firm, and this allows construction of per-employee compensation.

The labor variable represents the costs of employees' compensation and benefits allocated to continuing operations. This variable contains information about the magnitude of annual firm expenditures on wages, salaries, incentive compensation, profit sharing, payroll taxes, pension costs, and some other benefit plans. This variable represents a gross accounting cost of labor. The absence of detailed compensation information precludes the analysis of the incentives generated by different forms of compensation, but the labor variable allows measurement of the link between firm performance and average employee pay.

Point estimates based on the labor variable will understate the degree of incentive alignment. Most components of the labor variable are usually not tied directly to firm performance. An insignificant estimate of the relationship between Compustat's narrow

More generally, rational buyers of stock account for the existing contractual structure in their valuation of shares. The fiscal-year-end stock market valuation of the firm represents the value of the firm after the firm pays the employees. The market will downwardly adjust its valuation of the firm in response to unexpected performance increases if compensation contracts use performance incentives. Abowd (1989) documents the endogeneity of current labor costs and current firm value. He finds a dollar-for-dollar tradeoff between unexpected changes in collectively bargained labor costs and changes in the value of common stock. This endogeneity is not an important issue in the executive compensation literature because CEO compensation is a small fraction of total compensation, but failure to account for this endogeneity in the analysis of average employee compensation could severely bias parameter estimates.

What if the existing contractual structure is not fixed? This implies that increases in performance-based compensation may signal investors to increase their expectations of future profits. If investors believe that changes in the contractual structure will induce higher levels of effort from employees in the future then the increased labor costs may be more-than-offset by increases in expectations of future profits. This implies that changes in current compensation generate an upward bias in the current valuation of the firm. Regardless of the direction of the bias, ordinary least-squares techniques are not suitable for this problem. The data necessitates the use of empirical methods that account for the endogeneity of contemporaneous stock returns.

This paper uses a two-stage least-squares model to correct for this endogeneity, and the instruments are taken from an empirical model of accounting profit employed by Bhargava (1994). Bhargava uses changes in sales, historical firm performance, and industry-specific fixed time effects as the independent variables in a regression on changes in accounting profit. This paper does not seek to extend the literature on the determinants of firm performance, and so this paper uses three years of sales growth, two lags of the returns to common stock, and industry-specific fixed time effects to instrument current period common stock returns. There are many

The fixed time effects control for macroeconomic fluctuations. Separate regressions for durable and non-durable goods industries demonstrate this point. Durable goods industries exhibit greater fluctuations over the business cycle, and estimates of performance elasticities should be higher in durable goods industries if the fixed time effects are ineffective. Rayton (1995) finds no evidence of such differentials in the elasticity estimates.

B. Endogeneity of Contemporaneous Stock Returns

I assume firms adopt a contract structure with the employees at the beginning of the period. The employees then act as self-interest maximizers, and select the effort they will expend over the period. At the end of the period the firm looks at the results, and then pays employees according to the agreed upon contract structure. Given this structure, the ideal data source would contain observations on compensation as well as profits *before* compensation expenses, but existing data sources contain only the post-compensation value of the firm. A simple example clarifies the difference between pre-compensation and post-compensation value.

Consider a hypothetical firm that pays performance-based bonuses to employees that amount to the entire increase in firm performance. This is an example of "giving away the firm." The stock market valuation of this firm would remain constant through time if there were no changes in any firm characteristics besides employee performance. There would be no change in market valuation, but the bonus system would create significant incentives. The market valuation of the firm could never reflect increases in employee performance because these increases would be matched dollar-for-dollar by increases in labor costs. Put differently: market valuations reflect current profits as well as expectations over future profits. Suppose there is some shock to performance that increases the present value of the expected future profits in the hypothetical firm above. The increase in the present value of future profits generates a matching increase in the current labor costs of our hypothetical firm. The net effect on current market valuation in this example must be zero.

A. Regression Equation

The regression equation is given by

$$\ln\left(\frac{w_{i,t}}{w_{i,t-1}}\right) = \psi_{SIC,t} D_{SIC,t} + \beta_0 r_{i,t} + \beta_1 r_{i,t-1} + \omega_{i,t}. \qquad (1)$$

The dependent variable is the growth rate of average hourly compensation, *w*, for the *i*'th firm in year *t*. The primary dependent variables are historical growth rates of firm value. These growth rates, *r*, are defined as the rate of return to common stock. Jensen and Murphy (1990) use this measure in conjunction with beginning-of-period firm value to obtain the level change in firm value. This paper uses growth rates because rates of change are preferable to level changes when firms differ in size. A given level-increase in the value of a small firm represents better performance than the same level-increase in the value of a large firm because of the higher opportunity cost of owning a large firm. Industry-specific fixed time effects, detailed below, control for omitted variables. The regression coefficients are directly interpretable as elasticities, and the lag structure allows two years for changes in firm value to alter employee compensation.

1. Fixed Time Effects

The use of firm-level panel data allows imposition of fixed time effects. I impose these time effects at the two-digit industry level. The fixed effects control for industry-specific changes in omitted variables over time. Examples of such changes include cost shocks and industry-specific changes in market value.

Joskow, Rose, and Shepard (1993), Kruse (1993), and other previous studies have shown significant cross-industry variation and time series variation in pay-performance sensitivities. The use of disaggregated fixed time effects in a model already estimated in changes means that only time-varying shocks entering the model below the two-digit industry level of disaggregation can bias the parameter estimates. Regressions using four-digit industry-year fixed effects yield similar results.

receives a pay increase. These comparisons may induce other increases in compensation, or at least cause firms to incur costs of justifying the change. These comparison costs increase with firm size because the set of information about individual performances that is common knowledge shrinks as firm size increases, and the number of individuals to whom the equity of decisions must be justified increases. These effects combine to increase the comparison costs associated with performance-based contracts as firm size increases. Comparison costs may lead firms to raise the compensation of all employees by the same percentage to preserve existing relationships between compensation levels of employees. The minimization of agency costs subject to measurement and comparison costs induces small firms to select higher pay-performance sensitivities than large firms, all other things equal. See Zenger (1994) for a detailed discussion of measurement and comparison costs.

Other explanations for differentials in pay-performance sensitivities by size class include the implicit regulation hypothesis[6] and heterogeneous supervision costs.[7] Differentiation between alternative hypotheses is nearly impossible, but these myriad explanations combine to give the size hypothesis a great deal of attention in the incentive compensation literature. Examples include Jensen and Murphy (1990), Garen (1994), and Zenger (1994). Empirical work routinely supports the size hypothesis, but no previous work has used a broad panel of firms to establish the validity of the size hypothesis for average employee compensation.

III. Empirical Model

This paper hypothesizes a causal link between growth in firm value and growth in pay. Coefficients in this simple model are elasticities, and the sum of the value-growth coefficients is a measure of the alignment of shareholder objectives—increases in stock prices—with the objectives of self-interested employees—pay increases.

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[6] See Watts and Zimmerman (1986) and Jensen and Murphy (1990).

[7] Oi (1990).

wide incentives focuses on the effects of incentive compensation schemes on profitability. This paper combines these perspectives, and asks:

(i) Does the average employee have a residual claim on firm value?

(ii) Do small firms tie pay more closely to performance than large firms?

The first hypothesis is fundamental. Do firms link the pay of average employees with performance? Large bodies of literature argue that firms should use compensatory incentives as one tool for eliciting desired employee behavior, but this is the first study to address such incentives with a broad panel of firms. Empirical models previously used for examination of executive incentives can provide insight into the incentives of other employees. This is an important step toward understanding the role incentives play in compensation contracts.

The second hypothesis, referred to as the size hypothesis, recognizes that firms with higher costs associated with implementation of performance-based pay systems should restrict their use of these systems. Zenger (1994) separates the effects of firm size on optimal contract structure into measurement costs and comparison costs, and I briefly review each of these costs in turn.

Measurement of performance is less costly in small firms. Williamson (1975, 1985), Holmstrom (1989), and Rasmusen and Zenger (1990), among others, all argue that small firms have measurement cost advantages that increase the incidence of performance-based contracts. There are many reasons for this cost advantage of small firms, but one of the primary reasons is the depth of hierarchies. Large firms have multiple layers of managers, and each manager has incentives to manipulate evaluations and rewards to overstate her own performance. Potential manipulation and sheer size make it more difficult for large firms to determine the source of performance changes. These relatively high measurement costs discourage the use of performance-based compensation systems.

Comparison costs are another significant cost of incentive contracts. Every employee reevaluates his own compensation relative to the compensation of others whenever one employee

make depend on the relative costs and benefits of available alternatives. Firms can change the structure of the decision problem by rewarding correct behavior with increases in compensation.

The profit-sharing literature finds significant links between the structure of average employee compensation and firm performance. Most of these profit-sharing studies assume that pay causes performance.[3] The executive compensation literature finds robust empirical indications of a positive link between the pay of CEOs and firm performance. These studies of executives assume that performance causes pay, and they measure CEO claims to changes in firm value. For example, Jensen and Murphy (1990) find a $3.25 increase in executive pay for each $1,000 increase in shareholder wealth, and Coughlan and Schmidt (1985) find that a one percent increase in firm value leads to a 0.1 percent increase in CEO pay. This paper uses tools from the executive compensation literature to measure the claims of other employees to changes in firm value.

A. Hypotheses

Several authors examine the incentive structure of compensation contracts at the firm level, but their efforts focus on extremely narrow samples of firms.[4] Other studies use cross-sectional data that lacks useful firm performance data.[5] The articles in this body of literature focus on questions that require extremely detailed compensation information, and they must sacrifice on other margins.

This paper extends the agency literature by applying techniques from the executive compensation literature to the firm-level pay-performance relationship. Other authors find significant links between pay and performance for executives, and the existing work on firm-

[3] See Kruse (1993) for an excellent review of the profit-sharing literature.

[4] Medoff and Abraham (1980), Zenger (1994), and Baker, Gibbs and Holmstrom (1994-a and 1994-b) are examples of this literature.

[5] Drago and Heywood (1993) .

complaint records for service personnel. Regardless of the mechanisms used to measure performance, market value will be positively correlated with employee compensation if firms choose benchmarks that align the objectives of employees with the objectives of shareholders.

Firms have access to many compensatory mechanisms for rewarding good performance. Firms link some forms of compensation directly to performance, but most forms of compensation have only indirect links to performance. Wages, salaries, and bonuses are good examples. These types of pay are unlikely to have any direct link to performance, but firms can indirectly account for past performance when revising wages and salaries, or when granting bonuses. Firms may explicitly tie bonuses to performance, but these awards usually depend on an *ex post* administrative evaluation. Baker, Jensen, and Murphy (1988) discuss the problems with subjective evaluations, and Rayton (1995) presents average employee statements documenting the importance of the administrative connection in several firms.

Of course, firms have other incentive alignment tools at their disposal. Firms can use other forms of compensation, promotion incentives, dismissal incentives, and other tools to elicit desired behavior from employees. Still, 86 percent of U.S. employees are paid by the hour or by the month,[2] and so most employees have greater incentive to maximize firm value if wage and salary decisions depend on performance, all else equal. This paper focuses on the incentives generated by wages, salaries, and bonuses because these forms of compensation are the most common forms of compensation in the economy.

II. Why Link Pay to Performance?

The average employee of the firm faces decisions on the job: Should I work hard or not work hard? Should I spend the extra time and effort required to use resources efficiently, or should I waste resources (paid for by my employer) to make my work easier? The decisions employees

[2] Ehrenberg and Smith (1988, page 408).

I. Introduction

The CEO is not the only employee of the firm. Despite this obvious fact, much of the economic literature on incentive compensation ignores the importance of the incentives of other employees. We can learn many valuable lessons from the analysis of CEO compensation, but the degree of incentive alignment throughout the firm is not one of these lessons. This paper documents the existence of a link between the pay of average employees and the performance of the firm, and thus demonstrates that incentive alignment is an important part of the production process in U.S. manufacturing firms. This link between pay and performance is similar in magnitude and character to the residual income claim of CEOs documented in the executive compensation literature.[1] It is unclear what mechanisms firms use to tie the pay of average employees to performance, but clearly they do.

The incentives of average employees are an important element in any theory of the firm because incentives determine behavior, and because labor costs represent a large fraction of production costs. Blinder (1990) argues that a given increase in labor productivity can achieve a much greater increase in overall productivity than an analogous increase in the productivity of other inputs. A complete understanding of average employee incentives is therefore necessary to determine the nature of potential productivity increases.

This paper furthers our knowledge of incentives by analyzing firm level compensation data. Specifically, this paper analyzes the elasticity of per-employee hourly compensation with respect to changes in firm value. Firms will link the pay of average employees to performance if the consequences of not establishing this link are more costly than the maintenance of incentive contracts. Baker, Jensen, and Murphy (1988) discuss the merits of different definitions of performance, and the choice of a benchmark will undoubtedly vary across firms, and vary across individuals within the same firm. Examples include piece rates for assembly workers and

[1] Jensen and Murphy (1990), Coughlan and Schmidt (1985), etc.

firm value increases to employees. These results indicate that average employees hold a significant stake in firm performance.

Are CEOs the Only Residual Claimants?
Estimation of the Performance Elasticity of Per-Employee Compensation

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This paper evaluates the intensity of the value-maximization incentives for average employees generated through wage, salary, and bonus mechanisms. This is accomplished through estimation of the elasticity of average employee hourly compensation with respect to changes in firm performance. This performance elasticity indicates the degree of alignment between employee and shareholder objectives, and it can also be interpreted as a residual income claim for employees. The estimated performance elasticity for the full sample of firms is indistinguishable from a CEO performance elasticity of 0.1 published in Coughlan and Schmidt (1985). The estimated performance elasticity is 0.152 in small firms and indistinguishable from zero in large firms. While CEO rewards are larger than the rewards of average employees in absolute terms, these rewards represent comparable fractions of income for both the CEO and the average employee. Firms use wage, salary and bonus adjustments to direct approximately 4.1 percent of

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