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SEEING THE INVISIBLE: A TEST OF RATIONAL EXPECTATIONS IN THE VALUATION OF HUMAN CAPITAL

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JOHN W. DARCY
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SEEING THE INVISIBLE: A TEST OF RATIONAL EXPECTATIONS
IN THE VALUATION OF HUMAN CAPITAL

A Dissertation APPROVED FOR THE
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BY

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ABSTRACT

This paper investigates the relation in the U.K., U.S., Germany, and Japan between employee compensation and intangible firm value. Tests are conducted of the persistence of changes in wages relative to the average levels of persistence in changes in the other components of earnings, and the relation between changes in wages and value perceived by markets. Whether the persistence information in changes in wages is being used efficiently by markets is examined in tests of rational expectations.

The valuation tests indicate markets respond *less* to changes in wages in the U.K., U.S. and Japanese samples than to the average effect of the other components of income (significant incremental results were not found for the wage variable in Germany in either the market valuation or persistence tests). This suggests that wages and human capital are not "invisible" in the U.K., U.S. and Japan and provides support for the proposition that a portion of the wages expense is valued as an investment with future benefits. However, changes in wages are found to have *greater* persistence than the average levels of persistence in the changes in other components of earnings in the U.K., U.S. and Japan, a result seemingly inconsistent with wages having greater future valuation benefits than other components of earnings. Rational expectations tests indicate that this inconsistency is not explained by market inefficiency.

Seeing the Invisible:
A Test of Rational Expectations in the Valuation of Human Capital

CHAPTER I

INTRODUCTION

Stein (1989: 657) describes expenditures for intangibles as creating "invisible assets" which are not easily identified and cannot be accurately disentangled from increased operating costs. Many researchers believe that this invisibility biases the markets away from companies that invest in intangibles because investors fixate on earnings (Blair 1996: 12, 1995: 327, Levine 1995: 87, Porter 1992: 44, Jacobs 1991: 36). But there is also a widely held assumption in the economics literature that even if the costs of creating an asset are expensed for accounting purposes, in an efficient market the value of an intangible may be expected to be included in the market value of a firm (Hirschey and Wichern 1984, Ross 1983, Lindenberg and Ross 1981, Ben-Zion 1978, Thomadakis 1977). In accounting research, this efficient markets assumption underlies the market-based approach to the study of the associations between accounting measures of intangibles and firm value (e.g., Lev and Sougiannis 1996, Amir and Lev 1996, Sougiannis 1994, Bublitz and Ettredge 1989, Hirschey and Weygandt 1985).

This paper tests the rational expectations (market efficiency) assumption underlying market-based valuation of human capital. Three tests are used. The first examines the incremental contribution of the wages component of changes in income to future changes in earnings (the time-series test). The second is a test of whether changes in wages provide incremental value relevance to the stock market beyond changes in earnings (the valuation test). The third test (the rational expectations test) examines whether the persistence of wage changes in a time-series model are consistently reflected in a value model.

Much of the wealth creating power of a company may be attributed to the firm-specific resources created by its stakeholders, including investors, employees and lenders. This paper focuses on the relation between employee compensation (wages) and intangible firm value and questions whether market-based inferences regarding the contribution of human capital to firm value are based on rational expectations.

Lipe (1986) showed that income components demonstrate greater value relevance than earnings alone and that this value relevance is positively associated with the persistence of the components. But there is also evidence that investors tend to fixate on earnings and do not fully use information regarding the relative persistence of the cash flow and accrual components of income (Sloan 1996) and the domestic and foreign components of income (Thomas 1999). It is possible that similar mispricing may occur for wages and the other components of income.

It is increasingly accepted in the literature that a portion of the compensation to employees is in the nature of an investment (Ballester et al. 1999), and a measurement approach toward human capital in financial statements has long been proposed (Lev and Schwartz 1971). This provides the basis for my hypothesis that wages have implications for future earnings that differ from the average persistence of the other components of income. If the persistence of wages differs from that of the average levels of persistence in the other components of earnings changes, then in an efficient market the wage component would have incremental ability to explain current returns. Whether the persistence in the time-series model is used consistently in valuation provides the basis for the market rationality test. In an efficient (rational) market, the relation between abnormal security returns and unexpected earnings should reflect public information about the time-series properties of earnings and earnings components. Abnormal returns which fail to incorporate differences in the time-series properties of wages and income components other than wages support the inference that investors fixate on earnings as suggested by Blair (1996, 1995), Levine (1995), Porter (1992) and Jacobs (1991).

Data from U.S., U.K., German and Japanese firms are used in the tests conducted in this paper. Because only a small percentage of U.S. firms report the compensation information necessary to be included in the study, the sample of U.S. companies is likely to be subject to self-selection bias, and the results from the U.S. sample may not be generalizable. To expand the number of U.S. companies in the sample, exploratory tests are conducted using the growth rate of employees as a proxy for changes in wages. In contrast to the U.S., virtually all large companies from the U.K., Germany, and

Japan report compensation information and are included in their country samples. Separate country tests, therefore, should provide richer samples than would be possible if only U.S. companies were used. The multi-country sample also enables informal comparisons of differences across the business cultures. But cross-country significance tests are not contemplated due to the difficulties of making international comparisons of financial information (Ballester et al. 1999: 7 n. 1).

Aoki (1988: 166) provides a basis for expecting different results across countries. In his model of the firm, employees with strong bargaining power may cause firms to grow beyond levels consistent with share price maximization, and this diverts value away from the shareholders in the form of excess wages. Among the sample countries in this study, only employees in Germany have this kind of strong bargaining power. Unlike employees of U.S., U.K., or Japanese firms, German employees have the legal right to participate directly in decision-making on the board of directors.[1] Wage information was, therefore, expected to have greater positive (or less negative) associations with future earnings and with equity value in the U.S., the U.K., and Japan than in Germany. Although Japan is more like the U.S.

[1] Participation is provided through two legally mandated structures: the Betriebsrate, or Works Councils, which provide for participation in the immediate workplace, and Mitbestimmung, or codetermination, which provides for employee decision-making on the board of directors. Under these laws, half of the "supervisory board" members of large firms (over 2000 employees) and one-third in medium size firms (500-2000 employees) are elected by employees. The supervisory board supervises important strategic company decisions and appoints and dismisses the "management board," which is composed of professional managers who run day to day operations. Japanese employees have little German-style voice in important decisions beyond some operating issues on the factory-floor. The "lifetime employment" system provides Japanese employees with a relatively high level of job security. But the potential for excess wages in Japan is mitigated through the bonus system, whereby

and U.K. regarding the bargaining power of employees, the relationship between key investors and Japanese firms is more similar to German firms than to firms in the U.S. or U.K. In both Germany and Japan, there are higher levels of insider trading and informal information exchanges between key investors and the company than in either the U.S. or U.K. (Blair 1995: 282, Porter 1992: 47-48, 70). Because of these information flows, it is possible that fixation on earnings might be less in Japan and Germany than in the U.S. or U.K.

The argument that intangible human capital is "invisible" is not supported by the results of either the time-series and valuation tests in U.K., U.S., or Japan. In each of these three countries significant incremental information content is observed for the wage variable in both the time-series and valuation tests. However, how time-series information in wages is reflected in value is not resolved here. *A priori* predictions were that the wage variable would demonstrate lower persistence than the average levels of persistence in the other components of earnings, thus demonstrating time-series behavior consistent with the creation of intangible value by employees. Similarly, the market was expected to respond less to changes in wages than to the other components of income, indicating that a portion of the wages expense component represents an investment with future benefits. The valuation tests for U.K., U.S., and Japanese firms produced results consistent with expectations. But, contrary to my expectations, the observed persistence of

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a substantial portion of the annual compensation of Japanese employees is paid in the form of incentive compensation tied to the success of the enterprise.

the wage variable in the time-series tests for the U.K., U.S. and Japan is lower than that of the other components, which does not appear to be consistent with the creation of intangible value. Rational expectations tests indicate that the differing implications for value associated with the wage variable in the time-series and valuation tests cannot be attributed to market inefficiency.

This paper contributes to a growing body of literature concerned with the benefits of increased disclosure of human resources information and a measurement approach toward human capital reporting. The fundamental accounting problem in this area is how to measure the human capital of organizations. Market rationality (efficiency) tests like those in this paper are necessary if capital markets techniques are to make an effective contribution to this measurement question.

CHAPTER II

REVIEW OF RELATED STUDIES

This paper investigates the persistence qualities of the employee compensation component of income, its incremental value relevance, and whether this component is rationally priced by markets. Prior research into the value relevance of the components of income has tended to be motivated by one of two basic approaches: (i) an analysis of components which are required to be disclosed separately under various Generally Accepted Accounting Principles (GAAP) or which are otherwise commonly reported by companies in financial statements, and (ii) empirical tests of the relevance of fundamental signals used by analysts in security valuation.

Lipe's (1986) study provides a comprehensive examination of the relations between components of earnings and stock returns. Lipe (1986) decomposed income into six components routinely disclosed by companies, including gross profits, general and administration expense, depreciation expense, interest expense, income taxes, and other items. He found a significant variation in the return reactions associated with the unexpected changes in the components. Defining persistence as the present value of the revisions in expected earnings given a $1 shock in the component, he also found a positive relation between the return reactions to the component shocks and the persistence of the individual components.

Several studies have estimated the intangible asset characteristics of expenditures treated as expenses for accounting purposes based on an explicit or implicit assumption of market efficiency. Bublitz and Ettredge (1989) tested for the market treatment of advertising and R&D expense as intangible assets by decomposing changes in earnings into changes in sales, advertising, R&D, and other expenses, and regressing these components on abnormal returns. Failure to reject a null hypothesis of zero or positive coefficients for changes in R&D expense was interpreted as consistent with those costs representing long-lived intangible investments. However, a parallel test comparing the coefficients of advertising and R&D with the coefficient of other expenses failed to confirm these results. Sougiannis (1994) based an estimation of the investment value of R&D on the coefficients from a system of equations that relate the impact of R&D on earnings and value. Using cross-sectional data, Lev and Sougiannis (1996) estimated firm-specific R&D capital by relating current R&D expenditures to subsequent earnings. They also found some indication of possible market inefficiency in an association between their estimate of the unamortized portion of current and prior R&D expenditures and subsequent stock returns. Ballester et al. (1999) performed a regression of earnings and wages on equity value using time-series data to estimate that about 16 percent of the compensation paid by U.S. firms which disclose labor costs is valued by the market as investments in human capital.

Market inefficiency in the form of a failure by the market to recognize differences in the persistence of components was examined by Sloan (1996) using the framework developed by Mishkin (1983) to test rational expectations hypotheses in macro-economics. By simultaneously estimating a system of equations incorporating the contributions of accruals and cash flow components of income to both future earnings and market returns, Sloan (1996) observed that prices behave as if investors fixate on earnings. Thomas (1999) found similar evidence of market mispricing of the persistence of the foreign and domestic components of earnings. Herrmann, Inoue, and Thomas (2001) performed a test for Japanese companies using parent-only data for 1985 through 1997 and found that earnings were used efficiently by the market in making earnings forecasts.

Prior research has shown that components of income commonly disclosed by companies exhibit different levels of persistence. The market responds to some of these differences, but the response is sometimes incomplete. Thus, there is a possibility that the markets may be mispricing the information in the components. My paper extends this line of prior research by examining the market's rationality in valuing employee compensation relative to the other components of income. A study of this kind is necessary to verify the appropriateness of the assumptions of rationality underlying market-based approaches to valuation of human capital.

CHAPTER III

HYPOTHESES AND RESEARCH DESIGN

3.1 The earnings implications of wages

Companies invest in human capital in order to generate future profits (capital surplus) for the shareholders. Wages contain an investment in human capital when companies incur the cost of formal education and training of employees (Ross 1983). Bassi et al. (2000) and Bassi and McMurrer (1998) provide evidence that measures of human capital such as spending on training per employee and the percentage of employees receiving training are positively associated stock market measures.[2] Economist Robert Topel (1991) at the University of Chicago estimates that as much as 10 to 15 percent of the total compensation of employees of large corporations represents compensation for firm-specific skills rather than payments for generic skills. This is similar to the results obtained by Ballester et al. (1999), who used time-series data to estimate that about 16 percent of the compensation paid by U.S. firms which disclose labor costs is valued by the market as investments in human capital. Ballester et al. (1999) also find that this investment amortizes at a rate of 34% a year. Using cross-sectional data, Darcy (2000) found a similar amortization rate (35%) for the human capital asset of U.K. companies.

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[2] Baker (1999) provides a survey of empirical research into the effects of training on firm value.

Wages can also have adverse implications for future earnings power. Where non-equity stakeholders have strong bargaining power over the disposition of firm resources, the non-equity stakeholders tend to demand overinvestment in firm growth, including excess investment in human resources (Blair 1995: 269, Porter 1992: 67, Kester 1992: 94). Aoki (1988: 166) demonstrates how employee stakeholders with strong bargaining power may cause firms to grow beyond levels consistent with share price maximization. In such cases, the incremental value relevance of wages and the intangible value of human capital may be impacted. Two-sided tests are, therefore, appropriate in testing hypotheses regarding the time-series characteristics and value relevance of employee compensation.

The time-series properties of changes in income and the incremental contribution of the wages component of changes in income are represented by the following equations (WAGE is defined as a negative amount and firm subscripts are suppressed):

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \quad (1)$$

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \quad (2)$$

where,

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t deflated by the market value of equity at the beginning of the year,

$\Delta WAGE_{it}$ = the change in employee compensation expense (defined as a negative number) of firm i in year t deflated by the market value of equity at the beginning of the year, and

ε_{t+1} = error term, assumed normally distributed with mean zero.

$H1_0$: $\gamma_2 = 0$.

$H1_A$: Changes in wages have different implications for future earnings changes than the average effect of the changes in the other components of earnings.

$H1_0$ is tested separately for each country sample using two-tail *t*-tests. Separate tests are performed on regressions of pooled samples of data from 1994 through 2000 for each country (1992 through 1997 for Japan) and on annual regressions for each separate year for the samples from the U.K., U.S., and Germany. (Due to data limitations, only results from the pooled regressions are reported for Japan.) Because of the possibility that the standard errors of the regression coefficients in the annual regressions may be biased due to cross-sectional correlation, I focus primarily on cross-temporal two-tail *t*-tests of the means of the separate yearly coefficients (Fama and McBeth 1973) in evaluating the significance of the annual regression coefficients. Sensitivity tests expand the models to incorporate parameters reflecting industry effects (Lev 1989) and the interactions between the industry effects and the explanatory variables.

Aoki's (1988) bargaining power model provides a basis for predicting differences in the time-series characteristics of wage information across countries. Firms in the U.S. and U.K. generally use a compensation-based system with few guarantees to employees of employment security and little employee power over corporate governance. Japanese companies are typified by a system incorporating incentive compensation and employment security, but little employee power over corporate governance. In Germany, employees have extensive ownership and control rights guaranteed to them under the postwar legal structure which established a codetermination system with workers' participation in management. There is greater potential in Germany for excess growth and for employees to divert future wealth away from the shareholders. Therefore, the coefficient of changes in wages is expected to be more positive (or less negative) relation with future earnings changes in Germany than in the low employee bargaining power countries, the U.S., U.K. and Japan.

3.2 Incremental value relevance of wages

Incremental value relevance tests are conducted using a valuation model, equation (3), which is a variation of a basic returns-net income model using annual data. As above, WAGE is defined as a negative amount and firm subscripts are suppressed.

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \varepsilon_t \qquad (3)$$

where,

AR_t = the abnormal return in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a value weighted comparison portfolio, with weightings based on beginning market value of equity. Comparison portfolios are formed by dividing the sample into quartiles based on firm size, defined as the beginning market value of the firm's equity. Because of the small number of observations, separate quartile portfolios are not used in the German yearly samples.

ΔNI_t = the change in net income before extraordinary items of firm i during year t deflated by the market value of equity at the beginning of the year, and

$\Delta WAGE_{it}$ = the change in employee compensation expense (defined as a negative number) of firm i in year t deflated by the market value of equity at the beginning of the year, and

ε_{t+1} = error term, assumed normally distributed with mean zero.

The regression coefficient for changes in wages (α_2) represents the difference between the valuation information in the wage component versus the average effect of the other components of earnings. A negative coefficient on the wages expense component means that the market responds less to changes in that component than to the average effect of the other components of income (recall that WAGE is defined as a negative amount). A negative coefficient is consistent with a portion of the wages expense component representing an investment with future benefits (Amir and Lev 1996, Lev and Sougiannis 1996). A positive coefficient means that the market expects incremental future detriments. If the response coefficient for changes in wages expense is not significantly different from zero, then investors do not appear to view the item differently from the average effect of the other components of income.

$H2_0$: $\alpha_2 = 0$.

$H2_A$: Changes in employee compensation are incrementally value relevant beyond changes in net income.

Equity owners in the U.K., U.S., and Japan have greater control over wage policy than owners in Germany. According to Aoki's (1988) bargaining power model, higher degrees of control over wage policy enable equity owners to use wages to increase equity value, while lower degrees of owners' control over wages provide opportunities for the benefits of wages to be diverted away from the equity holders. In that case, the coefficient of the wage variable in equation (3) might be expected to be significantly negative in the U.K., U.S., and Japanese samples, but less negative or positive in the German sample. $H2_0$ is tested separately for each country using two-tail *t*-tests of the significance of the coefficients for regressions of pooled samples of data from 1994 through 2000 (1992 through 1997 for Japan). Significance tests based on two-tail *t*-tests employing the Fama-MacBeth procedure are used to evaluate the significance of the mean coefficients of yearly regressions from those years for the U.K., U.S., and Germany. Sensitivity tests expand the models to incorporate parameters reflecting industry effects (Lev 1989) and the interactions between the industry effects and the explanatory variables.

Another sensitivity test is performed to examine whether the explanatory variables are proxying for risk in the valuation model (Lev and Sougiannis 1996: 130). Two potential risk factors, lagged size (the market value of equity) and the lagged book-to-market ratio, are added to equation (3) in order to control for the possibility of an incomplete adjustment for risk (Fama and French 1992). The resulting model is represented by equation (3c).

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \log(SIZE_{t-1}) + \alpha_4 (BM_{t-1}) + \varepsilon_t \qquad (3c)$$

where,

$SIZE_{t-1}$ = the market value of equity of firm i at the beginning of year t, and

BM_{t-1} = the ratio of the book value to the market value of the common equity of firm i at the beginning of year t, and

ε_{t+1} = error term, assumed normally distributed with mean zero.

3.3 Rational expectations test

Prior research suggests that the persistence of components of income may not be priced correctly by the markets. The hypotheses described below explore whether the time-series properties of earnings and the relative contribution of the wages component toward future earnings are understood by the markets in forming earnings expectations used to make price decisions. The research design follows Sloan (1996) and Thomas (1999), who use a framework developed by Mishkin (1983) to test rational expectations hypotheses in macro-economics. If the time-series properties of earnings are reflected in earnings expectations, but the time-series properties of wages are not, there is support for the argument that investors are fixating on earnings as suggested by Blair (1996, 1995), Levine (1995), Porter (1992) and Jacobs (1991).

Rational expectations are tested using the following two systems of equations,

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \quad (1)$$

$$AR_{t+1} = \delta(\Delta NI_{t+1} - \phi_0 - \phi_1^* \Delta NI_t) + \eta_{t+1} \quad (4)$$

and

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \quad (2)$$

$$AR_{t+1} = \delta(\Delta NI_{t+1} - \gamma_0 - \gamma_1^* \Delta NI_t - \gamma_2^* \Delta WAGE_t) + \eta_{t+1}. \quad (5)$$

where AR_{t+1} = abnormal returns of firm i during year t+1, and

η_{t+1} = error term, assumed normally distributed with mean zero.

$H3_0$: $\gamma_2 = \gamma_2^*$.

$H3_A$: The relation between abnormal returns and unexpected earnings does not correctly incorporate the contribution of wages to earnings persistence.

H3 tests whether stock prices correctly anticipate the average persistence of wages. The null hypothesis is that the market correctly incorporates the persistence of wages.

The two systems of equations are estimated using iterative weighted non-linear least squares (Mishkin 1983: 18). H3 is tested using a likelihood ratio statistic which is distributed asymptotically as:

$$X^2_{(q)} = 2n \log (SSR^c / SSR^u) \quad (6)$$

where,

q = the number of constraints imposed by market efficiency (q = 1 for each separate test),

n = the number of observations,

SSR^c = the sum of squared residuals from the constrained weighted system, and

SSR^u = the sum of squared residuals from unconstrained weighted system.

Rejection of the null hypothesis of market efficiency is indicated by a X^2 statistic greater than the critical value, indicating that the corresponding coefficients are not equal across the system of equations. Annual regressions are also performed for the U.K., U.S., and Germany and evaluated using two-tail *t*-tests of the mean coefficients based on the Fama-MacBeth (1973) procedure.

Lower chi-square statistics for H4 in equation (6), indicating an inability to reject the null hypotheses of rational expectations regarding the time-series properties of wages, could occur in the German and Japanese samples than in those of the U.K. or U.S. if insider information is used more efficiently in Japan and Germany. German and Japanese companies typically have high percentages of relationship driven investors who hold large stakes in the company. These relationship investors engage in ongoing and direct information gathering on the company's businesses and prospects. Porter (1992:47-48) and others maintain that relationship investors in Japan and Germany do not trade frequently enough to incorporate inside information into stock prices. However, researchers are coming to believe that lax insider trading rules in Japan and Germany do enable insider information to be reflected in prices (Jacobson and Aaker 1993). Hodder and Tschoegl (1993:151-52) document how Japanese relationship investors, although nominally stable shareholders, actively trade in stocks of their affiliates through sales-and-repurchases and investments in *tokkin* funds.[3] If this is so, the higher levels of insider trading and informal information exchanges

[3] Specified money trusts (*tokutei kinsen shintaku,* abbreviated as *tokkin*) are investment funds operated by trust banks and investment management firms through which Japanese corporations commonly trade in the stock of affiliated companies on an anonymous basis.

between key investors and the company in Germany and Japan may be associated with lower degrees of fixation on earnings than in the U.S. or U.K.

3.4 Measurement issues

In addition to human capital, technical knowledge is an important intangible asset of the firm (Ben-Zion 1978). Hirschey and Weygandt (1985) demonstrate that R&D expense has a long-term effect on the value of a company which can be thought of as a form of intangible capital. R&D expense may also include a wage component. Adding a variable for R&D expense may be helpful in separating the value effects of the firm's R&D expense from the value effects of expensed wages. But because the number of firms reporting R&D is relatively small[4] and concentrated in a narrow range of industries, R&D is not included in the main tests and is incorporated into the models in separate sensitivity tests only.[5]

The wage variable used in this study generally includes stock-based compensation and pension costs to the extent they are included in income by the firm. Stock-based compensation and pension costs may have different persistence and valuation qualities than other components of employee compensation. For example, Barth et al. (1992) found that pension expense weighs more heavily against value than nonpension components of income

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[4] About one-third of U.S. and Japanese companies report R&D information, compared to about 20% of U.K. and German companies.

[5] Advertising costs may also be associated with long-lived intangible values related to firm market power. Lack of separate reporting for advertising costs by non-U.S. countries precludes its inclusion in this study.

because it is seen as being *less risky* than other components.[6] But detailed information regarding stock-based compensation and pension costs is not generally available for the firms in this study. Inferences drawn from the tests in this paper must be interpreted subject to the limitations resulting from cross-sectional and cross-country inconsistencies in the makeup of the wage variable.

Stock-based compensation is widely used in the U.S. and U.K., but rules enabling the general use of option plans have only very recently been implemented in Germany and Japan, and very few companies in those countries have plans in effect. Baber et al. (1998) examined the contribution to earnings persistence of stock-based CEO compensation. They provide evidence of positive associations between earnings persistence and current cash wages and bonuses, but not between persistence and deferred compensation such as stock options or restricted stock. Aboody, Barth, and Kasznik (2000) find an insignificant association between share prices and stock-based compensation expense for U.S. companies, and they attribute this to the benefits associated with stock-based compensation (which are determined endogenously with stock price) being offset by the associated cost. Winter (1999) came to a similar conclusion using data from the small number of German firms which have recently adopted stock-based compensation plans. In order to gain a measure of the impact of stock-based

[6] Companies in Germany and Japan generally use defined benefit plans and report higher pension expense than U.S. or U.K. companies, but their plans tend to be underfunded and their pension costs are *more risky* than those of U.S. or U.K. companies.

compensation on the tests in this proposal, the tests are repeated after partitioning the U.S. and U.K. firms into separate subsamples of firms in industries which are more (i.e., high technology companies) and less likely to use substantial amounts of stock-based compensation.

CHAPTER IV

DATA SAMPLE AND ECONOMETRIC ISSUES

Annual firm data for the years 1992-2000 for each variable in this study are collected from the *Worldscope Global Access* database in the case of firms from the U.K. and Germany and from *Research Insight* (Compustat) for U.S. firms. Japanese returns and market value data is from the *Worldscope Global Access* database and other Japanese data is from the Nikkei NEEDS database. Japanese data covers the years 1992 to 1997 only. 1992 is selected as the starting point because it is the year the *Worldscope Global Access* database begins to report employee compensation information for large numbers of German and U.K. companies. Results of the tests in this paper are generally reported based on pooled samples containing data from each sample year for each country and for separate annual regressions for each year in the country sample. Two-tailed *t*-tests are used to evaluate the significance of coefficients in the pooled regressions for the time-series and valuation tests Chi-square likelihood ratio statistics are used to evaluate the significance of coefficients for the pooled regressions in the rational expectations tests. The results of the annual regressions in each of the tables in this paper are evaluated using cross-temporal *t*-statistics based on the mean value of the separate yearly coefficients divided by their standard errors (Fama and McBeth 1973). The Fama-McBeth procedure provides the benefit of controlling for cross-sectional correlations in the residuals, but is limited by small number of years for which wage information is available in the data samples. Due to the limited number of annual samples for Japanese companies, only results from the pooled regressions are reported for Japan.

Annual samples used in the hypothesis tests for each country were compiled based on the availability of data required to compute changes in earnings and wages and abnormal returns for non-financial firms in each country. Samples for sensitivity tests employing other data began with these basic data sets, dropping firms for which the additional data were not available. In order to avoid disproportionate influences, extreme observations whose absolute value of their studentized residuals exceeds two are removed from the samples (Belsley et al. 1980). Restricting the data by dropping extreme values results in a loss of information, but is consistent with prior research, e.g. Kothari and Zimmerman (1995), Easton and Harris (1991), Rayburn (1986).

Earnings in this study are defined as net income before extraordinary items. Wages in the U.S. samples consist of *Research Insight* (Compustat) data item A 42, labor and related expense. Included in this item are costs of wages and benefits allocated to continuing operations, including salaries and wages, incentive compensation, other benefit plans, payroll taxes, pension costs, and profit sharing. The comparable data item for wages and related benefits in the *Worldscope Global Access* database is designated as "staff costs," and in the Nikkei NEEDS database as *ningenhi-rodohi* (employee and labor expense). In each database, the wages expense item includes amounts included in cost of goods sold expense, sales, general and administration expense, and officers salary expense.

Abnormal returns are calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a value-weighted comparison portfolio, with weightings based on beginning market value of equity. Comparison portfolios are formed by dividing the sample into quartiles based on firm size, defined as the beginning market value of the firm's equity. Because of the small number of observations, separate quartile portfolios are not used in the German yearly samples.

This study employs consolidated financial information for U.S., U.K., and Germany companies. For Japanese companies, unconsolidated (parent-only) information is used in the main tests because consolidated information on wages is only very recently becoming widely available for Japanese companies.[7] Prior research supports the generally held view that parent-only data provides the basis for most market analysis in Japan (French and Poterba 1991) and that it tends to outperform consolidated information in empirical testing (Sakurai 1988, Darrough and Harris 1991, Hall et al. 1994). In the exploratory tests, where the growth rate of employees is used as a proxy for changes in wages, consolidated Japanese company information is used.

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[7] The information on wages of Japanese companies used in this study comes from the financial statements required to be filed by public companies with the Japanese Ministry of Finance under Article 24 of the Japanese Securities and Exchange law. Before 1999, details on the components of income, including wages, were available in these reports only for parent companies and these reports included consolidated financial information only in summary form.

Researchers using U.S. data often measure returns as of three months after the end of the fiscal year in order to allow time for the annual report to be released (Dodd et al. 1984). But reporting lags in the countries sampled in this paper can range from 3 months in the United States and Japan to 8 or 9 months in Germany (Alford et al. 1993). Lack of comprehensive returns information in the *Worldscope Global Access* database requires that returns in this paper be measured as of the fiscal year end only in this paper. Use of fiscal year end returns is consistent with prior international research (King and Langli 1998).

Except for the market efficiency tests, which use weighted nonlinear least squares estimates, the returns models used in this paper are estimated using ordinary least squares (OLS) under the assumptions of normally distributed, homoscedastic error variances with mean zero, and the absence of cross-sectional correlation. In the presence of heteroscedasticity, ordinary least squares estimation is inefficient relative to generalized least squares. Heteroscedasticity arising from variations in the scale of variables in the models is addressed by deflating the explanatory variables by the beginning market value of equity. The presence of heteroscedasticity in the models is tested using White's general heteroscedasticity test (White 1980) employing a statistic following the chi-square distribution. In the returns regressions in this study, chi-square statistics significant at the 5% level (indicating possible heteroscedasticity) were observed in two of the 21 sample years and in the time-series regressions in eight of the 21 sample years. In cases where heteroscedasticity was detected at the 5% significance level, standard errors of the regression coefficients are reported using White's consistent estimator.

Cross-sectional dependencies among the security return residuals may cause bias in the standard errors used for significance testing in this research, although OLS coefficients remain unbiased. Cross-sectional correlation is mitigated where samples of firms with varying measurement dates are taken from a large number of industries (Bernard 1987, Bowen et al. 1987). In this research, about 60% of the U.K. firms and 21% of the German firms have non-December 31 year ends. However, Japanese firms tend to report financial information uniformly as of March 31. Approximately 50 two-digit SIC (or equivalent) industries are represented in each country sample, resulting in a sample which is highly diverse across industries (Chaney and Jeter 1994). These factors should tend to mitigate bias in standard errors attributable to cross-sectional correlation. In the annual regressions in this paper, conclusions are based on an unbiased cross-temporal *t*-statistic obtained from the mean value of the separate yearly coefficients divided by its standard error (Chaney and Jeter 1994, Ali 1994, Easton and Harris 1991, Rayburn 1986).

Collinearity among the explanatory variables can affect the ability to interpret the significance of individual coefficients in incremental information studies (Christie et al. 1984). A table of correlations of the explanatory variables used in the regressions is provided. The condition index procedure is used to detect collinearity (Belsley et al. 1980) and results of the condition index tests are reported in the table of correlations.

Both yearly and pooled regressions are estimated for the models used in this paper. Pooled regressions may give rise to serial correlation in the residuals because multiple observations are included for each firm. Serial correlation is tested for using the Durbin-Watson test and a table of Durbin-Watson *d* statistics is provided for each of the pooled regressions based on models (2) and (3).

CHAPTER V

EMPIRICAL ANALYSIS

5.1 Descriptive statistics, collinearity, and serial correlation

The hypotheses in this paper are concerned with differences between the persistence and value relevance of changes in wages compared to the other components of earnings. Descriptive statistics for the main variables in this study, abnormal returns, changes in earnings, and changes in wages, are provided in Table 1. These descriptive statistics are based on samples for the years from 1994 through 2000 for the U.K., U.S., and Germany and the years from 1993 to 1997 for Japan.

Collinearity among changes in wages and earnings could affect the ability to interpret the significance of the individual coefficients of these variables (Christie et al. 1984). Table 2 presents the average Pearson correlations between the earnings changes and wages changes variables for each of the country/year samples used in this study. The average correlation across sample years is 4.8% for the U.K. samples, 8.5% for the U.S. samples, 2.1% for the German samples, and -2.4% for the Japanese samples. The condition index procedure (Belsley et al. 1980) was used as a diagnostic for collinearity in the yearly cross-sectional time-series and valuation model regressions in this paper. The average condition indexes for separate year regressions of the time-series properties of changes in earnings and wages (based on equation (2)) are 1.54 for the U.K. samples, 1.60 for the U.S. samples, 1.21

for the German samples, and 1.32 for the Japanese samples. In separate year regressions of changes in earnings and wages on abnormal returns (based on equation (3)) the average condition indexes for the U.K., U.S., German, and Japanese samples are 1.27, 1.32, 1.24 and 1.28 respectively. Overall, collinearity does not seem to pose a problem.

Serial correlation in the residuals was tested using the Durbin-Watson test (Durbin and Watson 1951). For these samples, a value of the Durbin-Watson *d* statistic of less than 1.748 indicates evidence of positive serial correlation, while a *d* statistic value greater than 2.252 indicates evidence of negative serial correlation. Table 2 presents the Durbin-Watson *d* statistics for the pooled time-series and valuation models used in this study. The values range from a low of 1.782 to a high of 2.067, indicating that the null hypotheses of no positive or negative serial correlation are not rejected.

5.2 The earnings implications of wages

The examination into the valuation implications of wages begins by testing how changes in current wages are associated with changes in future earnings relative to the other components of earnings. Changes in earnings (net income before extraordinary items) and changes in wages are deflated in this study by the market value of equity at the beginning of the year and represent accounting rates of return on equity. Accounting rates of return are generally believed to be mean reverting (Beaver 1970). Mean reverting coefficients of changes in earnings may be may be expected to be less than zero, but more than -1, which is the coefficient for earnings that are purely transitory. Permanent changes in earnings are indicative of a random walk process, in which case zero coefficients would occur. Positive coefficients represent an association between current earnings changes and growth in future earnings changes.

To provide a context within which to interpret the time-series properties of wages and other components of earnings, a preliminary step is to look at the time series properties of earnings from which wages have been deducted. This is represented by model (1).

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \quad (1)$$

Panel A of Table 3 presents the results for the model (1) regressions of the time-series properties of earnings for the pooled samples. The negative coefficients on the earnings variable (ϕ_1) for the U.S., U.K., and German samples indicates that changes in earnings demonstrates mean-reverting time-series behavior in each of the three country samples. The positive coefficient for the earnings variable in the Japanese sample indicates that changes in current earnings are positively associated with changes in future earnings. The lowest level of mean-reversion occurs in the U.K. samples (ϕ_1 = -.072), followed by the U.S. (ϕ_1 = -.235), with Germany showing the highest level of mean reversion (ϕ_1 = -.320). Coefficients for the earnings variable are significant in the pooled regressions at the 1% level for all four countries. Similar results are found in the annual regressions, except that the significance of the earnings variable drops to 8.1% in the U.K. sample. Due to lack of data, annual regressions are not performed for Japanese companies.

The first hypothesis is that changes in wages have different implications for future earnings changes than the average effect of the changes in the other components of earnings. This is tested using model (2).

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \qquad (2)$$

$\mathbf{H1_0}$: $\gamma_2 = 0$.

The null hypothesis is that the associations between changes in wages and period-ahead changes in earnings do not differ incrementally from that of the average of the other components of earnings . The results of tests of this hypothesis are shown in panel C of Table 3 for the pooled regressions. The wage variable coefficients (γ_2) in panel C of Table 3 are positive and significant at the 1% level in the pooled regressions for the U.K. (γ_2 = .109, p = .000), U.S. (γ_2 = .165, p = .000), and Japan (γ_2 = .220, p = .000). Similar results may be seen for the annual regressions in panel D of Table 3, except the significance level of the wage coefficient drops to 5.4% in the U.K. sample. In these three country samples, changes in wages appear to have measurably different implications for future earnings changes than the average effect of the changes in the other components of earnings.[8] The

[8] In separate tests, not reported in Table 3, dummy slope variables based on single-digit SIC industry codes were employed to account for industry effects on the regression models. The results reported in Table 3 were relatively insensitive to the use of dummy slope variables.

wage coefficient is not significant at conventional levels for the German sample in either the pooled regression (γ_2 = -.011, p = .402) or the annual regressions (γ_2 = .013, p = .705), and the null hypothesis of no incremental information content for the wage variable cannot be rejected for the German sample.

The coefficients on the wage variable in the U.K., U.S., and Japanese regressions indicate that changes in wages have greater persistence than the average levels of persistence in the other components of earnings. In the U.K. pooled regression, the coefficient of changes in wages (γ_2) is a positive .109. If changes in wages had the same association with period ahead earnings changes as the average of the other components, the coefficient on wages would be zero. The positive .109 coefficient indicates that an increase (decrease) in the wage variable in the current year is associated with a greater decrease (increase) in income changes in the following year than a current year decrease (increase) in the earnings variable attributable to non-wage components. The full association between the wage variable and next period earnings changes is observed by adding the coefficient of the wage variable (which represents its incremental information content), 0.109, to the coefficient of the earnings variable, -0.094. The result, .015, is more persistent than the coefficient applicable to the earnings variable, -.094.

For example, in the case of the U.K., 9.4% of a $1 shock in the earnings variable does not persist into the next period, while 90.6% (1 - .094) does

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Sensitivity tests incorporating variables representing the interaction of the industry dummy persist. For the wage variable 101.5% (1 + 0.109 -.094) of a $1 shock persists into the next period. Therefore, a $1 increase in wages expense is associated with a greater decrease in next period earnings changes than a commensurate $1 reduction in the earnings variable attributable to non-wage components. Similar relationships as those discussed for the U.K. sample results are seen in the results for the U.S. and Japanese pooled regressions. The significant positive coefficients for the wage variables in the U.K., U.S., and Japanese samples seem to be more consistent with diversion of value away from the shareholders in the form of excess wages than the creation of intangible value by employees.

The first hypothesis ($H1_A$) is supported by the significant coefficients for the γ_2 coefficient in the U.K., U.S., and Japanese samples. It was anticipated that the greater bargaining power of employees in Germany might cause the association between changes in wages and period-ahead earnings changes to be reflected by a γ_2 coefficient that is more positive (or less negative) in Germany than in either the U.K. or U.S. or Japan. The lack of statistically significant coefficients for the wage variable indicates that, unlike in the U.S., U.K., and Japan, German wages do not seem to have incremental information for future earnings.

In order to gain a measure of the impact of stock-based compensation on the tests in this paper, the time-series tests reported in panel C of Table 3 were repeated after partitioning the U.S. and U.K. firms into separate

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variables and the explanatory variables failed to show significant interactions.

subsamples of firms in industries which are more (i.e., high tech companies) and less likely to use substantial amounts of stock-based compensation. High tech firms were defined as those whose primary SIC codes belonged to any of the following groups (Kasznik and Lev 1995): Drugs (2833-2836), R&D services (8731-8734), programming (7371-7379), computers (3570-3577), or electronics (3600-3674). For both the U.K. and U.S. firms, the coefficients and significance levels of the wage variable in the samples of non-high tech firms were substantially unchanged from those reported for the combined samples in panel C of Table 3. For the high tech firms, the coefficients were higher in both the U.K. (γ_2 = .235, p = .000) and U.S. (γ_2 = .455, p = .004) samples, suggesting greater persistence of wages among high tech firms.[9]

The greater persistence observed for the wage variable relative to the average levels of persistence in the other components of earnings does not explain the characterization in prior research of a part of wage costs as an investment in human capital (Ballester et al. 1999) or the incremental value relevance of wages observed in this study (*see* section 5.3, below). It is possible that the time-series relation between wages and value develops over a longer period than is captured by the one-period model used in the time-series tests. A full examination of this issue is beyond the scope of the current study. But a series of regressions of an exploratory nature were performed to gauge the relative persistence of the earnings and wage

[9] Detailed results of the separate tests of high tech and non-high tech samples are not included in the tables, but are available from the author.

variables over an additional yearly period. For this purpose equation (2) was expanded in equation (2a) to include an additional lagged year for the earnings and wage variables.

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta NI_{t-1} + \gamma_3 \Delta WAGE_t + \gamma_4 \Delta WAGE_{t-1} + \varepsilon_{t+1} \qquad (2a)$$

Regressions were performed using pooled data from 1995 through 2000 for the U.K. and U.S. and from 1995 through 1997 for Japan. Results of these regressions are shown in panel E of Table 3. These results indicate that in each country sample the wage variable has an association with earnings for both lag years (t and t-1) which is significant at the 1% level, but the earnings variable is significant at the 5% level only for the first lag year (t). As in the one-period model, the coefficients for the wage variable are positive, indicating greater persistence than the average levels of persistence in the other components of earnings, for both lag years. While these results do not explain how the greater persistence of the wage variable translates into the greater value relevance for wages described in the next section of this paper, they do indicate that wages have a longer-term incremental effect on earnings than is captured by the one-period ahead time-series model.

Sougiannis (1994) examined the investment value of R&D expense using a system of equations made up of an earnings model and a valuation model. His earnings model regressed current earnings before extraordinary items and *before advertising and R&D* expenses on inflation-adjusted book values of assets, contemporaneous advertising expenses, and R&D expenses lagged up to seven periods. Current R&D expense was added back to current earnings in the dependent variable of his earnings model in order to avoid including R&D on both sides of the equation.[10] The coefficient of each of the lagged R&D variables thus represented the *gross* realized marginal benefit at time t from a dollar invested in R&D at time $t-\iota$ ($\iota=1\ldots7$). Significantly positive coefficients for the R&D variables (in his paper R&D expenses were represented by positive numbers) were observed for each of the seven lag periods, indicating benefits to future *gross* earnings (earnings without inclusion of R&D costs) from R&D expenditures over the lag periods. These results were consistent with those in his valuation model, which revealed significant associations between R&D expenses and the market value of equity in the short-run.

In my paper, the dependent variable in the time-series model (equation (2)) is the change in net income before extraordinary items and *after* deducting wages. It thus represents the *net* incremental benefit at time t from a dollar invested in wages at time t-1. The significant positive coefficients for the wage variables (which are expressed as negative numbers) in the U.K., U.S., and Japanese samples seem inconsistent with the creation of intangible value by employees and are generally inconsistent with the results of my

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[10] In a test of the association between software development costs and future earnings, Aboody and Lev (1998) also added back the relevant development and amortization expenses to their earnings dependent variable, so the coefficient of changes in software development costs would represent *gross* marginal benefits to earnings at time t from a dollar invested in development costs at time t-1. Similarly, in an examination of the time-series and valuation properties of R&D, Lev and Sougiannis (1996) added R&D back to the earnings

valuation tests discussed in the next section. An alternative, not explored in this paper, would be to exclude wages from the dependent variable in my equation (2) in order to examine the relation between current wage changes and future *gross* benefits of wages reflected in future earnings changes before deduction of wages.

5.3 Incremental value relevance of wages

The results of the time-series tests of the earnings implications of wages demonstrate that changes in wages are more persistent than the average levels of persistence in the other components of earnings changes for the U.K., U.S., and Japanese samples. In an efficient market, these differing associations with earnings persistence should correspond to incremental information content in wages. The second hypothesis examines this proposition using regressions based on model (3).

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \varepsilon_t \quad (3)$$

$H2_0$: $\alpha_2 = 0$.

The null hypothesis is that the coefficient on the wage variable (α_2) is equal to zero and the information content in wages does not differ from that of the average of the other components of earnings. Table 4 presents the results of pooled (panel A) and annual regressions (panel B) for each country based on

dependent variable because R&D expense represented a "largely ad hoc" writeoff of the R&D

model (3). In the pooled regressions the null hypothesis can be rejected at the 1% level of significance for the U.K. (α_2 = -.340, p = .000), U.S. (α_2 = -.195, p = .000) and Japanese samples (α_2 = -.469, p = .000). Similar results are seen for the annual regressions (p = .004 for the U.K. sample; p = .017 for the U.S. sample). As in the time-series tests, the coefficient on the wage variable is not significant at conventional levels for the German sample in either the pooled (α_2 = -.049, p = .174) or annual (α_2 = -.214, p = .169) regressions.

The significant negative coefficients for the wage variable in the U.K., U.S. and Japanese regressions indicates that the market responds *less* to changes in wages than to the other components of income and provides support for the proposition that a portion of the wages expense is valued as an investment with future benefits. However, in the time-series tests, changes in wages were found to have *greater* persistence than the average levels of persistence in the other components of earnings in each of these three countries. Exploratory regressions discussed in section 5.2, above, suggest that the relation between wages and value may develop over a longer period than is captured by the one-period time-series model.

Sougiannis (1994) used a valuation model and an earnings model to examine the benefits of investments in R&D on current firm value and future earnings. In the value model, he regressed the market value of equity on the book value of equity, earnings before expensing of R&D, and current and

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independent variable.

lagged R&D expenses, finding significant valuation information for R&D expenses in the short-run. As discussed in section 5.2, above, in his earnings model R&D expense was added back to earnings in the dependent variable in order to avoid including R&D on both sides of the equation. The coefficient of each of the lagged R&D variables thus represented the *gross* realized marginal benefit at time t from a dollar invested in R&D at time $t-\iota$ ($\iota=1\ldots7$). Significantly positive coefficients for the R&D variables (R&D expenses were represented by positive numbers) were observed in his earnings model for each of the seven lag periods, indicating future benefits to gross income (income before deduction of R&D and similar items) from R&D expenditures. The results of Sougiannis' time earnings and valuation tests were not inconsistent, but over the long-run, R&D expenses demonstrated greater long-term benefits to gross earnings than to market value. In contrast, the results of my tests appear to be inconsistent across my time-series and valuation models. My time-series model (equation (2)) uses net income before extraordinary items and *after* deducting wages as the dependent variable. It is possible that as in Sougiannis (1994), measuring the gross benefit of wages to future earnings in the time-series model may provide an indication of their benefits that are more consistent with their valuation associations.

It is also possible that the market is not using the information demonstrated in the time-series tests consistently in forming earnings expectations. This possibility is examined in the tests of rational expectations, the results of which are described in section 5.7, below.

If long-lived intangible value included in wages was part of the class of "invisible assets" described by Stein, any unique characteristics of wages should not be reflected in the valuation tests reported in panels A and B of Table 4. Except in the case of Germany, the results of the value relevance tests suggest that investors are able to disentangle the characteristics of changes in wages from that in other operating costs. This provides some evidence contrary to the theories of Blair (1996, 1995), Levine (1995), Porter (1992) and Jacobs (1991) that markets are biased against companies that invest in intangibles because investors fixate on earnings.

In order to gain a measure of the impact of stock-based compensation on the valuation tests, the valuation tests reported in panel A of Table 4 were repeated after partitioning the U.S. and U.K. pooled samples into separate subsamples of non-high tech and high tech firms.[11] For the non-high tech firms, the coefficients and significance levels of the wage variables were substantially unchanged from those reported for the combined samples in panel A of Table 4. In the high tech firm samples, the coefficient of the wage variable was not significant at the 5% level for either the U.K. ($\alpha_2 = -.552$, $p = .081$) or U.S. ($\alpha_2 = -.211$, $p = .614$).

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[11] High tech firms were defined as those whose primary SIC codes belonged to any of the following groups (Kasznik and Lev 1995): Drugs (2833-2836), R&D services (8731-8734), programming (7371-7379), computers (3570-3577), or electronics (3600-3674). Detailed results of the separate tests of high tech and non-high tech samples are not included in the tables, but are available from the author.

In the following sections, sensitivity tests are performed on the model (3) regressions reported in panel A of Table 4. Due to the lack of required data for Japan in the Worldscope database, these sensitivity tests are performed on the samples from the U.K., U.S. and Germany only.

5.4 Incremental value relevance of the growth rate of employees

Only a relatively small percentage of U.S. companies report the wage information used in this study.[12] For example, in the year 2000, wage information is available for only 1,616 companies out of the more than 10,000 companies in the Compustat database of active U.S. companies. On the other hand, 8079 of those companies report changes in the numbers of employees during the year. This section examines the possibility that changes in the numbers of employees may serve as a proxy for wages in order to expand the U.S. data sample. To test this proposition, model (3) has been modified by replacing the wage variable with one representing the percentage rate of change in the number of employees of firm i during year t (ΔEMP_{it}).

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta EMP_t + \varepsilon_t \qquad (3a)$$

[12] In addition to the U.K., Germany, and Japan, which are included in this study, information on wages is regularly available for companies in many other countries, including Belgium, Denmark, Finland, France, India, Ireland, Israel, Italy, the Netherlands, Norway, Pakistan, Portugal, Spain, Sweden, and Switzerland.

Panel C of Table 4 presents the results of regressions based on model (3a) for the three countries. To maintain comparability with tests based on the original wage variable, the samples in the tests reported in panel C represent companies which report both wages and changes in the number of employees.

In the U.K. and German samples the results for use of the employee growth proxy in panel C of Table 4 are fairly consistent with those reported for the wage variable in panel A. Note that a positive change in the percentage rate of change in the number of employees in panel C is expressed as a *positive* number, in contrast to a positive change in the change in employee compensation expense in panel A which is defined as a *negative* number. Therefore, a positive coefficient for ΔEMP_t in panel C would be interpreted similarly to a negative coefficient for $\Delta WAGE_{it}$ in panel A. For the U.K. sample, the coefficient of the employee growth rate variable shows significant positive associations with abnormal returns in both the pooled (α_2 = .094, p = .000) and annual (α_2 = .088, p = .022) regressions. The results for the German sample are not statistically significant at the 5% level in either the annual or pooled regressions, which was also the case for the German regressions incorporating the original wage variable. However, the results for the U.S. sample are inconsistent with those for the model incorporating the original wage variable, showing an inverse relation with value in both the pooled (α_2 = -.022, p = .042) and annual (α_2 = -.028, p = .141) regressions.

Employee growth information does not appear to be a reliable proxy for wages information for U.S. companies.

5.5 Incremental value relevance of wages and R&D expense

A sensitivity test is performed in order to examine the impact of changes in R&D expense on the valuation model used in this research and attempt to separate the value effects of the firm's R&D expense from the value effects of expensed wages. To accomplish this, model (3) was modified to include a variable (ΔRD_t) representing the percentage change in the expenditures for research and development by firm i during year t. The revised model is represented by equation (3b).

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \Delta RD_t + \varepsilon_t \qquad (3b)$$

The results of tests based on equation (3b) are reported in panel D of Table 4. Because comparably few companies report R&D expense, the samples reported in panel D are not directly comparable to those in other panels of Table 4. Changes in R&D are expected to be incrementally positively associated with abnormal returns (Lev and Sougiannis 1996), which would be evidenced by a negative α_3 coefficient because expenses are defined as negative numbers. In the pooled regressions, addition of the R&D variable does provide additional information content in the U.K. sample and the coefficient is negative (α_3 = -1.608, F= 14.844, *p*= .000). But the R&D coefficient is not significant and does not provide additional information content in either the U.S. (F= 2.182, *p*= .140) or German (F= .000, *p*= 1.00) pooled samples. None of the coefficients for R&D are significant at conventional levels for any country in the annual regressions.

5.6 Incremental value relevance of wages and risk proxies

An additional sensitivity test adds two potential risk factors, lagged size (the market value of equity) and the lagged book-to-market ratio, to the basic valuation model (equation 3) in order to control for the possibility that the regression results in panels A or B of Table 4 may be due to an incomplete adjustment for risk. The resulting model is represented by equation (3c).

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \log(SIZE_{t-1}) + \alpha_4 (BM_{t-1}) + \varepsilon_t \quad (3c)$$

where,

$SIZE_{t-1}$ = the market value of equity of firm i at the beginning of year t, and

BM_{t-1} = the ratio of the book value to the market value of the common equity of firm i at the beginning of year t.

The results of regressions based on model (3c) are presented in panel G of Table 4. Addition of the two risk variables provides additional information content in each of the pooled regressions (U.K.: $F= 82.633$, $p= .000$; U.S.: $F= 173.139$, $p= .000$; Germany: $F= 61.887$, $p= .000$). After adding the two risk proxies to the model, the significance levels of the earnings and wage variables in the pooled and annual regressions are substantially unchanged from those reported in panels A and B of Table 4, except for the wage variable in the U.S. whose significance level drops from .017 to .065 in the annual regressions. The magnitudes of the coefficients of the earnings and wage variables in the pooled and annual regressions are also substantially unchanged after addition of the risk proxies. The earnings and wage variables do not appear to be proxying for the risk factors represented by size or the book-to-market ratio.

5.7 Rational expectations tests

5.7.1 The relation between the time-series properties of earnings and earnings expectations

Tests of rational expectations are used to gauge the degree to which the incremental contribution of changes in wages toward the persistence of earnings changes are reflected in market expectations of future earnings changes. As an initial step, a baseline of market efficiency is established by determining how consistently earnings changes as a whole are reflected in expectations of future earnings. This is accomplished by simultaneously estimating a system of equations consisting of the earnings time-series model (equation (1)) and a valuation model (equation (4)) using iterative weighted non-linear least squares. The valuation model regresses abnormal returns on the difference between current earnings changes and the time series model of expected earnings changes.

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \quad (1)$$

$$AR_{t+1} = \delta_0 + \delta_1(\Delta NI_{t+1} - \phi_0 - \phi_1^* \Delta NI_t) + \eta_{t+1} \quad (4)$$

If the earnings expectations embedded in stock prices reflect the time-series characteristics of earnings (referred to here as "rational expectations" or "market efficiency"), the coefficients of the lagged earnings variable (ΔNI_t) would be expected to be consistent across the system of equations ($\phi_1 = \phi_1^*$). The market efficiency test is valid even if variables relevant to the forecasting of future earnings are omitted from the time-series model (Abel and Mishkin 1983: 9).

Results of these regressions are reported in panels A and B of Table 5. Panel A presents the results of market efficiency tests using chi-square likelihood ratio statistics to evaluate the results of pooled regressions of the system of equations for each country sample. The magnitudes and significance levels of the coefficient of the lagged earnings variable in the time-series model (ϕ_1) are identical to those in the time-series tests reported in panel A of Table 3. In the pooled regressions the corresponding unrestricted coefficient in the valuation model (ϕ_1^*) is significant at the 1% levels in the U.K. ($\phi_1^* = -.126$, $p = .003$) and U.S. ($\phi_1^* = -.277$, $p = .001$) samples and at the 10% level in the German sample ($\phi_1^* = -.506$, $p = .077$). The ϕ_1^* coefficient is not significant at conventional levels for Japan ($\phi_1^* = -.007$, $p = .711$). In the valuation model annual regressions reported in panel B of Table 5, the ϕ_1^* coefficient is significant at the 5% level for the U.K., U.S., and Germany. Annual regressions are not performed for Japan.

Market efficiency is represented by equality of the lagged earnings changes coefficient across the system of equations ($\phi_1 = \phi_1^*$). Market efficiency cannot be rejected at the 5% level in the pooled regressions for the U.K. ($\phi_1 - \phi_1^* = .054$, $\chi^2_{(1)} = 3.181$, $p = .075$), U.S. ($\phi_1 - \phi_1^* = .043$, $\chi^2_{(1)} = .392$, $p = .531$), Germany ($\phi_1 - \phi_1^* = .186$, $\chi^2_{(1)} = 1.770$, $p = .183$) or Japan ($\phi_1 - \phi_1^* = .041$, $\chi^2_{(1)} = 3.696$, $p = .055$). In the annual regressions two-tailed *t*-tests of differences in means are employed and market efficiency also cannot be rejected at the 5% level for the U.K. ($t = 2.005$, $p = .092$), U.S. ($t = .464$, $p = .659$), or Germany ($t = 1.922$, $p = .103$). These results suggest that the time-series properties of earnings is being used efficiently in forming earnings expectations in the four countries.

5.7.2 The relation between the time-series properties of wages and earnings expectations

Having established a baseline of market efficiency for the earnings variable, the inquiry now proceeds to examine whether earnings expectations efficiently incorporate the incremental persistence information that has been observed to exist for the wage component of earnings changes in the U.K., U.S. and Japanese samples. (In tests of the first hypothesis, summarized in panels C and D of Table 3, the coefficient of the wage variable for the German sample was observed to be insignificant at conventional levels in both the pooled and annual regressions.) This issue is addressed formally in the third hypothesis:

$H3_A$: The relation between abnormal returns and unexpected earnings does not correctly incorporate the contribution of wages to earnings persistence.

The third hypothesis is tested using the following system of equations:

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \quad (2)$$

$$AR_{t+1} = \delta_0 + \delta_1 (\Delta NI_{t+1} - \gamma_0 - \gamma_1^* \Delta NI_t - \gamma_2^* \Delta WAGE_t) + \eta_{t+1} \quad (5)$$

Using this system of equations, the null hypothesis of efficient (rational) market use of information in the wage variable may be stated as:

$H3_0$: $\gamma_2 = \gamma_2^*$.

Panels C and D of Table 5 summarize the results of these regressions for the pooled regressions (panel C) and annual regressions (panel D). The coefficients for earnings (γ_1) and wages (γ_2) in the time-series regressions are identical to those discussed in connection with the first hypothesis and reported in panels C and D of Table 3 above. These coefficients indicate that for the U.K., U.S. and Japanese samples the wage changes in the pooled regressions demonstrate greater persistence than the average levels of persistence in the other components of earnings changes. The significantly positive coefficients for the wage variable in the valuation model (γ_2^*) for the pooled regressions indicate that the market also recognizes greater persistence of wages relative to the average levels of persistence in the other components of earnings changes in the U.K., U.S. and Japanese samples.

The null hypothesis of market efficiency for the wage variable is satisfied only for the U.S. sample. In the U.S. pooled regression the difference in the coefficients of the wage variable is not significant across the system of equations ($\gamma_2 - \gamma_2^*$ = -.066, $\chi^2_{(1)}$ = .631, p = .427). Tests of differences in the coefficient means in the annual tests for the U.S. sample also fail to reject the hypothesis of market efficiency for the wage variable ($\gamma_2 - \gamma_2^*$ = -.016, t = -.120, p = .909). In the U.K. sample the market seems to assign greater persistence to the wage variable than demonstrated by its time-series properties, and the difference is significant at the 5% level in both the pooled regression ($\gamma_2 - \gamma_2^*$ = -.166, $\chi^2_{(1)}$ = 9.763, p = .002) and the annual regressions ($\gamma_2 - \gamma_2^*$ = -.235, t = -2.723, p = .035). In the pooled regression of Japanese data, lower persistence is assigned by the market to the wage variable than is indicated by its time-series properties ($\gamma_2 - \gamma_2^*$ = .099, $\chi^2_{(1)}$ = 6.943, p = .008).

For the German pooled regression, the likelihood ratio test fails to reject market efficiency in the use of information in the wage variable ($\gamma_2 - \gamma_2^*$ = -.020, $\chi^2_{(1)}$ = .026, p = .872) and similar results occur in the annual regressions ($\gamma_2 - \gamma_2^*$ = -.200, t = -1.534, p = .176), but neither the time-series model or valuation model coefficient of the wage variable is significant at conventional levels in either the pooled regression (γ_2 = -.011, p = .402; γ_2^* = .009, p = .955) or annual regressions (γ_2 = .013, p = .705; γ_2^* = .214, p = .197).

In order to gain a measure of the impact of stock-based compensation on the rational expectations tests, the tests reported in panel C of Table 5 were repeated after partitioning the U.S. and U.K. pooled samples into separate subsamples of non-high tech and high tech firms.[13] For the non-high tech firms, the coefficients and significance levels of the wage variable in the valuation model (γ_2^*) were substantially unchanged from those reported for the combined samples in panel C of Table 5. For the high tech firms, in the U.K. sample the significance level of the γ_2^* coefficient drops to 5.4% and the null hypothesis of market efficiency for the wage variable is satisfied ($\chi^2_{(1)}$ = .586, p = .444), whereas it is rejected in both the combined sample which includes both high tech and non-high tech firms and the partitioned sample of non-high tech firms. In the U.S. high tech sample, the significance of the γ_2^* coefficient and results of the rational expectations test do not differ substantially from those of either the combined sample or the partitioned sample of non-high tech firms.

Positive coefficients for the wage variable in the time-series tests summarized in panels C and D of Table 3 indicated that changes in wages have greater persistence compared to the average levels of persistence in the

[13] High tech firms were defined as those whose primary SIC codes belonged to any of the following groups (Kasznik and Lev 1995): Drugs (2833-2836), R&D services (8731-8734), programming (7371-7379), computers (3570-3577), or electronics (3600-3674) Detailed results of the separate tests of high tech and non-high tech samples are not included in the tables, but are available from the author.

other components for the samples from the U.K., U.S., and Japan. But the valuation tests reported in panels A and B of Table 4 indicate incrementally greater positive value associations between changes in wages and returns in those countries compared to the average value relevance of other components of earnings. An explanation for this could be that the market is not using the information demonstrated in the time-series tests consistently in forming earnings expectations. The results in panels C and D of Table 5 indicate that for the U.S. sample, investors perceive the persistence implications of changes in wages on earnings reflected in the time-series properties of wages, while at the same time recognizing the impact of changes in wages on firm value. In the case of the U.S., the differing implications of the time-series and valuation tests cannot be attributed to market inefficiency. In the U.K. and Japanese sample, inconsistent use of time series information is observed. In the Japanese sample, investors appear to underestimate the persistence of the wage variable, which would be to some degree consistent with a market inefficiency explanation for the inconsistencies in the time-series and valuation tests for Japan. However, in the U.K., investors appear to be overestimating the persistence of wages, which does not serve to reconcile the results of the time-series and valuation tests for that country.

CHAPTER VI

SUMMARY

This paper investigated the relation between employee compensation and intangible firm value from the perspective of the observed time-series relationship between wages and earnings persistence, and the relation between wages and value perceived by markets. Testing the consistency of these associations provides evidence whether the contribution of wages expense toward the development of intangible human capital is an "invisible asset" as suggested by Stein (1989: 657) and whether any such invisibility biases the markets away from companies that invest in intangibles because investors fixate on earnings as suggested by Blair (1996: 12, 1995: 327), Levine (1995: 87), Porter (1992: 44) and Jacobs (1991: 36).

Contrary to predictions, the results of the time-series tests indicate that wage changes are more persistent than the average levels of persistence in the other components of earnings changes in the U.K., U.S., and Japan. Unlike in the U.S., U.K., and Japanese samples, for the German sample incremental information content was not observed for the wage variable in either the time-series or valuation tests.

The results for the U.K., U.S., and Japan in the time-series tests seem to be more consistent with diversion of value away from the shareholders in the form of excess wages than the creation of intangible value by employees.

However, the results of the valuation tests are more consistent with the creation of intangible value by employees. The significant negative coefficients for the wage variable in the U.K., U.S. and Japanese valuation regressions indicates that the market responds *less* to changes in wages than to the other components of income and provides support for the proposition that a portion of the wages expense is valued as an investment with future benefits.

Tests of rational expectations do not provide a market inefficiency explanation for the differing results for the U.K., U.S., and Japan in the time-series and valuation tests. For the U.S. sample, the incremental contribution of changes in wages toward the persistence of earnings changes are reflected in market expectations of future earnings changes. In the U.K. and Japanese samples, inconsistent use of time series information is observed. In the Japanese sample, investors appear to underestimate the persistence of the wage variable, which would be to some degree consistent with a market inefficiency explanation for the inconsistencies in the time-series and valuation tests for Japan. However, in the U.K., investors appear to be overestimating the persistence of wages, which does not serve to reconcile the results of the time-series and valuation tests for that country.

CHAPTER VII

CONCLUSIONS

The argument that the value relevance of wage information and human capital is invisible to investors is not supported by the results of testing for U.S. companies. Valuation tests indicate that the market responds *less* to changes in wages than to the other components of income and provides support for the proposition that a portion of the wages expense is valued as an investment with future benefits. Rational expectations tests also indicate that for the U.S. sample the incremental contribution of changes in wages toward the persistence of earnings changes are consistently reflected in market expectations of future earnings changes, although how the persistence information translates into value remains an open question.

The argument that the value relevance of wage information is invisible to investors finds mixed support in the results for the sample countries other than the U.S. Invisibility of human capital for German companies seems to be supported by statistically insignificant coefficients for the wage variable in both the time-series and valuation tests. Tests samples of firms from the U.K. and Japan indicate that, while markets in those countries appear to recognize incremental value relevance of the wage variable, that information does not seem to be used as efficiently as in the U.S.

Because the U.S. markets are using wage information efficiently in making valuation decisions, a case can be made for changing the disclosure rules in the United States to require disclosure of employee compensation information. Such disclosures would be useful to investors in making valuation decisions and would enable additional research into the relationship between wages and value. Although firms in the U.K., Germany, and Japan generally disclose information regarding employee compensation, and some U.S. firms report this information on a voluntary basis, differences in the items included in the disclosure detract from its usefulness in decision making and research. Even where companies are currently disclosing employee compensation information, that disclosure could be improved through harmonization of the disclosure of employee compensation across firms and countries.[14]

The coefficient of the wage variable in Germany was expected to have a more positive (or less negative) relation with future earnings changes in Germany than in the U.K., U.S. or Japan due to the greater potential in Germany for excess growth and wealth diversion by employees. The lack of statistically significant coefficients for the wage variables in the German tests provides only tacit support for this concept.

No clear pattern emerges in these tests regarding the impact of an insider trading environment on the rational expectations tests in this study. Earnings information appears to be used efficiently in Germany, a high insider trading environment, but not in Japan, which is also a high insider trading environment. Incremental information regarding the time-series properties of

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[14] E.g., a comprehensive concept of employee benefits is set out in International Accounting Standard IAS 19 "Employee Benefits."

wages is not observed in Germany and is being used inefficiently in Japan, which tends to reinforce the traditional view that the non-permanent investors in these countries tend to base trading decisions on less information than investors in either the U.K. or U.S.

Future research may explore several issues raised in this paper. For example, future research employing different returns periods may ascertain if some of the results are influenced by reporting lags, which can range from 3 up to 9 months for the countries examined in this paper. Interpretation of the results in this paper may also be assisted by future research which employs controls for macroeconomic factors. In particular, Japan was experiencing a period of "slow growth" for most of the time covered by this study,[15] which may have affected the results.

Apparent contradictions in the results of the time-series and valuation tests suggest two approaches for future research. First, as discussed in section 5.2, above, exclusion of wages from the dependent variable in an earnings (time-series) model may enable an examination of the relation between current wage changes and future *gross* benefits of wages reflected in future earnings changes before deduction of wages, which may be more value relevant than the relation between wage changes and future *net* (of wages) benefits of wages examined in this paper. An additional possibility is that the time-series and valuation characteristics of wages differ for firms that

[15] Japan's post-bubble recession officially ended in 1993. Growth in nominal and real GDP was positive for most of the period covered by this study, 1993-1996, but fell into negative growth at end of the period, beginning in 1996. Overall, the period is usually described as one of "slow growth" for Japan.

are upsizing or downsizing and/or are in differing states of financial health.[16] Future research is needed to establish how firm characteristic of these kinds relate to the persistence and value relevance of wages.

[16] Sebbens (2000) provides a survey of the literature relating to the differing valuation implications of firm upsizing and downsizing.

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Table 1
Descriptive Statistics

Country / Variable	Size of Pooled Sample	Mean	Standard Deviation	Minimum Observation	Maximum Observation
U.K.	4867				
AR_t		-0.06292	0.408	-1.195	2.359
ΔNI_{it}		0.00464	0.163	-1.433	1.201
$\Delta WAGE_{it}$		-0.02414	0.155	-3.467	2.022
U.S.	5800				
AR_t		-0.09228	0.360	-1.190	1.149
ΔNI_{it}		0.00768	0.225	-2.554	6.967
$\Delta WAGE_{it}$		-0.01940	0.184	-3.480	5.349
GERMANY	1727				
AR_t		-0.09461	0.294	-1.052	0.957
ΔNI_{it}		0.00843	0.130	-2.002	1.117
$\Delta WAGE_{it}$		-0.01830	0.194	-2.617	1.466
JAPAN	8988				
AR_t		-0.04058	0.193	-0.691	0.765
ΔNI_{it}		-0.00030	0.027	-0.139	0.154
$\Delta WAGE_{it}$		-0.00084	0.023	-0.949	0.315

Descriptive statistics are based on samples for the years from 1994 through 2000 for the U.K., U.S., and Germany. For Japan, they are based on the years from 1993 to 1997.
Expenses are defined as negative numbers.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 2
Correlations Between Earnings and Wages

Year	n	Average Correlations between ΔNI_t, $\Delta WAGE_t$	Average Condition Indexes		Durbin-Watson *d* Statistic	
			Time-Series	Valuation	Time-Series	Valuation
U.K.	4867	0.048	1.540	1.269	2.054	1.829
U.S.	5800	0.085	1.599	1.316	2.067	1.845
Germany	1727	0.021	1.208	1.239	1.923	1.808
Japan	8988	-0.024	1.316	1.278	1.926	1.782

Condition index and Durbin-Watson statistics are derived from the time-series regressions based on equation (2) and valuation regressions based on equation (3).
A value of the Durbin-Watson *d* statistic of less than 1.748 indicates evidence of positive serial correlation. A d statistic value greater than 2.252 indicates evidence of negative serial correlation.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.

Table 3 - Panels A and B
The Time-Series Properties of Earnings

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \qquad (1)$$

Panel A
Pooled regressions

	ϕ_0	ϕ_1
U.K.		
Estimated Coefficient	0.007	-0.072
Standard Error	0.002	0.007
Significance Level	*0.004*	*0.000*
n =4867		
U.S.		
Estimated Coefficient	0.012	-0.235
Standard Error	0.003	0.011
Significance Level	*0.000*	*0.000*
n =5800		
Germany		
Estimated Coefficient	0.014	-0.320
Standard Error	0.003	0.014
Significance Level	*0.000*	*0.000*
n =1727		
Japan		
Estimated Coefficient	0.000	0.034
Standard Error	*0.000*	*0.008*
Significance Level	*0.278*	*0.000*
n =8988		

Panel B
Annual regressions

	ϕ_0	ϕ_1
U.K.		
Mean	0.009	-0.093
Standard Error	0.006	0.043
Significance Level	*0.184*	*0.081*
n =4867		
U.S.		
Mean	0.011	-0.153
Standard Error	0.002	0.045
Significance Level	0.002	0.019
n =5800		
Germany		
Mean	0.012	-0.334
Standard Error	0.004	0.063
Significance Level	0.038	0.003
n =1727		

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000 (1993-1997 for Japan).
The pooled regressions are based on samples which combine all sample years for each country.
The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t

Table 3 - Panel C
The Earnings Implications of Wages - Pooled Regressions

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \qquad (2)$$

	γ_0	γ_1	γ_2
U.K.			
Estimated Coefficient	0.010	-0.094	0.109
Standard Error	0.002	0.007	0.012
Significance Level	*0.000*	*0.000*	*0.000*
n =4867			
U.S.			
Estimated Coefficient	0.018	-0.290	0.165
Standard Error	0.003	0.012	0.015
Significance Level	*0.000*	*0.000*	*0.000*
n =5800			
Germany			
Estimated Coefficient	0.014	-0.319	-0.011
Standard Error	0.003	0.014	0.013
Significance Level	*0.000*	*0.000*	*0.402*
n =1727			
Japan			
Estimated Coefficient	0.000	0.031	0.220
Standard Error	0.000	0.008	0.014
Significance Level	*0.968*	*0.000*	*0.000*
n =8988			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000 (1993-1997 for Japan).
The pooled regressions are based on samples which combine all sample years for each country.

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.

Table 3 - Panel D
The Earnings Implications of Wages - Annual Regressions

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \qquad (2)$$

	γ_0	γ_1	γ_2
U.K.			
Mean	0.012	-0.125	0.130
Standard Error	0.006	0.048	0.048
Significance Level	*0.103*	*0.059*	*0.054*
n =4867			
U.S.			
Mean	0.015	-0.189	0.139
Standard Error	0.002	0.053	0.041
Significance Level	*0.003*	*0.023*	*0.028*
n =5800			
Germany			
Mean	0.012	-0.333	0.013
Standard Error	0.004	0.063	0.033
Significance Level	*0.053*	*0.006*	*0.705*
n =1727			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000 (1993-1997 for Japan).

The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.

Table 3 - Panel E
The Earnings Implications of Earnings and Wages - Pooled Regressions
(two lagged years model)

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta NI_{t-1} + \gamma_3 \Delta WAGE_t + \gamma_4 \Delta WAGE_{t-1} + \varepsilon_{t+1} \quad (2a)$$

	γ_0	γ_1	γ_2	γ_3	γ_4
U.K.					
Estimated Coefficient	0.011	-0.148	-0.001	0.128	0.026
Standard Error	0.003	0.010	0.003	0.015	0.009
Significance Level	*0.000*	*0.000*	*0.717*	*0.000*	*0.004*
n = 3946					
U.S.					
Estimated Coefficient	0.020	-0.278	-0.008	0.162	0.107
Standard Error	0.004	0.015	0.008	0.017	0.014
Significance Level	*0.000*	*0.000*	*0.338*	*0.000*	*0.000*
n = 4459					
Japan					
Estimated Coefficient	0.002	-0.045	-0.016	0.201	0.119
Standard Error	0.000	0.011	0.009	0.020	0.018
Significance Level	*0.000*	*0.000*	*0.087*	*0.000*	*0.000*
n = 5423					

Results are reported for pooled data from sample years 1995 to 2000 for the U.K. and U.S.
For Japan, results are based pooled data from the years 1995 to 1997.
Expenses are defined as negative numbers.
Reported significance levels of coefficient estimates for the pooled regresssions are based on two-tail t-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t

$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t

Table 4 - Panel A
The Incremental Value Relevance of Wages - Pooled Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \varepsilon_t \qquad (3)$$

	α_0	α_1	α_2
U.K.			
Estimated Coefficient	-0.073	0.414	-0.340
Standard Error	0.006	0.035	0.037
Significance Level	*0.000*	*0.000*	*0.000*
n =4867			
U.S.			
Estimated Coefficient	-0.098	0.216	-0.195
Standard Error	0.005	0.021	0.026
Significance Level	*0.000*	*0.000*	*0.000*
n =5800			
Germany			
Estimated Coefficient	-0.097	0.126	-0.049
Standard Error	0.007	0.054	0.036
Significance Level	*0.000*	*0.021*	*0.174*
n =1727			
Japan			
Estimated Coefficient	-0.040	1.988	-0.469
Standard Error	0.002	0.073	0.084
Significance Level	*0.000*	*0.000*	*0.000*
n = 8988			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000 (1993-1997 for Japan).
The pooled regressions are based on samples which combine all sample years for each country.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 4 - Panel B
The Incremental Value Relevance of Wages - Annual Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \varepsilon_t \qquad (3)$$

	α_0	α_1	α_2
U.K.			
Mean	-0.077	0.504	-0.393
Standard Error	*0.021*	*0.079*	*0.066*
Significance Level	*0.022*	*0.003*	*0.004*
n =4867			
U.S.			
Mean	-0.093	0.444	-0.302
Standard Error	0.054	0.081	0.077
Significance Level	*0.161*	*0.005*	*0.017*
n = 5800			
Germany			
Mean	0.008	0.492	-0.214
Standard Error	0.009	0.102	0.128
Significance Level	*0.416*	*0.008*	*0.169*
n = 1727			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000 (1993-1997 for Japan).
The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 4 - Panel C
The Incremental Value Relevance of the Growth Rate of Employees - Pooled Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta EMP_t + \varepsilon_t \qquad (3a)$$

	α_0	α_1	α_2
U.K.			
Estimated Coefficient	-0.075	0.419	0.094
Standard Error	0.006	0.036	0.016
Significance Level	*0.000*	*0.000*	*0.000*
n =4775			
U.S.			
Estimated Coefficient	-0.140	0.194	-0.022
Standard Error	0.006	0.025	0.011
Significance Level	*0.000*	*0.000*	*0.042*
n =4246			
Germany			
Estimated Coefficient	-0.095	0.130	-0.060
Standard Error	0.007	0.055	0.049
Significance Level	*0.000*	*0.018*	*0.223*
n =1701			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
The pooled regressions are based on samples which combine all sample years for each country.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.
ΔEMP_{it} = the percentage rate of change in the number of employees of firm i during year t

Table 4 - Panel D
The Incremental Value Relevance of the Growth Rate of Employees - Annual Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta EMP_t + \varepsilon_t \qquad (3a)$$

	α_0	α_1	α_2
U.K.			
Mean	-0.075	0.497	0.088
Standard Error	*0.020*	*0.088*	*0.024*
Significance Level	*0.021*	*0.005*	*0.022*
n =4775			
U.S.			
Mean	-0.122	0.367	-0.028
Standard Error	0.047	0.081	0.015
Significance Level	*0.058*	*0.011*	*0.141*
n =4246			
Germany			
Mean	0.005	0.496	0.133
Standard Error	0.008	0.105	0.055
Significance Level	*0.571*	*0.009*	*0.071*
n =1701			

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.
ΔEMP_{it} = the percentage rate of change in the number of employees of firm i during year t.

Table 4 - Panel E
The Incremental Value Relevance of Wages and Research and Development Expenses - Pooled Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \Delta RD_t + \varepsilon_t \quad (3b)$$

	α_0	α_1	α_2	α_3
U.K.				
Estimated Coefficient	-0.101	0.755	-0.268	-1.608
Standard Error	0.010	0.079	0.110	0.416
Significance Level	*0.000*	*0.000*	*0.015*	*0.000*
n =1572				
F statistic				14.844
Significance Level				*0.000*
U.S.				
Estimated Coefficient	-0.180	0.104	-0.085	0.564
Standard Error	0.012	0.081	0.219	0.379
Significance Level	*0.000*	*0.201*	*0.697*	*0.136*
n =807				
F statistic				2.182
Significance Level				*0.140*
Germany				
Estimated Coefficient	-0.118	0.048	-0.040	-0.023
Standard Error	0.017	0.102	0.088	0.669
Significance Level	*0.000*	*0.635*	*0.647*	*0.973*
n =342				
F statistic				0.000
Significance Level				*1.000*

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
The pooled regressions are based on samples which combine all sample years for each country.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
ΔRD_t = the percentage change in the expenditures for research and development by firm i during year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 4 - Panel F
The Incremental Value Relevance of Wages and Research and Development Expenses - Annual Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \Delta RD_t + \varepsilon_t \qquad (3b)$$

	α_0	α_1	α_2	α_3
U.K.				
Mean	-0.103	0.754	-0.345	-1.315
Standard Error	0.024	0.141	0.139	0.705
Significance Level	*0.013*	*0.006*	*0.068*	*0.136*
n =1572				
U.S.				
Mean	-0.179	0.431	0.019	0.064
Standard Error	0.036	0.193	0.285	0.272
Significance Level	*0.008*	*0.089*	*0.951*	*0.825*
n =807				
Germany				
Mean	0.067	0.658	-0.642	-3.086
Standard Error	0.025	0.171	0.537	2.543
Significance Level	*0.054*	*0.018*	*0.298*	*0.292*
n =342				

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.
The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
ΔRD_t = the percentage change in the expenditures for research and development by firm i during year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 4 - Panel G
The Incremental Value Relevance of Wages and Risk Proxies
- Pooled Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \log(SIZE_{t-1}) + \alpha_4 (BM_{t-1}) + \varepsilon_t \quad (3c)$$

	α_0	α_1	α_2	α_3	α_4
U.K.					
Est. Coefficient	0.194	0.448	-0.349	-0.026	0.054
Standard Error	0.038	0.036	0.039	0.003	0.010
Sig. Level	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
n =4689					
F statistic					82.633
Sig. Level					*0.000*
U.S.					
Est. Coefficient	-0.066	0.370	-0.190	-0.019	0.001
Standard Error	0.017	0.029	0.027	0.002	0.000
Sig. Level	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
n =5696					
F statistic					173.139
Sig. Level					*0.000*
Germany					
Est. Coefficient	0.145	0.153	-0.061	-0.020	0.000
Standard Error	0.060	0.055	0.039	0.004	0.000
Sig. Level	*0.015*	*0.006*	*0.122*	*0.000*	*0.057*
n = 1707					
F statistic					61.887
Sig. Level					*0.000*

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
The pooled regressions are based on samples which combine all sample years for each country.

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_t = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
$SIZE_{t-1}$ = the market value of equity of firm i at the beginning of year t
BM_{t-1} = the ratio of the book value to the market value of the common equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 4 - Panel H
The Incremental Value Relevance of Wages and Risk Proxies
- Annual Regressions

$$AR_t = \alpha_0 + \alpha_1 \Delta NI_t + \alpha_2 \Delta WAGE_t + \alpha_3 \log(SIZE_{t-1}) + \alpha_4(BM_{t-1}) + \varepsilon_t \quad (3c)$$

	α_0	α_1	α_2	α_3	α_4
U.K.					
Mean	0.153	0.575	-0.409	-0.023	0.061
Standard Error	0.128	0.084	0.063	0.010	0.027
Sig. Level	*0.356*	*0.021*	*0.023*	*0.147*	*0.150*
n =4689					
U.S.					
Mean	-0.058	0.487	-0.302	-0.017	0.001
Standard Error	0.068	0.059	0.081	0.007	0.000
Sig. Level	*0.479*	*0.015*	*0.065*	*0.135*	0.045
n =5696					
Germany					
Mean	-0.284	0.502	-0.242	0.020	0.000
Standard Error	0.084	0.099	0.135	0.007	0.000
Sig. Level	*0.077*	*0.037*	*0.215*	*0.089*	*0.387*
n = 1707					

Expenses are defined as negative numbers.
Results are reported for sample years 1994-2000.
The annual regressions employ the Fama-MacBeth procedure to evaluate the significance of the mean of the yearly regression coefficients from 1994 to 2000.

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the coefficient equals zero.

ΔNI_t = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
$SIZE_{t-1}$ = the market value of equity of firm i at the beginning of year t
BM_{t-1} = the ratio of the book value to the market value of the common equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 5 - Panel A
Tests of Rational Expectations (Earnings) - Pooled Regressions

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \qquad (1)$$
$$AR_{t+1} = \delta_0 + \delta_1(\Delta NI_{t+1} - \phi_0 - \phi_1^* \Delta NI_t) + \eta_{t+1} \qquad (4)$$

	ϕ_0	ϕ_1	ϕ_1^*	δ_0	δ_1
U.K. n = 4867					
Estimated Coefficient	0.007	-0.072	-0.126	-0.066	0.409
Marginal Significance Level	*0.004*	*0.000*	*0.003*	*0.000*	*0.000*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
Likelihood Ratio Statistic	3.181				
Marginal Significance Level	*0.075*				
U.S. n = 5800					
Estimated Coefficient	0.012	-0.235	-0.277	-0.095	0.199
Marginal Significance Level	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
Likelihood Ratio Statistic	0.392				
Marginal Significance Level	*0.531*				
Germany n = 1727					
Estimated Coefficient	0.014	-0.320	-0.506	-0.098	0.192
Marginal Significance Level	*0.000*	*0.000*	*0.077*	*0.000*	*0.000*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
Likelihood Ratio Statistic	1.770				
Marginal Significance Level	*0.183*				
Japan n = 8988					
Estimated Coefficient	0.000	0.034	-0.007	-0.041	1.996
Marginal Significance Level	*0.000*	*0.000*	*0.711*	*0.000*	*0.000*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
Likelihood Ratio Statistic	3.696				
Marginal Significance Level	*0.055*				

The pooled regressions are based on combined samples from 1994-2000 (1993-1997 for Japan). Reported significance levels of coefficient estimates for the pooled regressions are based on chi-square likelihood ratio statistics.
Similar significance levels for coefficients and for differences between coefficients are obtained using two-tailed asymptotic *t*-tests based on the standard normal distribution.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 5 - Panel B
Tests of Rational Expectations (Earnings) - Annual Regressions

$$\Delta NI_{t+1} = \phi_0 + \phi_1 \Delta NI_t + \varepsilon_{t+1} \quad (1)$$
$$AR_{t+1} = \delta_0 + \delta_1(\Delta NI_{t+1} - \phi_0 - \phi_1^* \Delta NI_t) + \eta_{t+1} \quad (4)$$

Fama-MacBeth test of significance of yearly regression coefficients, 1994 to 2000

	ϕ_0	ϕ_1	ϕ_1^*	δ_0	δ_1
U.K. n = 4867					
Mean coefficient	0.020	-0.093	-0.139	-0.041	0.503
Marginal Significance Level	*0.140*	*0.081*	*0.046*	*0.344*	*0.004*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
t-statistic	2.005				
Marginal Significance Level	*0.092*				
U.S. n = 5800					
Mean coefficient	0.029	-0.153	-0.176	0.361	0.448
Marginal Significance Level	*0.006*	*0.019*	*0.030*	*0.035*	*0.007*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
t-statistic	0.464				
Marginal Significance Level	*0.659*				
Germany n = 1727					
Mean coefficient	0.040	-0.334	-0.598	0.770	0.768
Marginal Significance Level	*0.050*	*0.003*	*0.006*	*0.010*	*0.011*
Test of Market Efficiency:	$\phi_1 = \phi_1^*$				
t-statistic	1.922				
Marginal Significance Level	*0.103*				

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the mean coefficient equals zero.
Tests of market efficiency report the *t*-statistics for two-tailed tests that the means are equal and the marginal significance level of these results.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t.
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 5 - Panel C
Tests of Rational Expectations (Wages) - Pooled Regressions

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \quad (2)$$

$$AR_{t+1} = \delta_0 + \delta_1(\Delta NI_{t+1} - \gamma_0 - \gamma_1^* \Delta NI_t - \gamma_2^* \Delta WAGE_t) + \eta_{t+1} \quad (5)$$

	γ_0	γ_1	γ_2	γ_1^*	γ_2^*	δ_0	δ_1
U.K. n = 4867							
Estimated Coefficient	0.010	-0.094	0.109	-0.181	0.275	-0.070	0.426
Marginal Significance Level	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Tests of Market Efficiency:	$\gamma_1 = \gamma_1^*$				$\gamma_2 = \gamma_2^*$		
Likelihood Ratio Statistic	7.693				9.793		
Marginal Significance Level	*0.006*				*0.002*		
U.S. n = 5800							
Estimated Coefficient	0.018	-0.290	0.165	-0.353	0.231	-0.096	0.205
Marginal Significance Level	*0.000*	*0.000*	*0.000*	*0.001*	*0.006*	*0.000*	*0.000*
Tests of Market Efficiency:	$\gamma_1 = \gamma_1^*$				$\gamma_2 = \gamma_2^*$		
Likelihood Ratio Statistic	0.826				0.631		
Marginal Significance Level	*0.363*				*0.427*		
Germany n = 1727							
Estimated Coefficient	0.014	-0.319	-0.011	-0.507	0.009	-0.098	0.192
Marginal Significance Level	*0.000*	*0.000*	*0.402*	*0.019*	*0.955*	*0.000*	*0.000*
Tests of Market Efficiency:	$\gamma_1 = \gamma_1^*$				$\gamma_2 = \gamma_2^*$		
Likelihood Ratio Statistic	1.903				0.026		
Marginal Significance Level	*0.168*				*0.872*		
Japan n = 8988							
Estimated Coefficient	0.000	0.031	0.220	-0.008	0.120	-0.040	2.025
Marginal Significance Level	*0.000*	*0.000*	*0.000*	0.670	0.001	*0.000*	*0.000*
Tests of Market Efficiency:	$\gamma_1 = \gamma_1^*$				$\gamma_2 = \gamma_2^*$		
Likelihood Ratio Statistic	3.458				6.943		
Marginal Significance Level	*0.063*				0.008		

Pooled samples consist of combined samples from 1994-2000 (1993-1997 for Japan). Reported significance levels of coefficient estimates and tests of market efficiency are based on Chi-square likelihood ratio statistics.
Similar significance levels for coefficients and for differences between coefficients are obtained using two-tailed asymptotic t-tests based on the standard normal distribution.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.

Table 5 - Panel D
Tests of Rational Expectations (Wages) - Annual Regressions

$$\Delta NI_{t+1} = \gamma_0 + \gamma_1 \Delta NI_t + \gamma_2 \Delta WAGE_t + \varepsilon_{t+1} \quad (2)$$
$$AR_{t+1} = \delta_0 + \delta_1(\Delta NI_{t+1} - \gamma_0 - \dot{\gamma}_1 \Delta NI_t - \dot{\gamma}_2 \Delta WAGE_t) + \eta_{t+1} \quad (5)$$

Fama-MacBeth tests of significance of yearly regression coefficients, 1994 to 2000

	γ_0	γ_1	γ_2	$\dot{\gamma}_1$	$\dot{\gamma}_2$	δ_0	δ_1
U.K. n = 4867							
Mean coefficient	0.030	-0.125	0.130	-0.206	0.366	-0.048	0.527
Marginal Significance Level	*0.079*	*0.059*	*0.054*	*0.048*	*0.035*	*0.286*	*0.008*
Tests of Market Efficiency:		$\gamma_1 = \dot{\gamma}_1$			$\gamma_2 = \dot{\gamma}_2$		
t-statistic		2.529			-2.723		
Marginal Significance Level		*0.045*			*0.035*		
U.S. n = 5800							
Mean coefficient	0.037	-0.189	0.139	-0.273	0.155	0.371	0.461
Marginal Significance Level	*0.006*	*0.024*	*0.028*	*0.014*	*0.382*	*0.049*	*0.013*
Tests of Market Efficiency:		$\gamma_1 = \dot{\gamma}_1$			$\gamma_2 = \dot{\gamma}_2$		
t-statistic		2.359			-0.120		
Marginal Significance Level		*0.056*			*0.909*		
Germany n = 1727							
Mean coefficient	0.042	-0.333	0.013	-0.595	0.214	0.771	0.771
Marginal Significance Level	*0.070*	*0.006*	*0.705*	*0.011*	*0.197*	*0.020*	*0.020*
Tests of Market Efficiency:		$\gamma_1 = \dot{\gamma}_1$			$\gamma_2 = \dot{\gamma}_2$		
t-statistic		1.941			-1.534		
Marginal Significance Level		0.100			0.176		

Reported significance levels of coefficient estimates are based on two-tail *t*-tests that the mean coefficient equals zero.
Tests of market efficiency report the *t*-statistics for two-tailed tests that the indicated coefficients are equal and the marginal significance level of these results.

ΔNI_{it} = the change in net income before extraordinary items of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
$\Delta WAGE_{it}$ = the change in employee compensation expense of firm i in year t, deflated by the market value of equity of firm i at the beginning of year t
AR_t = the abnormal return of firm i in year t, calculated as the twelve-month buy-and-hold return for the stock less the buy-and-hold return for a size-matched, value-weighted portfolio of firms from the same country.