

How Does Residual Income Affect Investment? The Role of Prior Performance Measures

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This paper examines whether “you get what you pay for” in firms that implement residual income (RI)-based compensation. Specifically, this paper explores differences in investment patterns of firms that implement RI-based compensation plans conditional on whether the firms switched from earnings or return on investment (ROI)-based compensation. I find that the pattern of investment for firms switching to RI from earnings-based compensation is opposite to that of firms switching from ROI-based compensation. Changes in investment within each individual subgroup yield weaker, mixed results. In addition, this paper documents that delivered RI increases in firms that implement RI. My paper contributes to the literature on the investment effects of RI by examining the relevance of a set of arguments that have been made in management accounting textbooks since 1965. These arguments are still found in current textbooks and are commonly taught to students in graduate level managerial accounting classes. The arguments help us to examine a natural experiment in which we can better specify the conditions under which RI use is expected to be associated with changes in investment.

Key words: residual income; performance measurement; incentives; investment decisions; economic value added

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1. Introduction

This paper examines whether investment differs for firms switching to residual income (RI)-based compensation from earnings versus return on investment (ROI)-based compensation plans. Prior empirical research (Wallace 1997, Kleiman 1999) presumed that firms implementing RI switched from earnings-based plans, hypothesized that investment should decrease, and found mixed results. The hypothesis of prior research is consistent with discussions about the incentives provided by earnings versus RI, commonly found in accounting textbooks (from Solomons 1965 to Horngren et al. 2000). Yet these same texts also compare incentives provided by ROI and argue that in certain situations investment might increase for firms switching from ROI to RI. This paper explores whether such a difference is relevant in explaining the mixed results of prior research.

This paper identifies 181 firms that have implemented RI-based compensation plans. It examines changes in investment for the pooled sample of implementing firms and finds no evidence of changes in investment associated with the implementation of RI. It then partitions this sample into two subsamples: The first subsample consists of firms that previously used earnings-based compensation plans and the second subsample consists of firms that used ROI-based

plans. The subsamples are then viewed as a natural experiment to examine whether changes in investment are different for firms switching to RI from earnings or ROI.

This paper finds that investment is significantly different between the two subsamples. The differences in investment are robust to alternate specifications that include controls for potentially correlated variables such as factors that may affect the firm's decision to implement RI, factors that may affect the firm's investment decisions, and other changes that may be made concurrent with the implementation of RI. The differences are also robust to additional tests using year and industry indicator variables, further refinements to identify underinvestment, and tests in a matched control sample. As predicted, delivered RI¹ increases with the implementation of RI and there is no difference between the two subsamples. The results of the tests between the two subsamples are consistent with the notion that “you get what you

¹ In this paper, I use terms such as implementing RI to refer to a firm including an RI-based performance measure in the incentive compensation plan given to its executives. These plans may or may not use EVA, a form of residual income advocated by the consulting firm Stern Stewart. I use terms such as delivered RI to refer to the value of the firm's RI in a given period.

pay for,"² because they provide evidence that investment behavior differs as predicted by the change in incentives.

This paper documents weaker, mixed evidence on the changes in investment within each subsample. Tests for decreasing (increasing) investment in firms switching from earnings (ROI) are only marginally significant in some specifications and are insignificant in others.

This paper answers the question, "Do you get what you pay for?" in the context of RI. This paper documents that RI-based compensation contracts affect investment in ways that are consistent with classic textbook arguments. Related theory (Rogerson 1997, Reichelstein 1997, Dutta and Reichelstein 2002) suggests that RI-based contracting is optimal given appropriate accrual accounting choices. This paper makes no assumption about the optimality of RI-based compensation and does not test optimality. It does provide evidence that RI affects real management actions, a necessary condition for assessing the optimality of those actions. This paper contributes to the literature on RI-based incentives by examining the relevance of a long-held set of arguments about RI, ROI, and earnings, which appear regularly in managerial accounting textbooks and are commonly taught to undergraduate and MBA students. These arguments can be traced back to accounting texts from as early as 1965. These arguments help us examine a natural experiment that better specifies conditions under which use of RI is expected to be associated with changes in investment. Section 2 develops hypotheses. Section 3 discusses research design. Section 4 presents test results and §5 concludes.

2. Development of Hypotheses

Prior literature has investigated whether firms that implement RI-based compensation "get what they pay for." Wallace (1997) presumes that firms implement RI to improve delivered RI, so we expect to observe improvement. Wallace's presumption is consistent with management practice in firms implementing RI. In particular, the bonus paid to managers in such firms is typically based on improvements in delivered RI, which should provide incentives to an economically rational manager to improve RI (for examples of RI-based bonus plans, see Simons 2001 and Young and O'Byrne 2001).³ Correspondingly, this paper also begins with the presumption that delivered RI is likely to improve. Formally stated, I hypothesize:

² Wallace (1997), the first empirical paper in this area, is titled "Adopting residual income-based compensation plans: Do you get what you pay for?"

³ Garvey and Milbourne (2000) find that firms with a higher contemporaneous correlation between RI and stock returns are ex ante more likely to implement RI. In their paper, the contemporaneous

HYPOTHESIS 1. *Ceteris paribus, the implementation of RI-based incentives will be associated with an increase in delivered RI.*

This paper departs from prior literature by explicitly identifying the performance measure from which firms switched when implementing RI. Prior research has presumed that firms implementing RI had incentives based on earnings in the preceding period. For example, Wallace (1997, p. 277) states:

The cost of debt financing is charged to earnings in the form of interest expense on existing debt, however there is no corresponding charge against earnings for equity financing. Any project that is expected to earn greater than the embedded cost of debt increases the absolute level of earnings, but reduces shareholder wealth unless it also earns greater than the firm's opportunity cost of capital. In contrast, because of the charge on all capital, a residual income performance measure provides incentive to avoid such over-investment.

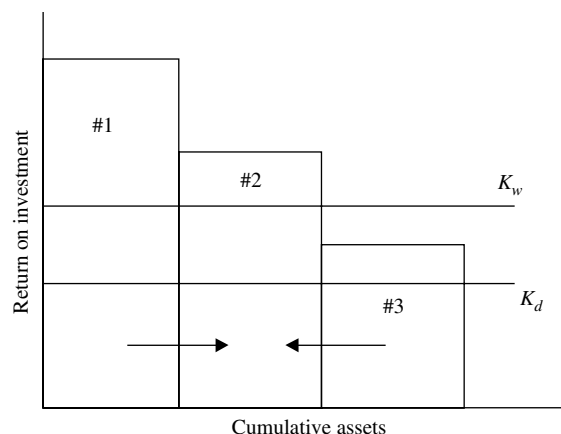
Using this presumption, both Wallace (1997) and a follow-up paper by Kleiman (1999) hypothesize that investment should decrease with the implementation of RI. This paper expands on these hypotheses by considering an argument that has been in management accounting textbooks since Solomons (1965) and has continued to be taught in management accounting courses till the present day. Example of texts that discuss Solomons' original argument include Anthony (1973), Dearden (1972), Reece and Cool (1978), Morse and Zimmerman (1997), and Horngren et al. (2000).

Figure 1 summarizes Solomons' argument. Figure 1 depicts the investment choice of a manager who faces three investment opportunities ordered in terms of ROI. K_w represents the weighted average cost of capital and K_d the cost of debt for the firm. Project 1 has the highest ROI. Project 2's return is lower, but higher than the firm's cost of capital. The return for project 3 is lowest, but still higher than the firm's cost of debt. The manager can choose to invest in any or all of these projects. Reflecting the manager's choice, the firm's cumulative assets are on the x axis and the ROI for each project is on the y axis. Given incentives to maximize earnings, the manager will choose all three. Given incentives to maximize ROI and appropriate initial circumstances,⁴ the manager might only choose

aneous correlation between a performance measure and stock returns reveals information about the measure's signal content and hence plays a role in weighting a measure in the optimal contract. The presumption that implementing firms expect RI to improve is consistent with this finding, but it focuses on performance observed after implementation.

⁴ In this simplified example the entire firm is represented by these three projects so the manager chooses project 1. If the firm had prior investments, the manager's choice is unclear as it would be influenced by the use of ROI incentives, the ROI for the projects already in place, and the size of the existing projects.

Figure 1 Investment Choice



- To maximize earnings, select projects #1, #2, and #3.
- To maximize ROI, select project #1 only.
- To maximize RI, select projects #1 and #2.

project 1. Given incentives to maximize RI, the manager will choose projects 1 and 2. In summary, investment under earnings will be greater than that under RI, which in turn will be greater than that under ROI. The arrow from project 3 to project 2 represents a firm that switches from earnings to RI. Consistent with prior research, this firm will invest less under RI than under earnings. In contrast, the arrow from project 1 to project 2 represents a firm that switches from ROI to RI; this firm will invest more under RI than under ROI.

The scenario in Figure 1 implies that changes in investment will be different for firms that switch from earnings and firms that switch from ROI. I hypothesize:

HYPOTHESIS 2. *Ceteris paribus, changes in investment for firms switching from earnings will be opposite the changes for firms switching from ROI.*

3. Research Design

The hypotheses presented in §2 are examined using the sample described next.

3.1. Sample Selection and Description

A sample of firms that implement RI-based compensation plans is selected using an approach similar to prior research. Consistent with Wallace (1997), RI adoption is defined as the first year in which a firm includes RI as a performance measure in determining the compensation of named executives.⁵ RI-implementing firms were identified through

⁵ A firm's named executives are its five most highly paid executives. Under section 14 of the 1934 Securities Exchange Act, a firm must name these executives and summarize the value of their total compensation in its proxy statements.

searches of proxy statements using Lexis-Nexis, Disclosure, and EDGAR databases.⁶ The searches found more than 400 firms that satisfied the search criteria. The proxy statements of these firms were reviewed by hand to confirm the use of RI in executive compensation and to identify the year of adoption.⁷

The content of the proxy statements was examined to further refine the adoption date. Firms typically disclose their use of RI in one of two ways. Firms may propose the inclusion of RI in a proposal for ratification by the shareholders; in this case, the year of the proxy is one year before the event year. Alternatively, firms may disclose their use of RI in the report of the executive compensation committee, which describes how compensation was determined in the current year. In this case, the year of the proxy statement is the event year.⁸

The sample selection process identified 181 firms as RI implementers. These firms implemented RI in their compensation plans between 1986 and 1998. Table 1 describes the pattern of RI adoption. Panel A shows that the frequency of adoption was increasing over time, consistent with heightened attention in the business press. The number of adopters declines from 1997 to 1998, suggesting that there may be some degree of saturation in the market for RI-based compensation contracts. Panel B shows that adoption of RI by industry differs from the overall distribution of firms in Compustat. Industries such as textiles, utilities, and durable goods are overrepresented among RI adopters; financial institutions, real estate, computers, and service industries are underrepresented. A chi-square test shows the frequency distribution in this sample to differ significantly from that of the population of all Compustat firms.

Data from the financial statements of firms in this sample were gathered from Compustat. Table 2, Panel A, summarizes the availability of financial data for the 181 residual income adopters identified. Of the

⁶ Initial searches used broad search terms such as "profit" within 25 words of "capital" and permutations of commonly used names for residual income, including "economic value added," "value added," "economic profit," "capital cost," "capital charge," and "cost of capital."

⁷ The broad nature of the search terms used frequently led to spurious hits that identified sections of proxy statements that were not related to performance measurement. In addition, some regulated utilities use a measure called "economic value added," which is defined by their regulators and is not a form of residual income.

⁸ A detailed set of instructions was written to identify the RI adoption date. I initially identified and confirmed the adoption dates. Undergraduate students subsequently replicated the identification process to confirm the reliability of the adoption dates. This confirmation process was run twice, each time with a different person examining the proxy statement. The first pass identified three errors in adoption date. These were updated prior to the second pass, which found no errors.

Table 1 RI Implementation Over Time and By Industry

Panel A: RI implementation by year			
Year	Number of implementers	Percent of sample	Cumulative percent of sample
1986	1	0.55	0.55
1987	1	0.55	1.10
1988	1	0.55	1.65
1989	0	0.00	1.65
1990	2	1.10	2.75
1991	2	1.10	3.85
1992	3	1.65	5.50
1993	16	8.84	14.34
1994	25	13.81	28.15
1995	30	16.57	44.72
1996	32	17.78	62.50
1997	51	28.17	90.67
1998	17	9.33	100.00
Total	181	100%	100%

Panel B: RI implementation by industry			
Industry*	Number of implementers	Percent of sample**	Average percent of Compustat firms***
Mining and construction	6	3.2	7.7
Food	7	3.8	2.3
Textiles, printing, publishing	19	10.8	5.1
Chemicals	7	3.8	1.8
Pharmaceuticals	4	2.7	2.8
Extractive Industries	3	1.6	0.5
Durable goods	63	34.8	20.1
Computers	3	1.6	9.8
Transportation	10	5.4	5.7
Utilities	17	9.7	2.4
Retail	18	9.7	10.9
Financial institutions	10	5.4	11.5
Real estate	0	0.0	8.5
Service	13	7.0	9.8
Other	1	0.5	1.1
Total	181	100%	100%

*Industry classification was determined using the procedure developed in Barth et al. (1998).

**The chi-square statistic for the frequency in the sample versus the frequency in the Compustat population is 114.6 (the critical value for the chi-square test at the 1% level is 31.32, and at the 5% level is 23.68).

***The average percentage (by number) of Compustat firms in each of these industries for the years 1990–1998.

181 firms identified, 147 have publicly available financial statement information in Compustat. The data from these 147 firms could be used to conduct the tests described in the following sections. Because the hypotheses developed in §2 are conditional on firms' switching from ROI- or earnings-based plans, the sample is further partitioned. Some firms have both earnings and ROI in their prior compensation plans. These firms are classified as ROI firms. This design choice will bias against finding changes in the ROI subsample if these firms are using both earnings and

Table 2 Data Availability

Panel A: Data availability	
Firms with data available	147
Firms missing data in the event period due to	
• acquisition	18
• being private during part of the period	16
Firms with missing data	34
Total	181

Panel B: Performance measure used by implementing firms before RI	
Firms with data available	147
• Firms using return on investment	56
• Firms using earnings	67
• Firms in which the proxy statements do not identify the prior measure	24
Total	147

ROI; maximizing the combination might lead to the selection of projects 1 and 2 in Figure 1. If this is the case, then switching to RI is less likely to be associated with a change in investing. Table 2, Panel B, shows that 56 firms used ROI-based performance measures and 67 firms used earnings-based measures before adopting RI. For 24 firms, I was unable to determine which measure was used before RI from the proxy statement information.

Table 3 compares the sample in this paper with the samples used in Wallace (1997) and Kleiman (1999). Out of Wallace's sample of 40 firms, I was able to identify the prior measure for 30 firms. Of these 30 firms, 40% switched from ROI and 60% switched from earnings. For Kleiman's sample of 69 firms, I was able to identify the prior measure for 41. Of these 41, 51% switched from ROI and 49% switched from earnings. Under the hypotheses developed in §2, the composition of Kleiman's sample would bias against finding decreased investment in a test that pools both sets of firms. Although not a formal hypothesis test, this difference in composition is consistent with Wallace's (1997) finding evidence of reduced investment associated with RI implementation and Kleiman's (1999) not finding reduced investment. My sample of 147 firms contains 46% firms

Table 3 Comparing Samples of This Paper (2006), Wallace (1997), and Kleiman (1999)

Switch from	This paper		Wallace		Kleiman	
	#	%	#	%	#	%
Returns	56	46	12	40	21	51
Earnings	67	54	18	60	20	49
Subtotal	123	100	30	100	41	100
Unidentified	24		10		28	
Total	147		40		69	

Table 4 Descriptive Statistics of Firms That Implemented RI

Panel A: Residual income over time						Panel C: Control variables and other descriptive statistics				
	Year	−3	−2	−1	0	Variable	Mean	Median	Q1	Q3
ALL	Mean	−34.21	−58.29	−26.21	−11.32	In \$ millions				
	Median	−6.53	−10.36	−6.15	−5.00	Assets	7,330.77	1,455.20	321.96	5,017.20
EARN & ROI	Mean	−33.94	−61.20	−18.54	2.16	Sales	4,708.52	1,616.70	398.01	4,676.68
	Median	−5.03	−10.36	−4.78	−2.92	Rates or ratios				
Panel B: Investment over time						Asset growth	0.103	0.054	−0.008	0.139
	Year	−3	−2	−1	0	PPE to assets	0.357	0.315	0.191	0.700
ALL	Mean	0.091	0.101	0.093	0.106	Sales growth	0.115	0.076	0.005	0.174
	Median	0.057	0.068	0.064	0.073	ROE	0.102	0.129	0.063	0.243
EARN	Mean	0.088	0.109	0.088	0.076	ROA	0.042	0.043	0.162	0.075
	Median	0.054	0.069	0.061	0.070	Market to book	2.782	1.984	1.427	3.262
ROI	Mean	0.088	0.086	0.094	0.122	Ownership	0.092	0.034	0.011	0.104
	Median	0.063	0.065	0.065	0.075	In thousands				
					Employees	24.802	8.638	2.729	19.492	
					Indicator variables					
					Stern Stewart	0.206	n/a	n/a	n/a	
					Multimeasures	0.634	n/a	n/a	n/a	
					Multiyear	0.298	n/a	n/a	n/a	
					Subjectivity	0.574	n/a	n/a	n/a	

Notes. Panel A provides a description of the delivered RI for the 147 firms with available data as described in Table 2. Year 0 is the first year in which the firm used RI as a measure to determine bonus compensation; Years −1, −2, and −3 are the three prior years. The ALL rows include all 147 sample firms with available data; the rows titled EARN & ROI present pooled means and medians for 123 firms in which the performance measure used in the prior regime could be identified (see Table 2).

Panel B provides a description of investment for the 147 firms with available data as described in Table 2. Year 0 is the first year in which the firm used residual income as a measure to determine bonus compensation; Years −1, −2, and −3 are the three prior years. The ALL rows include all 147 sample firms with available data; the rows EARN include all firms that switched from earnings; the rows ROI include all firms that switched from ROI.

Panel C provides additional descriptive statistics for the 147 firms with available data as described in Table 2 in the year before they implemented RI-based compensation. Assets is the end-of-period value of assets (Data6 in Compustat). Asset growth is the growth in assets for the year. PPE to assets is the ratio of net property plant and equipment (Data8) to assets. Sales is sales revenue for the year (Data12). Sales growth is sales growth over the preceding year. Employees is the number of employees as reported by the company (Data29). ROE is return on equity measured as Data18/Data216. ROA is return on assets, measured as Data18/Data6. The market to book ratio is measured as (Data24 * Data25)/Data216. Ownership is the percentage of the firm's outstanding shares owned by management and the board as a group. Stern Stewart is an indicator variable that takes the value 1 if the firm voluntarily identified using the consulting firm Stern Stewart in their proxy statement. Multimeasures is an indicator that takes the value 1 when the firm uses multiple performance measures in the compensation contract. Multiyear is an indicator that takes the value 1 if RI is used in a multiyear contract. Subjectivity is an indicator that takes the value 1 if the firm indicates that subjective discretion can be used in addition to objective performance measures in determining performance-based compensation.

switching from ROI and 54% firms switching from earnings. The composition of my sample is also likely to bias against finding decreased investment in a test that pools both sets of firms.

Panel A of Table 4 presents the mean and median delivered RI in the first year in which RI was used in compensation (year 0) and the three prior years (years −1 to −3). The row labeled “ALL” is the delivered RI for all 147 sample firms and the row labeled “EARN & ROI” is the delivered RI for the 123 firms that could be identified as switching from earnings- or ROI-based compensation. The means and medians show RI decreasing from years −3 to −2, increasing from years −2 to −1, and increasing again from years −1 to 0. Table 5 will use this data to examine the association between changes in delivered RI and the implementation of RI-based compensation.

Panel B of Table 4 presents the means and medians of investment net of asset dispositions, scaled

by beginning period total assets, for all firms (ALL), firms switching from earnings (EARN), and firms switching from ROI. The mean level of investment for all firms is first increasing (years −3 to −2), then decreasing (years −2 to −1), and then again increasing (years −1 to 0). The medians show primarily an increase in the level of investment over time. The subsequent two rows present the means and medians of investment by year for the firms switching from earnings and ROI, respectively. The changes in investment during these firm years will be examined in more detail in the test results presented in Table 6.

Table 4, Panel C, provides additional descriptive statistics for the sample of firms implementing RI. The table shows that these firms have mean assets (in the year before implementation) of over \$7 billion and median assets of over \$1.4 billion. Skewness in the distribution of these size measures, as reflected in both the difference between the means

and medians as well as differences between the first and third quartiles, is similar to other papers that use similar samples (e.g., Garvey and Milbourne 2000, Hogan and Lewis 2005). In addition, related research (Balachandran 2001) shows that the mean and median size measures are significantly larger than the industry (2-digit SIC level) medians for firms implementing RI. Finally, firms have a mean of approximately 24,000 employees and a median of approximately 8,600 employees.

The ratios in Table 4 show that assets are growing at a rate of 10% in the mean and 5.4% in the median, and the pattern is similar to that of sales growth. Further, firms implementing RI have property, plant, and equipment (PPE) that is approximately one third of all their assets. These descriptive statistics, although not formal hypothesis tests, are consistent with those we might expect of firms implementing approaches to manage investment decisions. These firms are large in absolute size and relative to their industry, have substantial fixed assets, and are growing. In terms of economic significance, the median firm is investing over \$750 million per year (median asset growth multiplied by median assets).

In terms of performance, these firms have return on equity (ROE) of approximately 10%–12% and return on assets (ROA) of 4%. In addition, they have market-to-book ratios in the neighborhood of 1.43 (the first quartile cutoff) and 3.26 (the third quartile cutoff). Balachandran (2001) compares these measures to industry medians and finds that the mean and median performance of firms implementing RI is significantly greater than industry norms. Finally, management and the board of directors as a group own a mean of approximately 9% and a median of 3.4% of the firm's outstanding stock.

The indicator variables in Table 4 describe important aspects of how firms implement RI-based contracts. Approximately 20% of the firms disclosed that they had retained the assistance of Stern Stewart, a consulting firm that publicized the potential benefits of RI-based compensation in the business press in the 1990s. Based on discussions with current and former managers at Stern Stewart, this figure is likely a lower bound because many firms implementing RI do not publicly disclose their use of consultants. Approximately 40% of implementing firms use RI as the only measure in the compensation contract; the remaining 60% include other measures such as sales growth and customer satisfaction.

Approximately 70% of the firms implement contracts based only on performance in the current year. The remaining 30% implement contracts that span multiple years. This is typically done using a "bonus bank," in which a portion of the bonus earned in a given year is not paid unless performance targets are

met in subsequent years. If performance falls short of targets in subsequent years, negative bonus amounts can be deducted from the bonus bank. For more details on bonus banks, see Young and O'Byrne (2001) and Simons (2001). Multiyear contracts are also sometimes implemented using a "performance plan" structure similar to those studied in Larcker (1983).

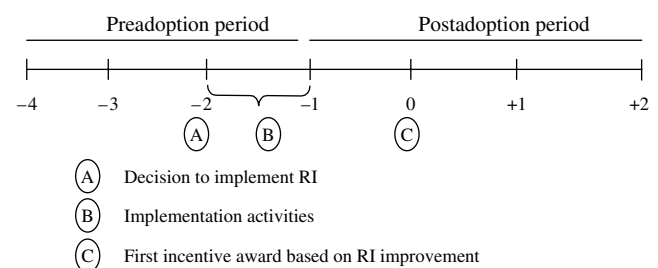
Finally, most firms allow subjective discretion in addition to objective performance-based formulas in their RI compensation contracts. Approximately 57% of implementing firms allow subjective discretion, and the remaining firms base their contracts on delivered RI and potentially other objective measures. These indicator variables are used as control variables in tests of whether the implementation of RI is associated with improvements in delivered RI and changes in investment behavior.

3.2. Implementing Hypothesis Tests

The hypotheses developed in §2 are tested in two parts: First, a set of pooled tests that examine evidence of changes associated with the implementation of RI for the sample is conducted, regardless of the measure used prior to RI. Second, partitioned tests are conducted in which two subsamples, based on whether the firms previously used earnings or ROI, are used to test for differences between subsamples. Conducting this analysis requires (1) identifying the periods in which dependent variables are measured, (2) measuring the portion of the dependent variable that is associated with the performance measure used in compensation, (3) testing changes before and after the implementation of RI for the sample, differences between subsamples, and changes within each subsample, (4) specifying regression-based tests, (5) addressing unobservability of actions for firms switching from ROI, and (6) adding control variables.

3.2.1. Identifying the Periods in Which Dependent Variables Are Measured. Tests of investment and delivered RI are constructed using the timeline presented in Figure 2. Consistent with past research on RI, year 0 is the first year in which the firm pays incentive compensation based on RI. Implementation activities occur from year -2 to year -1 . Firms use

Figure 2 Timeline of RI Implementation Events



their old incentive regimes based on either earnings or ROI in the three preadoption years (−3, −2, −1). Firms use RI-based incentives in the postadoption years (0, 1, 2).

3.2.2. Measuring the Association Between the Dependent Variable and the Performance Measure Used in Compensation. Using the timeline in Figure 2, I calculate the level of each dependent variable defined in the appendix in year −3, −2, −1, and 0. The level in year 0 is the level at the end of the first year in which the firm used RI. Because the level absent incentives is unobservable, the firm is used as its own control. Correspondingly, the change in investment from year −1 to year 0 is interpreted as a proxy for the incremental level associated with RI incentives. Following the same logic, the change from year −3 to year −2 are used as a proxy for the level associated with the old incentive regime.⁹ Using the change as the dependent variable has the additional advantage of controlling better for time trend and other unspecific heterogeneity. Further, using the change is consistent with business practice because firms implementing RI-based plans typically set targets based on improvements in RI (Simons 2001, Young and O’Byrne 2001).

3.2.3. Specifying Tests. Differences between the old regime and RI are first examined for the sample as a whole. In these tests I do not distinguish whether the firm previously used earnings or ROI. Rather, I examine the difference in the dependent variable before and after RI. Next, each firm year observation is classified along two dimensions: (1) whether the firm was using RI or its old performance measure (earnings or ROI) during the period, and (2) whether the firm was switching from earnings or ROI. Differences in differences are then examined using the regressions specified in the next section.

⁹In the period from year −2 to year −1 firms are also under their old incentive regimes, but this period is not used as the benchmark for comparison with RI incentives for three reasons. First, firms are actively implementing RI from year −2 to year −1. Because managers are aware of this upcoming change in performance measures, they likely have incentives to “sandbag” in this period, which potentially biases toward finding results. Second, using observations from year −2 to year −1 potentially violates independence assumptions of ordinary least squares estimation, because the period is contiguous with the period in which managers are under RI incentives (year −1 to year 0). Using the period from year −3 to year −2 is attractive because it is the nearest, noncontiguous period in which implementation is not taking place and firms are under their old regimes. Third, using observations from noncontiguous periods minimizes the likelihood of statistical artifacts such as year-to-year mean reversion affecting subsequent tests.

3.2.4. Regression Analysis. Hypothesis 2 suggests that if there are two different sets of subsamples that implement RI, and the effects for the subsamples are likely to be in opposite directions, then (1) we may not observe any effects that may be associated with RI if we pool the subsamples, and (2) we should observe that effects between the two subsamples are in opposite directions. Regressions (1) and (2) below are designed to examine these two possibilities. In all regressions the dependent variable will be winsorized at the first and 99th percentile to dampen the effects of outliers on parameter estimates.

To test the changes for the sample as a whole (a pooled test), the parameters of regression (1) are examined:

$$DEPVAR = \alpha + \beta_1(NEW) + \varepsilon, \quad \text{where} \quad (1)$$

DEPVAR change in investment, or RI,
NEW 1 if the firm is under the RI-based compensation regime (from year −1 to year 0) and 0 if the firm is under its old compensation regime (from year −3 to year −2).

In this regression, the parameter α is the mean of the dependent variable under the old performance measure; the coefficient β_1 is the difference between the mean of the dependent variable under the old measure and the mean under RI. Based on Hypothesis 1, β_1 is predicted to be positive when delivered RI is the dependent variable. In the pooled test of investment the prediction on β_1 is unclear, because the tests pool two sets of firms in which the effects are predicted to be in opposite directions.

The parameters of regression (2) are estimated to test changes in investment between subsamples:

$$\begin{aligned} \Delta INVEST = \alpha + \beta_1(NEW) + \beta_2(RET) \\ + \beta_3(NEW * RET) + \varepsilon, \quad \text{where} \quad (2) \end{aligned}$$

$\Delta INVEST$ change in investment,
NEW is as defined in Equation (1) above,
RET 1 if the firm switches from ROI, and 0 if the firm switches from earnings.

The indicator variables *NEW* and *RET* represent whether the observation is from the regime where the firm is using RI or its old performance measures and whether the observation is from a firm that switched from earnings or ROI. The interactive term *NEW * RET* facilitates a test of differences in differences. Based on Hypothesis 2, β_3 is predicted to be positive.

3.2.5. Unobservability of Action in the ROI Regime. The actions of firms under ROI-based incen-

tives are ex post unobservable. Accordingly, one can never be sure whether the investment observed is the result of forgoing a project or not having an appropriate project to begin with. In this paper, I address this problem in a specification that examines firms that switched from ROI, but whose prior period ROI was greater than their cost of capital. This specification presumes that the previous year's performance is correlated with the potential to forego investments in the current year.

3.2.6. Control Variables. The regression approach used in Equations (1) and (2) is similar to tests of differences in the means of the dependent variables. The advantage of specifying the tests as a regression over tests of means is that control variables can be added.

Two sets of control variables are included: one set from prior literature and another set that is unique to this paper. The first set of control variables was used in Wallace (1997) and includes leverage, changes in leverage, changes in share ownership by management and the board of directors, and changes in the number of employees. As in Wallace (1997), these variables control for operating changes and changes in ownership that may take place concurrent with the implementation of RI.

The second set of control variables proxies for additional important constructs. The book to market value of the firm is included as a proxy for differences in investment opportunity. To proxy for the effects of life cycle, sales and the growth in sales are included. To proxy for replacement of depreciated assets, the ratio of accumulated depreciation to gross property plant and equipment is included. To proxy for expertise in implementation, I include an indicator that is set to 1 if the firm disclosed using the consulting firm Stern Stewart to implement a version of RI called EVA. To capture differences in contract structure I include an indicator for the presence of subjectivity in determining bonuses (Ittner et al. 2003), and an indicator for whether a multiyear compensation structure such as a performance plan (Larcker 1983) or a bonus bank (Simons 2001) was used.

4. Results

4.1. Pooled Tests of Changes in Residual Income and Benchmarks for Investment Tests

Table 5 reports the results of pooled tests of delivered RI and investment. Each panel presents three specifications. The first two use the firm as its own control and differ only in the control variables they include; the third uses both the firm as its own control and a matched control firm.¹⁰ All three specifica-

tions provide qualitatively similar results. In Panel A, the dependent variable is the change in delivered RI. Panel A shows that on average an increase in RI is associated with the implementation of RI-based compensation. This association is consistent with the prediction of Hypothesis 1 and the findings in Wallace (1997). Panel B shows that in the pooled sample there is no evidence of changes in investment being associated with the implementation of RI. The lack of significant changes in investment is not consistent with the findings in Wallace (1997). The tests in Table 5 use only observations from RI-implementing firms for which I am able to identify the measure used prior to RI. Replication of this analysis on the full sample of implementing firms provides results that are qualitatively the same. The investment results presented in this table are consistent with those reported in Kleiman (1999).

Table 5, Panel B, provides a point of departure for the analysis in Table 6. The hypotheses for investment presented in §2 suggest that although we may not observe an overall effect of RI on investment, this could be driven by the possibility that there are two associations in opposite directions. By comparing Table 5, Panel B, to Table 6, we can assess the extent to which the hypotheses in §2 are supported.

4.2. Tests of the Investment Hypothesis

Table 6¹¹ reports the results of tests that examine changes in investment conditional on whether firms switched from earnings or ROI. The first three specifications are similar; they all use the firm as its own control and only differ in the inclusion of control variables. These three specifications show that the overall difference in investment between firms switching from earnings and firms switching from ROI is positive, as predicted. The specifications show

firm, the matching algorithm identified all other firms in the same 2-digit SIC code. These firms were then grouped into performance quintiles. Of the firms in the same industry and performance quintile as the sample firm, the firm closest in size was selected. Identifying a matched control sample, one that is alike in all ways except for the implementation of RI, was not possible. For example, if industry was defined more finely than a 2-digit SIC code, the resulting control firms differed significantly in size, even in the year of selection (i.e., the period when the matching was done). Using a 2-digit SIC code provides a match on size, but treatment firms still have significantly better performance. Further, it leads to firms such as Caterpillar (a manufacturer of heavy earth moving equipment) matched with Compaq (a computer manufacturer). Correspondingly alternative approaches to control are also used.

¹¹ For brevity in exposition, Table 6 reports the relevant combinations of parameters of central interest. A full report of all parameter estimates including the control variables is available upon request from the author.

¹⁰ Matched control firms were selected using three criteria: industry, performance (return on invested capital), and size. For each sample

Table 5 Pooled Tests of Changes in Delivered RI and Investment of Firms Implementing RI-Based Compensation

Panel A: Test of mean RI before and after implementation				
Based on the OLS parameter estimates of a regression of the form $\Delta RI = \alpha + \beta_1(NEW) + \sum \gamma_j CONTROLS_j + \varepsilon$				
Variable	Prediction	Model I coefficient	Model II coefficient	Model III coefficient
Intercept		-44.38	-46.08	-51.40
<i>NEW</i>	+	57.88 ⁺⁺	51.52 ⁺⁺	96.74 ⁺⁺
Controls		Included	Included	Not included
LEVERAGE		7.88	24.81 ^{***}	
Δ LEVERAGE		-60.46 ^{**}	-30.25	
OWNERSHIP		10.74	-87.17	
Δ EMPLOYEE		-13.93 ^{***}	-14.27 ^{***}	
B/M			24.10 ^{**}	
SALES			-0.01 ^{***}	
SALESGRTH			-114.13	
AD/GPPE			-96.33	
STSTEWART			22.72	
SUBJECT			-3.66	
MULTIYR			-7.29	
Number of observations		240	231	246
Adj. <i>R</i> -square (%)		10.74	23.23	1.88
Panel B: Test of mean investment before and after implementation				
Based on the OLS parameter estimates of a regression of the form $\Delta INVEST = \alpha + \beta_1(NEW) + \sum \gamma_j CONTROLS_j + \varepsilon$				
Variable	Prediction	Model I coefficient	Model II coefficient	Model III coefficient
Intercept		-0.007	-0.001	0.007
<i>NEW</i>	?	-0.004	-0.003	-0.005
Controls		Included	Included	Not included
LEVERAGE		-0.001	0.000	
Δ LEVERAGE		-0.009	0.003	
OWNERSHIP		0.002	0.007	
Δ EMPLOYEE		0.001	0.001	
B/M			-0.016 ^{***}	
SALES			0.000	
SALESGRTH			-0.117 ^{**}	
AD/GPPE			-0.038	
STSTEWART			0.005	
SUBJECT			-0.014	
MULTIYR			0.006	
Number of observations		240	231	246
Adj. <i>R</i> -square (%)		0.00	3.06	0.00

Notes. +, ++, and +++ indicate significance in a one-tailed test at the 1%, 5%, and 10% levels, respectively. *, **, and *** indicate significance in a two-tailed test at the 1%, 5%, and 10% levels, respectively.

Panel A: RI is defined as net operating profit after tax less a charge for capital employed: $RI = (Data18 + Data15 * (1 - 0.35)) - (0.12 * Data37)$.

Panel B: Investment is defined as investment net of disposition, scaled by beginning period total assets: $INVEST = ((Data128_t + Data129_t) - (Data107_t)) / Data6_{t-1}$.

NEW is an indicator variable that is set to 1 when the observation is from the period when the firm uses RI, and zero otherwise. Control variables are as defined in the appendix. Specification I includes all control variables in Wallace (1997), II includes all control variables defined in the appendix, and III uses Δ RI less the corresponding change in investment in a control firm as the dependent variable.

mixed results on differences in investment between each subsample depending on the choice of control variables. Although there is an overall significant difference between the subsamples, the first specification shows a significant difference within the earnings subsample, the second shows a significant difference within the ROI subsample, and the third shows no significant difference within either subsample. This illustrates the difficulty in empirically identifying unidirectional changes in either subsample but shows that the differences between the subsamples provide a more robust test.

Specification IV in Table 6 examines the differences in differences for treatment firms, relative to control firms that were selected based on industry, performance, and size. This specification also shows that the differences in differences of investment between firms that switch from earnings and firms that switch from ROI is positive and significant at the 10% level. Specification V is an alternative for the potential that firms using ROI may have foregone a project. In this specification, firms that switched from earnings are compared to firms that switched from ROI and also had ROI greater than their weighted average cost of capital in the previous year. In the other specifications all firms using ROI-based compensation were presumed potentially susceptible to the problem described in Figure 1. In specification V an alternative approach, based on prior performance, is used to identify those firms.¹² Specification V also shows that overall there is a significant difference in investment between firms switching from earnings and firms switching from ROI.

In addition, the differences in differences of the median investment (relative to control firms) is 0.018 and is significant at the 5% level in a one-tailed test.

4.3. Robustness Checks

One potential risk of using the firm as its own control is that economy-wide or industry-specific trends may confound the interpretation of my empirical results. To address this concern, additional regression-based tests of time and industry effects are conducted. The between subsample results presented previously were similar in magnitude and significance in specifications that included indicator variables for the year of implementation to control for economy-wide effects. The between subsample results were also similar in specifications that included indicator variables for industry (defined using the same Barth et al. 1998

¹² One potential problem introduced by this selection approach is the possibility of mean reversion. To address this possibility, I select ROI firms based on performance in period -3 in the before RI period and again in period -1 in the after RI period. In this way, we difference away any potential mean reversion effects.

Table 6 Tests of Changes in Investment for Firms Implementing RI-Based Compensation, Conditional on Measures from Which Firms Switched

Based on the OLS parameter estimates of a regression of the form $\Delta INVEST = \alpha + \beta_1(NEW) + \beta_2(RET) + \beta_3(NEW * RET) + \sum \gamma_j CONTROLS_j + \varepsilon$								
Specification	Measure switched from	Column A before RI		Column B after RI		Column B – Column A difference		
		Mean	Regression parameters	Mean	Regression parameters	Prediction	Mean	Regression parameters
I	Earnings	0.020	α	-0.012	$\alpha + \beta_1$		-0.032*	β_1
	ROI	-0.002	$\alpha + \beta_2$	0.028	$\alpha + \beta_1 + \beta_2 + \beta_3$		0.030	$\beta_1 + \beta_3$
	Difference	-0.022	β_2	0.040	$\beta_2 + \beta_3$	+	0.062**	β_3
II	Earnings	0.017		-0.006			-0.023	
	ROI	-0.0003		0.036			0.036*	
	Difference	-0.0173		0.042		+	0.059**	
III	Earnings	0.011		-0.016			-0.027	
	ROI	-0.027		-0.001			0.026	
	Difference	-0.038		0.016		+	0.053**	
IV	Earnings	0.004		-0.026			-0.030	
	ROI	0.010		0.034			0.024	
	Difference	0.006		0.060		+	0.054*	
V	Earnings	0.020		-0.012			-0.032*	
	ROI > CC	0.016		0.044			0.028	
	Difference	-0.004		0.056		+	0.060*	

Notes. *, **, and *** indicate significance in a one-tailed test, respectively. Investment is defined as investment net of disposition, scaled by beginning period total assets: $INVEST = ((Data128_t + Data129_t) - (Data107)_t) / Data6_{t-1}$. *NEW* is an indicator variable that is set to 1 when the observation is from the period when the firm uses RI, and zero otherwise. *RET* is an indicator value that is set to 1 if the firm switches from ROI-based compensation, and zero otherwise. Specification I includes no control variables, II includes the control variables included in Wallace (1997), III includes all control variables defined in the appendix, IV uses $\Delta INVEST$ less the corresponding change in investment in a control firm as the dependent variable, and V redefines *RET* to take the value of 1 if the firm both switches from ROI and has prior period returns that are higher than its weighted average cost of capital.

classification used in Table 1, Panel B). The use of the regression-based approach could potentially be affected by heteroscedastic error terms because the approach assumes a common variance for all observations. A White test (White 1980) fails to reject the null hypothesis that the error terms are homoscedastic in the regressions presented.

In addition to economy- and industry-wide trends, there may be some firm-specific activity other than RI implementation that yields the same pattern of results. This possibility is examined by looking at the association between RI implementation and R&D expenditures. R&D expenditures provide an interesting benchmark for comparison because under GAAP accounting, earnings, ROI, and RI are all decreasing in R&D expenditures, so the implementation of RI is not expected to affect firms' R&D spending decisions.¹³ I find that the implementation of RI is not

associated with changes in R&D expenditures either in the pooled sample specification as in Table 5, or in a differences in specification as in Table 6, providing additional corroborating evidence that the changes observed are associated with the implementation of RI and not with other concurrent firm-specific activity.

Overall, the tests of delivered RI and investment are consistent with the hypotheses presented in §2. These results are robust to the inclusion of control variables and are not likely to be the result of firm-specific or industry- or economy-wide artifacts that affect the research design.

5. Conclusion and Discussion

This paper examines whether the investment of firms using RI was different between firms switching to RI from earnings-based and firms switching to RI from ROI-based compensation plans. Table 5 documents an increase in delivered RI in the pooled sample as predicted. Table 6 documents that the change in investment between subsamples is opposite as predicted. Tables 5 and 6 are consistent with the notion that "you get what you pay for," and demonstrate the empirical relevance of a set of concepts that have been in

¹³ Stern Stewart advocates making a series of adjustments to GAAP accounting, including capitalizing R&D expenditures. The main tests of this paper included a specification that controls for whether the implementing firm was a Stewart client.

accounting textbooks since the mid-1960s. These concepts continue to be included in current textbooks and are commonly taught to undergraduate and graduate MBA students. The hypotheses and tests conducted in this paper provide the first empirical evidence consistent with these long-held concepts. Further, these results show how the expected differences between firms switching to RI from ROI and firms switching to RI from earnings can be used to construct more powerful and robust tests of the overall effects of implementing RI.

It is important to note, however, that there are limitations to be considered when examining and interpreting the results of this study. First, the implementation of RI is associated with overall improvements in delivered residual income and with different patterns of investment depending on the prior performance measurement regime from which firms switched. However, it is inappropriate to generalize that the patterns observed in this sample would occur for any randomly selected firm. Academics and practitioners are urged to avoid interpreting the findings presented to argue *for or against* the value of RI implementation.

Second, it is important to be mindful of the implications of self-selection in the interpretation of test results even within the sample of RI implementing firms. First, there may be some factor associated with that choice of RI that could also be associated with the observed results. Although the study explicitly controls for some factors that may be associated with choosing RI such as growth opportunities, there remains much that is not known about the process by which firms select RI-based compensation. To the extent that unknown factors are associated with changes in delivered RI the results presented are affected by an omitted-correlated variable bias. The omitted variable problem, however, cannot affect the between sample results if the omitted factor is the same for firms switching from ROI-versus earnings-based compensation. The research design used in this paper uses the prior compensation regime as a partition to examine a natural experiment, so potential effects of omitted factors are differenced out in the between sample result.¹⁴ In order for an omitted selection factor to affect the between sample result, the factor itself must be different for firms that switched from ROI- versus earnings-based compensation. The extant literature

does not provide us with any theory to identify such a factor.

Third, this paper has interpreted the results presented in terms of whether “you get what you pay for” instead of “you pay for what you expect to get.” The statistical associations documented in this paper could be interpreted both ways, and it is rarely possible to disentangle these two interpretations. Prior literature has interpreted the associations observed with the phrase “you get what you pay for.” Because RI use as a performance measure to create incentives and *influence* managerial actions, it seems intuitive to say “you pay for what you expect to get” rather than the other way around. However, as a purely empirical matter, we cannot infer causality in either direction from statistical associations as documented in this paper.

Subject to the above caveat, this paper examines the question, “Do you get what you pay for?” in the context of RI. This paper documents that RI-based compensation contracts affect investment in ways that are consistent with classic textbook arguments. Related theory (Rogerson 1997, Reichelstein 1997, Dutta and Reichelstein 2002) suggests that RI-based contracting is optimal given appropriate accrual accounting choices. This paper does not make any assumption about the optimality of RI-based contracting and it does not test the optimality of RI-based compensation. It does provide evidence that RI affects real management actions, a necessary condition for assessing the optimality of those actions.

Given the results of this paper, the limitations above suggest two fruitful avenues for future research: first, investigating the optimality of a firm’s investment decisions under alternative performance measurement and compensation schemes and second, investigating the choice and timing of RI implementation.

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¹⁴ An analogy that is useful in thinking about the natural experiment in this paper is to consider measuring the height of a ship in water. The problem is that the ship’s height will be affected by, among other things, the tide. However, if we examine the difference in height between two ships in the same body of water, we can reliably measure the difference regardless of tide at any point in time.

Appendix. Definitions of Variables

Dependent variable	Description ¹⁵	Source
<i>INVEST</i>	Investment net of disposition, scaled by the beginning of period total assets: $((\text{Data128}_t + \text{Data129}_t) - (\text{Data107}_t)) / \text{Data6}_{t-1}$	Compustat
RI	Net operating profit after tax less a charge for capital employed: $(\text{Data18} + \text{Data15} * (1 - 0.35)) - (0.12 * \text{Data37})$	Compustat
Regime indicator	Definition	Source
<i>NEW</i>	Indicator variable set to 1 if the observation(s) are from the period after RI implementation, and zero otherwise	Firm proxy statements
<i>RET</i>	Indicator variable set to 1 if the firm switched to RI from ROI, and 0 otherwise	Firm proxy statements
<i>NEW * RET</i>	Product of <i>NEW</i> and <i>RET</i> as described above	Firm proxy statements
Control variable	Definition	Source
LEVERAGE	Period average assets divided by period average book value of equity: $((\text{Data6}_t + \text{Data6}_{t-1}) / 2) / ((\text{Data216}_t + \text{Data216}_{t-1}) / 2)$	Compustat
Δ LEVERAGE	Change in leverage, defined above	Compustat
OWNERSHIP	Percentage of the firm's equity owned by management and the board of directors as a group	Firm proxy statements
Δ EMPLOYEE	Change in the number of employees: $(\text{Data29}_t - \text{Data29}_{t-1})$	Compustat
B/M	Ratio of the book value of equity to the market value of equity: $\text{Data216}_t / (\text{Data24}_t * \text{Data25}_t)$	Compustat
SALES	Annual revenues as reported in the income statement: Data12_t	Compustat
SALESGRTH	Change in sales over the preceding year	Compustat
AD/GPPE	Total accumulated depreciation divided by the gross book value of property plant and equipment: $\text{Data196}_t / \text{Data67}_t$	Compustat
STSTEWART	Indicator set to 1 if the firm is using EVA tm , a trademark of Stern Stewart company, the consulting firm commonly associated with RI in the business press	Firm proxy statements
SUBJECT	Indicator set to 1 if the firm allows subjective judgment in the awarding of bonuses	Firm proxy statements
MULTIYR	Indicator set to 1 if the firm implements a "bonus bank" or uses RI in a long-term incentive plan	Firm proxy statements

¹⁵Data items of the form DataXXX refer to the data item in the Compustat annual file (i.e., D6 is total assets in Compustat).

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