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PREVIEW

REVISION OF ANALYSTS' FORECASTS IN RESPONSE TO  
CHANGES IN RESEARCH AND DEVELOPMENT EXPENDITURES

by

Ann B. Hendricks

A DISSERTATION

Presented to the Faculty of  
The Graduate College at the University of Nebraska  
In Partial Fulfillment of Requirements  
For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Business (Accountancy)

Under the Supervision of Professor Thomas E. Balke

Lincoln, Nebraska

December, 1999

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PREVIEW

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DISSERTATION TITLE

Revision of Analysts' Forecasts in Response to Changes in

Research and Development Expenditures

BY

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GRADUATE COLLEGE  
UNIVERSITY OF NEBRASKA

REVISION OF ANALYSTS' FORECASTS IN RESPONSE TO  
CHANGES IN RESEARCH AND DEVELOPMENT EXPENDITURES

Ann B. Hendricks, Ph.D.

University of Nebraska, 1999

Advisor: Thomas E. Balke

This study investigated the possibility that unexpected changes in expenditures on research and development might influence individuals' investing decisions. If the study can show that R&D spending changes are noticed, this information could be useful in analyzing the process involved in making market choices. Firms from several research-intensive industries were included and the industries were ranked according to the benefits derived over time from R&D spending. Firms that were members of highly ranked industries were expected to be noticed more readily by financial analysts when R&D spending patterns changed. Analysts' forecasts would be revised to a greater extent for these firms in which research has higher returns than for firms in industries in which research activity is not as profitable. If this contention is supported by the study, additional information would be available to individual firms and to government sources of R&D funding as to the ranking of industries in terms of research productivity. This knowledge would contribute to the

effectiveness of resource allocation in generating useful innovations.

Separate tests were conducted on each industry group and for the sample as a whole to determine whether there exists a significant relationship between unexpected change in R&D spending and revision of analysts' forecasts. Unfortunately, this study was unable to demonstrate such a relationship for any of the industries or for the entire sample of firms. It is possible that some support for the hypothesized relationship might be gained through the use of a better source of data (to enhance the precision of measurement of the variables), larger sample sizes (to increase the degree to which the firms represent their industries), and by expanding the time period from a single year to several years. This study used 1996 as the base year, and this particular year could have been uninteresting to analysts because R&D spending changes were small or not unexpected.

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PREVIEW



## TABLE OF CONTENTS

### ABSTRACT

	Page
LIST OF TABLES	iv
LIST OF APPENDICES	v
Chapter	
I. INTRODUCTION	1
1.1 The Research Question	1
1.2 The Method of Study	3
1.3 Contributions of the Study	4
1.4 Limitations	8
1.5 Organization of the Study	10
II. REVIEW OF RELEVANT LITERATURE	11
2.1 Studies Dealing with Research and Development	11
2.1.1 Relationship Between R&D and Accounting Profitability	12
2.1.2 Relationship Between R&D and Market Value	13
2.1.3 Fundamental Analysis and R&D	17
2.1.4 Interpretation of Causality Links	19
2.1.5 Disincentives to R&D Spending	21
2.2 Studies Dealing with Analysts' Forecasts	24
2.2.1 Analysts' Forecasts and Investors' Expectations	25
2.2.2 Accuracy and Bias	28
2.2.3 Components of Analysts' Information Set	30

III. THEORETICAL FRAMEWORK AND HYPOTHESES	39
3.1 Formation of Investors' Expectations	39
3.1.1 Rational Expectations Hypothesis	39
3.1.2 Usefulness of Analysts' Earnings Forecasts	41
3.2 Incorporation of R&D Information Into Forecasts	44
3.2.1 Association with Profitability and Market Value	44
3.2.2 Interpretation of the R&D Signal	45
3.2.3 Investment Value of R&D	47
3.3 Theoretical Model	49
3.4 Testable Model and Hypotheses	51
IV. RESEARCH DESIGN AND RESULTS OF EMPIRICAL TESTS	54
4.1 Variable Definitions	54
4.1.1 Investment Value of Research and Development	57
4.1.2 Unexpected Change in R&D Expenditures	61
4.1.3 Forecast Revision	64
4.1.4 Control Variables	65
4.2 Sample Selection	70
4.3 Descriptive Statistics	72
4.4 Empirical Analyses and Results	85
4.4.1 R&D Investment Value	86
4.4.2 Sign Test	89
4.4.3 Forecast Revision Regressions	91
4.5 Almon Lag Method	94

<b>V. IMPLICATIONS OF THE RESULTS AND SUGGESTIONS FOR FUTURE RESEARCH</b>	<b>98</b>
<b>5.1 Implications of the Results</b>	<b>98</b>
5.1.1 Issues Involving R&D Expenditures	99
5.1.2 Timing of the Forecasts	100
5.1.3 Effects of the Control Variables Chosen	100
<b>5.2 Suggestions for Future Research</b>	<b>101</b>
<b>ENDNOTES</b>	<b>107</b>
<b>REFERENCES</b>	<b>112</b>
<b>APPENDICES</b>	<b>127</b>

## LIST OF TABLES

Table		Page
1	Empirical studies examining the relationship between R&D investment and return on R&D capital.	14
2	Studies demonstrating a positive relationship between innovative activity and market value.	15
3	Length of time over which profit effects are derived from R&D expenditures.	24
4	Variables tested for association with analysts' annual earnings forecast formation and revision.	32
5	Sources and definitions for required data.	54
6	Descriptive statistics for variables used in the earnings equation estimation and the valuation equation estimation.	74
7	Descriptive statistics for variables used in the estimation of the regression model.	83
8	Results of the estimation of R&D investment value for the industry groups.	87
9	Results of the sign test: percentage of positive long-term forecast revisions following disclosure of the actual annual earnings amount for year t.	90
10	Results of the regression of analysts' forecast revision on R&D spending change and the control variables.	93
11	Coefficients estimated through use of the Almon lag method.	96
12	Summaries of the results of a sample of studies investigating the relationship between firm size and innovation.	103

## LIST OF APPENDICES

Appendix		Page
A	Rationale for modification of the variable used to control for profitability.	127
B	Summary of the Almon lag procedure.	129

PREVIEW

## CHAPTER I

### INTRODUCTION

#### 1.1 The Research Question

Although research and development (R&D) activities have been shown to be associated with profit potential<sup>1</sup>, the role of R&D as a factor considered by market professionals in forming expectations of future firm value has received limited attention. Studies of revision in analysts' forecasts have centered on the effect of earnings disclosures<sup>2</sup>, but the impact of nonearnings information on the formation and revision of forecasts has not been characterized fully<sup>3</sup>. Individual firms vary in the degree to which they exhibit effective innovative behavior. Because of this diversity, consideration of R&D spending by financial analysts may depend upon the context within which the firm operates. An understanding of the parameters that influence analyst responsiveness to particular nonearnings information, such as R&D spending, provides insights into the importance that market participants attach to these variables.

There is general support for the contention that R&D contributes to the market value of the firm<sup>4</sup> despite the additional risk that results from the intangible nature of the investment and the uncertain outcome (Grabowsky and Mueller, 1978). Benefits flowing from research effort

typically lag behind investment by several years, and, as a result, an unexpected change in R&D expenditures may function as a signal of a change in firm profitability that will be realized in future years. If market participants view this signal as a relatively significant indicator of future prospects, adjustments in earnings forecasts will result. In an environment in which the information value of changes in R&D investment depends upon the importance of such activity to the firm, investors' assessments may be more sensitive to spending changes as the firm's dependence on R&D increases. A possible key issue in studying investors' reaction to R&D change is the determination of the importance of R&D, and the identification of groups of firms for which R&D spending is likely to have high investment value.

The purpose of the study is to extend research on the decision process applied by investors to the adjustment of earnings expectations, using financial analysts' forecasts as a proxy for investors' expectations. Specifically, the study tests the response of analysts' forecasts to changes in one of the firm's productive tools, R&D expenditures. Because the benefits accruing from innovative effort may not be related directly to expenditures, the relationship is tested within the context of the significance of R&D activity to the firm's operations, using a measure of the investment value of R&D developed by Sougiannis (1994).

While the major focus of the study is forecast responsiveness to information concerning R&D, effort is also directed toward defining the boundaries within which such a relationship might exist.

## 1.2 The Method of Study

The present study is an evaluation of R&D expenditure information as an indicator of future firm value. Empirical analyses are designed to test the following proposition: if R&D expenditure information is a credible signal of future profitability, changes in R&D spending will be significantly related to revisions in analysts' earnings forecasts.

Market participants make investment decisions within the framework of the rational expectations hypothesis. All available relevant information is considered in forming estimates of future firm value, but these estimates are subject to revision upon the arrival of new information. If changes in R&D expenditures are useful to investors as significant signals of future earnings, the rational expectations hypothesis predicts that earnings forecasts will respond to R&D information. Numerous elements of information, weighted according to their relative importance to the individual firm, constitute input to the process of forecast formation and revision. The adaptive response to R&D spending changes should be greater for earnings forecasts of firms for which R&D activity is a significant



focus of operations.

The approach used to define the importance of R&D is the market's valuation of investment in R&D, *i.e.*, the total expected future return to each dollar spent on R&D. The efficiency and effectiveness of innovative effort is not necessarily constant across all firms, due to differences in human resource talent, compensation incentives, computing technology, physical facilities, and private information. The importance of R&D effort is relatively greater for firms in which higher return on the R&D dollar is expected. This approach, which involves the determination of the investment value of R&D spending, has been used as a method for quantifying the importance of R&D (Lev and Sougiannis, 1996; Sougiannis, 1994).

### 1.3 Contributions of the Study

R&D activity consumes enormous resources. In the United States, R&D spending increased steadily over the period from 1975 to 1990, with record levels set in each of those years (Jensen, 1993). In 1995, total U.S. spending on R&D was \$171 billion, 44% of the world's research effort (Wysocki, 1996). For manufacturing firms engaged in R&D, total R&D funds averaged 4.2 percent of net sales in 1992, and constituted 2% of gross domestic product (U.S. Bureau of the Census, 1995). Both private and public sectors are involved in the research effort. In 1994, almost one-fifth

of the funding for industrial R&D came from federal monies, and industry provided \$2.25 billion for research conducted at universities and nonprofit institutions.

Innovation has been characterized as a significant factor in productivity growth in the economy ("the engine of economic growth and development" [Chaney, Devinney, and Winer, 1991]; "the main agent of change" [Lev, 1995]). Research activity resulting from both public and private funding is often accompanied by significant social benefits and improvements in general welfare (Cohen and Levin, 1989). This positive effect on productivity can also be demonstrated at the industry level where breakthroughs are transmitted from one industry to another by "spillovers" (Bernstein & Nadiri, 1988). At the level of the individual firm, R&D may be critical to the firm's survival and future profitability, especially in industries in which competitive advantage lies in innovative capability. For example, in the pharmaceutical industry, the average life expectancy of new formulations is only five years (Ferguson and Ferguson, 1994), and each drug firm must keep pace with competitors that are constantly improving the efficacy of pharmacological products.

The first objective of the present study is to investigate the importance market participants attach to R&D spending, and to increase our awareness of the factors that enhance efficient allocation of research effort along both

private and social dimensions. With greater understanding of contextual issues which contribute to the effective use of R&D funding and the promotion of innovative synergy, policy-makers and managers can make better decisions regarding research initiatives (Kamien and Schwartz, 1975). These decisions have implications with regard to tax incentives, competition policy, and structural relationships within the firm (Bernstein and Nadiri, 1988).

The second objective of the study is to gain a better understanding of the process used by market participants in forming projections of firm value. Earnings predictions and the processes through which they are generated are important areas of study (Schipper, 1991; Givoly and Lakonishok, 1984). Extensive research has been conducted in the investigation of the relationship between earnings information and forecast revision<sup>5</sup>. However, questions have been raised regarding the impact of nonearnings financial statement information (Zmijewsky, 1993; Givoly, 1985) and macroeconomic and/or industry change (Brown, 1993) on analysts' decisions.

An examination of the relationship between R&D spending and forecast revision contributes to our knowledge of whether investors use R&D information in forming decisions about investment opportunities. R&D activity may be influenced by macroeconomic factors (for example, interest rate fluctuations may affect funding availability), and by

industry effects (such as technological breakthroughs), as well as by opportunities unique to the individual firm. As a result, links between R&D and forecast revision may exist on several dimensions. This study is designed to investigate further the rationality of earnings projections based on a richer information set, one that supplements past earnings information with changes in R&D activity. The results of such an investigation may also provide insight for particular firms or industries in regard to the impact that change in R&D spending may have on future stock price.

The application of the methodology introduced by Sougiannis (1994) to a practical question in accounting provides a third contribution. The objective of Sougiannis' work was the development of a measure of investors' perceptions as to the future benefits of R&D expenditures, i.e., the expected innovative effectiveness (in terms of market return) of past and current R&D efforts. The application of this method as proposed in this paper may reinforce Sougiannis' contention that accounting numbers are useful in determining the market value of innovation.

Sougiannis' measure of investment value has the potential to be a better proxy of the effectiveness of R&D effort than those inputs and outputs to the research process that are commonly used in R&D studies (e.g., R&D spending as a percentage of sales, number of innovations, number of patents, etc.), which are often only weakly associated with

research quality. Pakes (1985) notes the problems involved in finding meaningful measures of inventiveness. The use of Sougiannis' methodology in this study provides additional background for future assessment of the method's value in quantifying the benefits of R&D activity. If this approach proves useful in indicating the economic benefits of R&D, its application in future research may enhance our understanding of the factors that stimulate innovation.

#### 1.4 Limitations

As is true of all research involving sampling and unobservable constructs, this study is subject to limitations, particularly with regard to external validity and measurement error. These limitations should be kept in mind when drawing inferences regarding the hypothesized relationships.

This study uses a subset of all firms, biased toward large firms with records of survival long enough for the firms to be included on Compustat. The requirement that earnings forecasts be available on Value Line leads to the possible perpetuation in the sample of any biases present in Value Line inclusion decisions. As a result, the findings presented here may not be generalizable beyond the sample of firms used in this study.

Measurement problems are common when dealing with unobservable attributes, as proxies rarely represent perfect

reflections of the constructs in question. In this study, both innovative activity and investors' expectations are unobservable, and the proxies used in place of these variables are R&D expenditures and analysts' earnings forecasts, respectively. Because of firm differences with regard to R&D measurement issues<sup>6</sup>, these proxies are not error-free representations of the underlying constructs. A second measurement problem concerns the possible omission of certain variables from the set of control variables which may affect the observed relationship between innovation and forecast revision. If the measurement error produced by either the use of the selected proxies or the failure to include additional control variables is important, conclusions regarding the hypothesized relationships may not be valid.

One popular stream of research in regard to the disclosure of R&D expenditures involves the controversy over how these expenditures should be reported, *i.e.*, whether R&D costs should be expensed in the current period or capitalized on the balance sheet as an asset and amortized over a number of years.<sup>7</sup> The present study does not focus on this question, but takes as given the disclosure rules of the Financial Accounting Standards Board (1974) as provided in SFAS No. 2 (R&D costs are expensed in the period in which they are incurred).

### 1.5 Organization of the Study

The remainder of the study is organized as follows. A review of literature in Chapter II initially describes the relationship between R&D activity and future firm value, and subsequently examines the process of formation/revision of analysts' forecasts. Chapter III presents the rational expectations hypothesis as it is applied to forecast revision, theoretical arguments supporting consideration of the importance of R&D as a contextual factor, the testable model, and the hypotheses considered in the study. Elements of the research design, including the variable definitions, data sources, and empirical analyses, are presented in Chapter IV. This chapter also presents the results of the empirical tests. The final chapter suggests possible implications of the findings and discusses potential directions for future research.

## CHAPTER II

### REVIEW OF RELEVANT LITERATURE

#### 2.1 Studies Dealing with Research and Development

If investors consider research activity to be relevant to the value of the firm, then changes in the expenditure levels of R&D would prompt re-evaluation of investors' expectations concerning future benefits derived from innovation. When firms spend relatively more on R&D, this increase in investment signals investors that current dividend payoffs have been foregone in favor of higher future returns (Chaney, et al., 1991). Investors anticipate that increased commitment to research effort in the present will translate into future earnings and cash flows (Lev and Sougiannis, 1996; Jose, Nichols, and Stevens, 1986).

Investment in R&D enhances firm value in several ways. In a general sense, R&D activity is expected to confer a competitive advantage (Mansfield, 1968; Baily, 1972) to firms willing to spend nontrivial amounts of their net income on innovative activity. Firms with significant R&D effort are more likely to modify existing products and to develop new product lines, often taking advantage of the lead time they achieve before competitors can imitate the innovation. With sufficient investment in R&D, research-oriented firms create economies of scale due to the