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SHAREHOLDERS, MANAGERS, AND CORPORATE R&D SPENDING: AN AGENCY COST MODEL

Steven S. Cherensky†

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ABSTRACT

Although the tendency of American corporations to decrease rates of research and development (R&D) investment in recent years has been noted by academic commentators, government officials, and the popular press, far less attention has been focused on the underlying causes for this underinvestment. Some blame has been laid at the feet of shortsighted shareholders who demand short term profits at the

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expense of long-term investments, and on the wave of corporate restructurings of the 1980s said to be motivated by such short-term thinking. This article, however, looks at the theory and data of corporate R&D spending, and determines that the "myopic investor" model is seriously flawed. An alternative explanation for corporate underinvestment in R&D is proposed, based on the divergence of interests between shareholders and managers, or "agency costs." This agency cost model suggests that while shareholders—at least fully diversified shareholders—prefer a high level of R&D investment, such investment is not in the best interests of corporate managers. The agency cost model is supported, and the "myopic investor" model refuted, by the empirical data discussed in the article. The choice of a model explaining corporate underinvestment in R&D is, of course, more than an academic question. An accurate model must form the basis for any effective governmental efforts aimed at increasing private R&D spending. The article looks at corporate restructuring as an example of the importance of the predictive ability of models. If the "myopic investor" model is correct, then corporate restructurings will harm R&D spending, and should be discouraged by measures such as anti-takeover legislation. If, however, agency costs are to blame, then restructurings, which tend to reduce agency costs by displacing entrenched managers, ought not to be discouraged.

INTRODUCTION

In his influential and insightful commentary, Dean Robert Clark described the evolution of the American capitalism over the last two hundred years as comprising four distinct stages driven by the increased specialization of the providers of capital: the age of entrepreneurs (or "robber barons," depending on one's perspective),¹ the age of professional managers,² the age of portfolio managers,³ and the age

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². Clark, supra note 1, at 563. As business enterprises grew in the beginning of the twentieth century, they required ever-increasing amounts of capital—more, even, than the wealthy owners of firms could provide. Thus, the second stage was characterized by the publicly held corporation, which divided the role played by entrepreneurs in the first stage into an ownership function and a professional management function. Id.
of the savings planner (or, in the phraseology of this article, the indexed investor). A similar transformation has been observed in corporate governance, fueled by the tension between shareholders and managers. This transformation is characterized by the transition, still underway, from shareholder primacy, to periods of managerial capitalism, monitored management, insulated manegerialism, and ultimately, to long-term shareholders. This article focuses on the nexus of these transformations in capitalism and corporate governance and how they have affected the level of corporate investment in research and development (R&D). More specifically, this article examines the divergent and evolving interests of shareholders and managers in R&D investment and seeks to explain why American corporations appear to invest less in R&D than shareholders (or citizens) might prefer.

The value of corporate R&D spending, both for the investing firm\(^6\) and for society,\(^7\) is beyond dispute. However, most commentators agree that American firms underinvest in R&D, relative to our international competitors.\(^8\) Several explanations have been offered for this relative underinvestment, such as the high cost of capital in the United States caused, at least in part, by the differential tax treatment

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3. *Id.* at 564. By the mid-twentieth century, the control of capital had largely shifted from wealthy households to financial institutions. In the third stage, the ownership function was divided again, this time between capital-supplying and investing. Those supplying the capital are shareholders, and those making the investment (or at least, making the investing decisions) are professional portfolio managers. *Id.*

4. *Id.* at 565. The fourth stage, which in 1981 was "barely discernible in its infancy," is in full flower in 1994. This stage, fueled by the rapid growth of public and private pension funds and diversifed mutual funds, is characterized by indexed and quasi-indexed investment, necessitated by the huge sums of money under management. Ironically, to a great extent, the decision of how to invest is eliminated in the fourth stage, replaced by the decision of whether to invest. *Id.* at 565-67. This is why the savings planner is really an indexed investor.

As Dean Clark notes, there is considerable overlap among the stages, and all four stages may be represented in the economy at any given time. *Id.* at 562.


6. See, e.g., Anthony J. Parisi, *How R&D Spending Pays Off*, BUS. WK.: INNOVATION 1989, 177, 178 (Special Issue, 1990) (reporting the results of a study demonstrating that companies with the strongest performance in their markets are also those that spend the most, relative to their size, on R&D).


8. See, e.g, *supra* note 7.
of debt and equity, and the fear of product liability lawsuits. Perhaps the most popular explanation for corporate underinvestment in R&D is premised on the existence of shareholder "myopia" or short-sightedness. This myopia may take several forms. Shareholders, particularly the institutional investors who make up an increasing percentage of firm ownership, are "short-term" oriented, more interested in this quarter's bottom line than in R&D investments that may take years to pay off. Second, shareholders are disinclined towards R&D, relative to other long term investments, such as plant and equipment, because the returns are more difficult to appropriate.

Shareholder or investor myopia, the popular argument follows, induces management myopia. Managers adopt the myopic perspective of their shareholders by underinvesting in R&D. This underinvestment is due, at least in part, to managers' concern that poor short-term returns will depress stock prices, upsetting shareholders, and placing managerial positions at risk, either directly (through boards of directors acting in response to shareholder dissatisfaction)


11. See, e.g., McKinnon & Robinson, supra note 9, at 281-82 (noting shrinking time horizons and preoccupation with short-term profits in American industry).

12. That is, the benefits, if any, that accrue from any given R&D investment may be shared with other non-investing firms. For example, the video cassette recorder was invented at Ampex Corporation, but this firm has seen little of the huge profits that VCRs have generated for other firms. See America's Empire Strikes Back, ECONOMIST, Feb. 22, 1992, at 51 ("The Japanese did not invent the VCR—Ampex, a California firm, did so in 1961. Yet Matsushita, JVC, Sony, Hitachi, Mitsubishi, Sharp and half a dozen others simply out-developed, out-produced, out-marketed and finally out-lasting their American rivals."). See also John Holusha, The Risk for High Tech, When Non-Techies Take Over, N.Y. TIMES, Sept. 5, 1993, § 3, at 7 (noting that Xerox Corporation's Palo Alto Research Center developed the computer mouse and user interfaces now in common use, but the benefits were reaped primarily by other companies such as Apple and Microsoft).


14. Recent events at IBM, GM, American Express, and Westinghouse, among others, make this threat more palpable than ever. But see Stuart Mieher, Weak Force: Shareholder Activism, Despite Hoopla, Leaves Most CEOs Unscathed, WALL ST. J., May 24, 1993, at A1 (discounting the effects of shareholder activism at all but the largest corporations).
or indirectly (through hostile takeover attempts.) Short-term financial performance is improved by cutting R&D spending, since accounting procedures require that R&D spending be expensed in the period incurred, while the benefits of such spending may take years to realize.

The myopic market has considerable intuitive appeal as an explanation for corporate underinvestment in R&D, but suffers a serious drawback: it is not well-grounded in either theory or fact. This article attacks the myopic market explanation and offers an alternative explanation based upon agency costs.

Data indicates that shareholders are not, in fact, myopic when R&D is concerned—indeed, they favor it. Share prices reflect not only a firm’s current earnings, but its future earnings potential discounted to present value. Future earnings potential depends, to a large extent upon a firm’s R&D efforts. It will be argued here that managers underinvest in R&D not to placate shareholder concerns but rather in their own (or at least, their own perceived) self-interest.

Unlike a shareholder, whose utility is maximized by maximizing share prices, a manager’s utility is more dependent upon such factors as job security and her firm’s latest quarterly results, factors that mitigate against risky, long-term R&D investments. Shareholders and managers thus have divergent interests with respect to R&D investment. Such conflicting interests are characterized in the economic and legal literature as agency costs—costs associated with organizing business structures in the form of principal-agent relationships.

Of course, agency costs will attach to virtually any corporate activity where shareholders delegate responsibility to others—directors, managers, or employees—and there is a burgeoning literature offering

15. See, e.g., Stein, supra note 13.
18. See, e.g., Parisi, supra note 6, at 178.
21. The problem may be more one of astigmatism (that is, a form of distorted perception) than myopia (nearsightedness).
22. An agent is a person who by mutual assent acts on behalf of another and subject to the other’s control. Restatement (Second) of Agency, § 1 (1958). The person for whom the agent acts is a principal. Id.
Agency costs in the corporate R&D context differ, however, from other aspects of corporate life in several important respects. This article examines agency costs in corporate R&D activities from a theoretical perspective, discusses why these agency costs are structurally different from other types of corporate agency costs, and explores how an agency cost theory comports with the available empirical data.

Part I of this article presents some background material on corporate research and development. Part II sets forth the basic theoretical background by describing the neoclassical agency theory model of the firm and by developing a second-order agency cost model for corporate R&D investment decisions. Part III tests the basic premises of the model by examining data concerning the relationships between firm size and R&D investments and market reactions to R&D investments, and then uses the model to study the relationship between corporate restructuring and R&D spending. Throughout Part III, the emphasis is on presenting empirical evidence to support theoretical assertions. Finally, this article concludes with a brief exploration of some of the implications of the agency cost model for policymakers seeking to address the R&D underinvestment problem.

The focus of the article is on large, publicly traded corporations with significant R&D efforts. Such firms account for the vast majority of private R&D spending. The theoretical framework discussed here is most applicable to large firms and may not accurately describe smaller firms with, for example, significant owner-management, controlling interests, and venture capital financing.

I. CORPORATE RESEARCH AND DEVELOPMENT

This part of the article provides background information for the subsequent discussion of agency costs and corporate R&D by discussing what R&D is, why firms spend money on it, how firms got into the business of organized R&D, the role of corporations in overall

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American R&D, and recent concerns over the level of corporate R&D investment.

Research and development has several characteristics that are relevant to the discussion below. It is an inherently risky, complex, expensive, and time-consuming activity. Research is said to come in two forms: basic and applied. Basic research is "investigation to gain knowledge for its own sake." Applied research is "investigation directed towards gaining knowledge with specific commercial implications." Development is the "translation of technical and scientific knowledge into concrete new products and processes . . . the lengthy sequence of detail-oriented activities, including trial-and-error testing, through which the original concept is modified and perfected until it is ready for commercial utilization."

The primary reason that corporations invest in R&D is, or at least should be, to increase shareholder wealth. R&D is expected to provide the corporation with improved processes and new and improved products. A 1977 survey of 600 companies, for example, indicated that 59% of corporate R&D was directed toward improving existing products. The costs associated with some types of innovations can be astronomical. Biotechnology is one example. In part because the underlying technology is inherently expensive and in part due to the high degree of regulatory oversight, the cost of introducing a single new biotechnology drug into the market has been estimated to range from $230 to $350 million. See William Neikirk, *Wonders of Technology Could Boost Economy*, Chi. Trib., Feb. 25, 1993, at 1. Semiconductors are another extraordinarily expensive technology to innovate, despite the lack of virtually any regulation. For example, Intel's 80486 microprocessor took 100 engineers three years to design at a cost of $250 million. See Don Clark, *How LSI Gets High-Tech Edge*, S.F. Chron., Dec. 10, 1990, at Cl.

There can be a considerable lag, often many years, between the time of investment and any payoff. Again, biotechnology provides a striking example. It can take 10 years for the FDA to complete its review and approval process. Neikirk, supra note 24. Simply getting a patent is typically a multi-year proposition. For example, a recent LEXIS search revealed that Motorola filed 302 patent applications in 1985 that were approved by the Patent Office as of March, 1993 (the company and year were picked at random). The mean time for patent approval was 2.4 years and several patents took over 5 years for approval. These numbers are typical. Of the 104,000 patent applications filed in the United States in 1980, 65,000 were granted by the end of 1984, 1,400 more by the end of 1988, and 300 or so were expected to follow over the next 3-5 years. Zvi Grilliches, *Patent Statistics as Economic Indicators*, 28 J. Econ. Lit. 1661, 1663 (1990).

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27. Id.

28. Id.


30. For a given firm size, there is a close correlation between the rate of research and development spending and the total number of important inventions. Morton I. Kamien & Nancy L. Schwartz, *Market Structure and Innovation: A Survey*, J. Econ. Lit., Mar. 1975, at 1, 5.
products, 28% toward development of new products, and 13% toward developing new manufacturing processes. Improved processes and new and improved products enable corporations to realize reduced costs, improved quality, and increased market share.

Corporate investment in R&D, then, is expected to generate assets for the corporation in the form of ideas, inventions and innovations. These assets become an important form of property for the investing firm. Perhaps the most important characteristics of ideas and information as corporate property are their "free good" and "public good" attributes. An idea can be used and enjoyed by many people at any given time without depriving other people of use or enjoyment of the idea, and thus have the attributes of an inexhaustible resource, or, in economic terms, a "free good." At the same time, it is difficult to prevent others from using an idea once it has been divulged and thus, like clean air or national defense, ideas have the attributes of a "public good." Therefore, ideas may be utilized by "free riders" who did not share in the cost of producing the information. The fact that competing firms may benefit from a sponsoring firm’s R&D investment is referred to as a "spillover" effect, or as imperfect or weak appropriability.

Private corporations play a large and increasing role in overall American R&D activities. For decades, it was the federal government that financed the lion's share of R&D. But, by 1980, private R&D

32. See Ian Ayres, How Cartels Punish: A Structural Theory of Self-Enforcing Collusion, 87 Colum. L. Rev. 295, 307 n.57 (1987) ("Investments in research and development might be modeled as either increasing the quality of a firm's product or as decreasing a firm's costs.").
34. See Scherer, Innovation and Growth, supra note 29, at 38 (noting that "the consensus among economists would probably be that inventions are better characterized as public goods rather than private goods"). See also Alfonso Gambardella, Competitive Advantages from In-House Scientific Research: The U.S. Pharmaceutical Industry in the 1980s, 21 Res. Pol’y 391 (1992) (noting that science exhibits "public goods" attributes); Richard R. Nelson, What is "Commercial" and What is "Public", in Technology and the Wealth of Nations, supra note 7 at 57, 61 (referring to technology as a "latent public good.").
35. Interestingly (and predictably), however, firms with significant internal R&D efforts are best able to capitalize on the innovations produced. See Gambardella, supra note 34, at 404.
36. See Thomas M. Jorde & David J. Teece, Innovation, Cooperation and Antitrust, 4 High Tech. L.J. 1, 6 n.6 (1989); Ayres, supra note 32, at 307 n.57 (1987) ("To the extent that other firms benefit from the newly discovered information of their rivals, there may be supply-side spillover effects from research and development. The spillover effect in general will result whenever a firm's actions result in public goods upon which its free-riding competitors can benefit.").
37. See Jorde & Teece, supra note 36, at 6.
spending had surpassed government spending.\textsuperscript{38} In 1988, for example, 53.5\% of all United States R&D spending was accounted for by the private sector.\textsuperscript{39} And in 1989, American industry spent $71.77 billion on R&D, compared to $68.72 billion from all other sources, including the federal government.\textsuperscript{40}

The increasing relative contributions of corporations to overall R&D spending raises several concerns. First, American corporations are underinvesting in R&D, especially in comparison with our international competitors, and this underinvestment appears to be worsening.\textsuperscript{41} American R&D spending as a percentage of Gross Domestic Product (GDP) hovered at about 1.5\% from 1971 to 1980 and rose slowly to about 2.0\% by 1989.\textsuperscript{42} Meanwhile, Germany and Japan each spent approximately 2.0\% of GDP on R&D in 1971 and this figure steadily rose to nearly 3.0\% by 1989.\textsuperscript{43}

Perhaps even more alarming than the statistics that show disappointing relative rates of investment are some recent reports of absolute numbers. One recent study has predicted decreased R&D spending by private industry in 1993, particularly with regard to such critical items as new hires, capital spending, and basic research,\textsuperscript{44} while another indicates that, in inflation adjusted dollars, total United States industrial R&D spending peaked in 1989, dropped slightly in 1990, and was projected to fall further in 1992.\textsuperscript{45} Several of

\begin{itemize}
\item \textsuperscript{38} William J. Broad, \textit{Japan Seen Passing U.S. in Research by Industry}, \textit{N.Y. Times}, Feb. 25, 1992, at C1 [hereinafter \textit{Japan Seen Passing U.S.}]. Government spending on research and development takes the form of funding for federal laboratories, universities and colleges, and non-profit institutions, as well as federally financed R&D at for-profit firms. The latter is primarily for goods and services supplied to DOD, NASA, Department of Energy, etc. \textit{See Scherer, INDUSTRIAL MARKET STRUCTURE, supra note 26, at 409.}
\item \textsuperscript{39} \textit{MICHAEL E. PORTER, THE COMPETITIVE ADVANTAGE OF NATIONS} 633 tbl. 12-1 (1990).
\item \textsuperscript{40} \textit{Japan Seen Passing U.S.}, supra note 38, at C1.
\item \textsuperscript{41} \textit{See e.g., Steven Greenhouse, Attention America! Snap Out of It!}, \textit{N.Y. Times}, Feb. 9, 1992, § 3, at 1.
\item \textsuperscript{42} Id. (graphically displaying American, Japanese, and German research and development spending as a percentage of GDP for the last 20 years). \textit{See also Porter, supra note 39, at 693 tbl. 13-1 (displaying similar data for the years 1975 to 1987 in tabular format). Overall American spending on R&D including defense as a percent of GDP lags that in Japan, Germany, and Sweden. Id. at 521.}
\item \textsuperscript{43} Greenhouse, \textit{supra} note 41, § 3, at 1.
\item \textsuperscript{44} William J. Broad, \textit{Companies Cut Research Budgets}, \textit{N.Y. Times}, Nov. 11, 1992, at A21 (reporting on survey by the Industrial Research Institute).
\item \textsuperscript{45} \textit{See William J. Broad, Ridden with Debt, U.S. Companies Cut Funds for Research}, \textit{N.Y. Times}, June 30, 1992, at C1 (reporting findings of the National Science Foundation) [hereinafter, \textit{Ridden with Debt}]. In fact, the numbers may be even worse, since the reported figures for United States R&D spending include amounts spent by foreign firms doing research in the United States. Such research has grown dramatically in recent years, accounting for 6\% of the total in 1980 and for 13\% of the total figure in 1989. \textit{Id. Moreover, adjusting for inflation may underestimate the extent of the decline in corporate investment in R&D. There is evidence...}
\end{itemize}
America's largest industrial corporations have announced or are expected to announce huge reductions in R&D spending. And it appears that Japan, a country with a significantly smaller GDP than the United States, now spends more in absolute terms on industrial R&D.

that the GDP deflator, typically used to adjust R&D spending for inflation, may significantly underestimate the rate of R&D inflation. See Edwin Mansfield et al., R&D Price Indexes and Real R&D Expenditures in the United States, 12 Res. Pol’y 105 (1983). Mansfield, et al. claim that this inflation differential accounted for the bulk of the apparent increase in R&D spending during the 1969-1979 period. Id. at 112. See also Holusha, supra note 12 (describing the “R&D Plateau”—flat or decreased R&D spending in inflation adjusted dollars by corporations and the federal government since 1987).

46. See, e.g., Michael Schrage, Innovation: R&D Realignment, L.A. TIMES, Nov. 19, 1992, at D1 (predicting that General Motors will reduce R&D spending by $1 billion per year, or 25% within 3 years, and IBM will reduce R&D spending by $500 million per year, or 12.5% within 4 years). The R&D picture at IBM appears to be worsening rapidly. See Josh Hyat, IBM to Cut 25,000 Jobs, Pay Out $6B, BOSTON GLOBE, Dec. 16, 1992, at 1 (reporting that IBM planned to cut $1 billion in R&D spending). Then-President-Elect Clinton reacted to this news, commenting that R&D spending was “the exact thing that we don’t want them to be cutting.” Id. The impact of these reductions on overall R&D spending is very significant. General Motors and IBM ranked number 1 and 2, respectively, in total R&D spending by United States firms in 1991. Robert Buderi, R&D Scoreboard: On a Clear Day You Can See Progress, Bus. Wk., June 29, 1992, at 104, 105 (hereinafter 1991 R&D Scoreboard). But see Steve Lohr, High-Tech Goliaths, Taking Pains to Act Small, N.Y. TIMES, Dec. 30, 1992 at D1 (noting that R&D spending by smaller, but faster growing high-tech companies is compensating for spending cuts by large corporations). The different behavior of small and large companies with respect to R&D spending will be examined infra Part III.

47. Japan Seen Passing U.S., supra note 38. The United States government disagrees, claiming that United States industry still spends more, though admits that its lead is diminishing. Id. It is undisputed that large Japanese firms have dominated the lists of top corporate grantees of United States patents in recent years, as indicated in the following chart:

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<td>Hitachi</td>
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The shift from government-financed to privately-financed R&D raises concerns for basic research. Private industry spending on R&D is heavily oriented towards the development end of the spectrum. In 1975, for example, basic research accounted for 3%, applied research for 19%, and development for 78% of all industrial R&D outlays. However, while the contributions of corporations towards overall R&D spending is most heavily felt in the development area, it is by no means insignificant in basic or applied research. “Private industry accounts for approximately 17% of all basic research conducted in the United States, 55% of all applied research, and 85% of all development.” Of particular concern is the fact that the percentage of the private R&D dollars spent on basic research or “breakthrough-oriented R&D” is declining.

The relative contributions of corporations for overall R&D spending is likely to increase in the coming years. Government spending on R&D is heavily oriented toward defense (68% in 1988), and even that has not kept up with inflation. Continuing fiscal pressure on the federal government combined with decreasing emphasis on defense spending will likely decrease federal research spending in absolute terms and increase the R&D spending of corporations rela-

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49. Id.
50. See id. at 266 (noting that RCA and DuPont have announced sharp reductions in breakthrough-oriented R&D). See also Nelkirk, supra note 24 (noting that “U.S. industrial research and development spending by corporations aimed at spurring new technology rose a meager 0.4 percent a year from 1985 to 1991, compared with 7.5 percent annually from 1980 to 1985,” citing the National Science Board); Robert Buderi, A Tighter Focus for R&D, Bus. Wk. (special issue: Quality 1991) 169, 171 (noting that United States corporations have shifted their spending focus “from the R to the D”).
52. Id.
53. The recent reduction in funding of the NASA space station and the defunding of the superconducting supercollider in Texas are prominent examples of this decreasing emphasis. See, e.g., High-Tech Dollars, Wash. Post, Feb. 11, 1994, at A11 (noting the tightening federal spending on basic research); Clifford Krauss, Deficit Taking Toll on Lawmaker’s Dreams of Big-Science Projects, N.Y. Times, June 28, 1993, at A13.
tive to government spending in the future. It is true that American high-technology industries are prospering today. The United States, for example, exports in excess of $35 billion more per year in high technology products than it imports. But R&D investments take a notoriously long time to pay off. Today's high-technology trade surplus is a result of investments made in the 1970s and early 1980s, when the United States was the clear world leader in R&D spending. Corporate investment decisions made today will impact Americans' quality of life ten and twenty years down the road.

II. AN AGENCY COST MODEL OF CORPORATE R&D SPENDING

A. An Agency Cost Model of the Firm

Part I, supra, discussed the nature of research and development, how corporations became involved, and eventually came to dominate research and development, and the fact that in recent years United States firms increasingly seem to underinvest in research and development. The remainder of this article examines corporate theory as an explanation for this underinvestment. This part provides the initial theoretical foundation by examining one model of the firm—the agency cost model. This model will form the basis for the remaining discussion of the theory and empirical data concerning firm-financed R&D activities.

The classical model of the firm viewed the corporation as a mere manifestation or extension of its owners. Because large firms required large amounts of capital, many "owners" were required for each firm. Because it was impractical and inefficient for these owners to make day-to-day operational decisions for the firm, the owners (the "principals") delegated this responsibility to professional managers (the "agents"). Despite this delegation of operational decision-making, classical theory understood the firm to be controlled

54. This trend will put us more in line with our international competitors. For example, in Japan in 1986 78.8% of research and development spending was accounted for by the private sector and only 3.5% of government R&D spending was defense-related. In Germany in 1987, the numbers were 59.1% and 12.5%, respectively. PORTER, supra note 39, at 633 tbl. 12-1.
56. See, e.g., Anthony Flint, Nobels Aside, Scholars See Perils for U.S. Research, BOSTON GLOBE, Oct. 15, 1993, at 1 (noting concern in academic community that Nobel prizes awarded United States scientists in the 1990s are for work performed in the 1970s, when government spending on R&D was more generous).
57. See note 1, supra.
58. See note 2, supra.
59. Id.
collectively by active, interested, informed shareholders rather than by managers. Berle and Means explored this model in the wake of the stock market crash of 1929 in their extraordinarily influential work, The Modern Corporation and Private Property. The Berle and Means "neoclassical" model, expanded upon in recent years by commentators such as Alchian, Demsetz, Fama, Jensen and Meckling, views the separation of ownership and control as the paradigmatic characteristic of the modern large firm. Modern industrial firms require huge amounts of capital. This capital is collected from large numbers of shareholders, each of whom typically holds only a minuscule percentage of the outstanding shares of the corporation. Ownership of the corporation is thus atomized (or at least severely fragmented), and individual shareholders' votes and voices are diminished. Shareholders then hold their shares as passive investments while the firm's management exercises effective control over the corporation.

Separation of ownership and control can, of course, be an efficient organizational paradigm. The flourishing of large corporations in the post Berle and Means period is testament to this efficiency. The conducting of a firm's business through an agency relationship is not

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63. It may be more accurate to state the paradigm as "separation of the decision and risk bearing functions." See Fama & Jensen, supra note 62, at 301.


65. See, e.g., EASTERBROOK & FISCHER, supra note 17, at 82.

66. See Mark J. Roe, A Political Theory of American Corporate Finance, 91 COLUM. L. REV. 1, 12 (1991); see also EASTERBROOK & FISCHER, supra note 17, at 11:

The separation of risk bearing from employment is a form of the division of labor. Those who have wealth can employ it productively even if they are not good managers; those who can manage but lack wealth can hire capital in the market; and the existence of claims that can be traded separately from employment allows investors to diversify their investment interests.
without its costs, however. The agency cost model of the firm focuses on these costs, which arise from two primary principal-agent asymmetries: interest and information.\(^6\)

Agency theory assumes, much as economic theory generally does, that everyone is motivated by self-interest—that is, that agents and principals are welfare maximizers.\(^6\) Asymmetries in interest arise because shareholders and managers seek to maximize personal utility in different ways: shareholders seek to maximize personal utility through maximizing share market value\(^6\) while management generally cannot maximize personal utility in this manner. Although there may be some psychic benefit\(^7\) and even a market benefit\(^7\) for managers in maximizing firm market value, managers generally will not maximize personal utility by maximizing share market value. This is so because managers who own less than the entire firm cannot capture all of the benefits of their efforts to maximize share price and do not suffer all of the cost of their failure to do so.\(^2\)

Information asymmetries arise because management and shareholders have different information available to them. Managers do not know exactly what shareholders would have them do in many situations, and shareholders do not know how managers in fact act. The information asymmetry exacerbates the interest asymmetry and can create a moral hazard:\(^7\) when manager-agents have complete discretion and are not observed by the shareholder-principals, there will be little incentive for managers not to maximize their own utility at the expense of the shareholders. For example, managers might shirk their responsibilities and increase their leisure time, use their effective control to give themselves excessive compensation, or to resist a takeover that was attractive to the shareholders but which would divest managers of their power and perquisites.

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\(^6\) See, e.g., Rehnert, supra note 20, at 1156.

\(^7\) See id. at 1157 (noting that some managers assert that personal pride in a job well done is their primary motivation).

\(^7\) This refers to the market for the manager’s services. It is implicit in the discussion here that the manager is not a shareholder in the firm (and thus does not enjoy a market benefit from increasing share market value) unless explicitly stated.

\(^7\) Rehnert, supra note 20, at 1157.

\(^7\) See Kenneth J. Arrow, The Economics of Agency, in PRINCIPALS AND AGENTS, supra note 23, at 37, 38 (referring to the moral hazard attaching to hidden action by agents); Iman Anabtawi, Note, Toward a Definition of Insider Trading, 41 STAN. L. REV. 377, 386 (1989) (same).
The traditional solution to the divergence of interests of principal and agent is increased monitoring. This monitoring, though, has associated costs. Shareholders must either perform the monitoring themselves (and thus suffer opportunity costs) or engage another agent to perform the monitoring for them, incurring not only the compensation costs of the monitors but the agency costs inherent in that relationship as well. Engaging an agent to monitor for shareholders, then, simply raises the question of who monitors the monitor.

Moreover, self-monitoring by shareholders is itself problematic when the ownership of the firm is atomized, as postulated by the Berle and Means model. The costs of monitoring are borne by the shareholder who performs the monitoring, but that shareholder cannot realize all of the gains that accrue from such monitoring. She can merely expect that percentage of the gains represented by her pro-rata ownership of the firm, as any gains are shared by all shareholders. Thus, absent a shareholder with sufficient holdings to justify the expenditure of monitoring costs, monitoring is likely to be inadequate.

Incentives offer an alternative to monitoring for principals to correct for informational and interest asymmetries between principals and agents. While monitoring seeks to correct the informational asymmetry, incentive structures seek to align the interests of principals and agents.

The most common means of using incentives to align the interests of management and ownership are through management share ownership or through other profit sharing schemes based on stock or individual performance. Under these schemes, managers' compensation is based at least in part on share market value. This can be an effective means of reducing agency costs, since not only are manage-

74. See EASTERBROOK & FISCHER, supra note 17, at 9-10.
75. Id. at 10.
76. See Ronald J. Gilson & Reinier Kraakman, Reinventing the Outside Director: An Agenda for Institutional Investors, 43 STAN. L. REV. 863, 873-74 (1991). Gilson & Kraakman cite an excerpt from Dr. Suess describing the monitoring costs incurred when the town of Hawtch-Hawtch engaged an agent to watch the town bee. The result: “And today all the Hawtchers who live in Hawtch-Hawtch are watching on Wath-Watcher-Watcherering-Watch, Watch-Watching the Watcher who’s watching that bee.” Id. at 874 n.38 (citing THEODORE GEisel (Dr. Suess), DID I EVER TELL YOU HOW LUCKY YOU ARE? 29 (1973)).
77. Rehnert, supra note 20, at 1166.
79. See, e.g., Rehnert, supra note 20 (discussing executive compensation contracts as an agency cost reduction mechanism); Louis Rorimer, Put More Incentive In Incentive Pay, N.Y. TIMES Jan. 16, 1994, § 3, at 11 (same). But see Eisenberg, supra note 19, at 1489-97 (expressing skepticism at the efficacy of executive compensation schemes to significantly align shareholder and management interests).
80. See supra note 79.
ment's interests more aligned with those of shareholders, but they are
given incentive to monitor their fellow managers and other agents,\textsuperscript{81} a
job they could presumably perform more efficiently than could share-
holders. Such incentives are not without drawbacks, however: 1) in-
centives have their own associated costs by reducing the profits that
would otherwise inure to the shareholders;\textsuperscript{82} 2) incentive schemes are
imperfect in that they are susceptible to free-riding (such as the case of
stock performance schemes);\textsuperscript{83} and 3) incentives may induce subordi-
nation of team goals for individual indicators (in the case of individual
performance schemes).

Bonding is another alternative to monitoring for reducing agency
costs. Bonds are "automatic devices that impose penalties for a
shortfall in performance."\textsuperscript{84} An example is a requirement that manag-
ers hold significant stock positions in their firms, thereby linking their
personal wealth to the fortunes of the firm.\textsuperscript{85} Another bonding device
is the investment of firm-specific (i.e., undiversified) human capital on
the part of the agent.\textsuperscript{86} This refers to skills, training, and other knowl-
edge acquired by the agent at her cost that have a reduced value
outside the firm.\textsuperscript{87}

Another approach to reducing agency costs in firms are the vari-
ous corporate governance rules that have been proposed and adopted
by both legislatures and courts. These rules include prohibitions
against certain self-dealing transactions,\textsuperscript{88} requirements for outside di-
rectors,\textsuperscript{89} and limitations on executive compensation\textsuperscript{90} which are in-

\textsuperscript{81} Easterbrook & Fischel, supra note 17, at 9.
\textsuperscript{82} See generally, Richard A. Booth, The Other Side of the Management Compensation
Controversy, 22 Securities Reg. L.J. 22 (1994). Hence the controversy over excessive grants of
stock options and other stock-based compensation to executives.
\textsuperscript{83} This is true even for relative market price schemes such as those discussed in Rehnert,
supra note 20, at 1168-80. It is not possible to attribute the movement (or some portion of the
movement) in the market value of a firm's securities, even when adjusted for overall market and
industry swings, to the efforts of a single, individual manager, unless the firm is a single-em-
ployee firm. See, e.g., Easterbrook & Fischel, supra note 17, at 9.
\textsuperscript{84} Easterbrook & Fischel, supra note 17, at 10.
\textsuperscript{85} Id.
\textsuperscript{86} See, e.g., Hu, supra note 7, at 319; Rehnert, supra note 20, at 1173.
\textsuperscript{87} See, e.g., Easterbrook & Fischel, supra note 17, at 29-30; John C. Coffee, Jr.,
Shareholders Versus Managers: The Strain in the Corporate Web, 85 Mich. L. Rev. 1, 74-75
(1986); Rehnert, supra note 20, at 1173. A more precise definition of firm-specific human capi-
tal might be the difference between the manager's expected stream of future earnings within the
firm and her expected stream of future earnings outside the firm. Fama, supra note 62, at 297.
\textsuperscript{88} See, e.g., Cal. Corp. Code § 310 (restricting self-interested transactions of directors);
Guth v. Loft, 5 A.2d 503, 510-13 (Del. 1939)(imposing duty on corporate officers and directors
not to appropriate corporate opportunities).
\textsuperscript{89} See, e.g., William W. Bratton, Jr., The New Economic Theory of the Firm: Critical
\textsuperscript{90} See generally Rehnert, supra note 20.
tended to curb those agency costs that are least responsive to market-based mechanisms such as monitoring and bonding, and thus most in need of government regulation.

Of course, no amount of monitoring, bonding, and regulation will completely eliminate agency costs—there will always be what Jensen and Meckling refer to as residual costs.\textsuperscript{91} Furthermore, as Jensen and Meckling point out, the cost of the agency relationship is minimized not by minimizing the residual cost, but rather by minimizing the sum of monitoring costs, bonding costs, and residual costs.\textsuperscript{92}

In an idealized (i.e., interest-aligned) model of the firm, management merely makes the day-to-day profit-maximizing decisions that owners would make had they not delegated that authority to their agents.\textsuperscript{93} Even this idealized firm is not without agency costs, however, as management’s compensation is a form of agency costs.\textsuperscript{94} In fact, all management costs may be characterized as agency costs of one sort or another. Because firms and managements are organized in hierarchies, agency costs can increase dramatically as firm size increases.\textsuperscript{95} The agency cost model of the firm would predict that firm size increase so long as the gains realized from increased economies of scale are not more than offset by increased management costs and other agency costs.\textsuperscript{96}

B. An Agency Cost Model of Corporate R&D

Before proceeding to apply agency cost concepts to corporate R&D investment decisions, a threshold question must be addressed: why is an agency cost model of corporate decisions regarding R&D

\textsuperscript{91} Jensen & Meckling, supra note 62, at 305. Residual cost is the reduction in the principal’s welfare through the nonfeasance, misfeasance, and malfeasance of the agent. McDaniel, supra note 68, at 231.

\textsuperscript{92} Id. See also Easterbrook & Fischel, supra note 17, at 10.

\textsuperscript{93} This assumes that managers are the perfectly dutiful and knowledgeable agents of the shareholders.

\textsuperscript{94} Of course management costs may be more than offset by efficiency gains, particularly in growing corporations. Nevertheless, these costs must be treated as real costs to the shareholders.

\textsuperscript{95} Management hierarchies tend to increase more rapidly than overall firm size. See infra note 208. For an analysis of how firm size can be management limited, see Oliver E. Williamson, Hierarchical Control and Optimum Firm Size, 75 J. Pol. Econ. 123 (1967).

\textsuperscript{96} Increased firm size can lead to increased economies of scale and increased efficiencies due to specialization of labor. However, increased firm size can also lead to increased agency costs. As discussed above, see supra note 95, management costs can be expected to increase more than linearly with firm size. Increased efficiency, however, would most likely increase less than linearly with firm size (this is the familiar diminishing returns effect). Thus, at some point, the efficiency gains realized from a marginal increase in firm size can be expected to be more than offset by the increase in agency costs. If firm profitability is maximized, the firm will stop growing at this point.
appropriate? Agency cost models are, after all, typically used for non-operational managerial decisions: corporate opportunities,\textsuperscript{97} executive compensation,\textsuperscript{98} insider trading,\textsuperscript{99} etc. One does not ordinarily look for agency cost models to explain corporate decisions concerning day-to-day production matters—the market is thought to "correct" managers for making "wrong" decisions on most operational issues. As one commentator has noted: "A skeptic might . . . ask why economists are so ready to second-guess business on research and development spending when they seem content to let the hidden hand of the market determine the output of, say, corn flakes or drill bits."\textsuperscript{100}

The answer is that R&D is different from other corporate operations: as discussed above, the investments are more risky, long-term, and difficult to appropriate the benefits from than many other investments, and technology is more difficult for lay managers and shareholders to understand than many other aspects of corporate life. Because the various participants in the corporate venture have different interests with regard to investment risk, time-scale, and appropriability, an agency cost model has the potential to provide insight. This section sets out the structure of an agency cost model of corporate R&D—that is, it will identify the divergent interests of shareholders and managers. Some data (empirical and anecdotal) will be used to establish what these interests are with respect to R&D investments.\textsuperscript{101} Following the presentation of this model, Part III exam-

\textsuperscript{97} See, e.g., id. at 141-42.
\textsuperscript{98} See, e.g., Rehnert, supra note 20.
\textsuperscript{100} Passell, supra note 55.
\textsuperscript{101} A word on the empirical data: research and development economic measurements are notoriously troublesome. See, e.g., Andrew G. Berg, Cost Efficiencies in the Section 7 Calculus: A Review of the Doctrine, 37 Case W. Res. L. Rev. 218, 241 n.89. (citing P. Areeda & D. Turner, 4 Antitrust Law 189 (1968) for the proposition that the proof problems in research and development economies "are truly formidable"). For one thing, it is very difficult to measure the effects of research and development—that is, R&D outputs—directly. Not only is it difficult to measure outputs, there is not even general agreement on the appropriate inputs. For example, it is very hard to isolate inputs on "research" or "inventing" alone, so it is common to settle for measurements of "research and development" inputs.

There are several possible measures of research and development "intensity." Scherer, for example suggests R&D expenditures and R&D employees as inputs, patent counts, a count of significant innovations, and estimates of sales associated with new products introduced as outputs. Scherer, Industrial Market Structure, supra note 26, at 418. See also Kamien & Schwartz, supra note 30, at 4 (suggesting R&D spending, R&D employees, and scientists and engineers employed as appropriate inputs, and patents awarded, important patents awarded, important inventions or innovations, and sales of new products as outputs). The easiest measures to obtain are R&D expenditures (typically included on the balance sheets and SEC filings of industrial corporations as a separate line item expense) and patent counts (determinable on LEXIS and WESTLAW).
ines the available empirical data with respect to the premises and conclusions of the model.

1. The Parties and Their Maximands
   
a. Shareholders

Shareholders provide an absolutely critical component of privately funded research and development: the private funds. Shareholders provide the initial capital, any necessary additional working capital, and are the claimholders for any residual profits remaining after the firm's expenses have been met. Shareholders, however, do not represent a monolithic group with undifferentiated interests with regard to R&D investments. For the purposes of analyzing shareholder interests in R&D investment, this article divides shareholders into three groups: underdiversified (or undiversified) shareholders, diversified shareholders, and indexed shareholders.

i. Underdiversified shareholders

Underdiversified shareholders are defined here as those shareholders who hold an investment portfolio dominated by the shares of one or a small number of firms. Such portfolios are "risky" investments, since the fortunes of the investor are closely linked to those of a single firm. Typical examples of underdiversified shareholders are investors with controlling interests in firms or with a large proportion of their investment portfolio devoted to a single firm. Thus, the truly undiversified investor (qua investor) maximizes personal utility by maximizing the market value of that single firm. Note, however, that few, if any, investors are truly undiversified, and most are more diversified than they think. However, as will be discussed below, there is one class of underdiversified investor that is very important to the analysis here—firm management.
ii. Diversified shareholders

Risk-averse shareholders seek a diversified portfolio of investments in order to reduce risk.\(^{107}\) For present purposes it is sufficient to state that the greater the number of different securities held by an investor, the less the risk.\(^{108}\) The precise number of securities required to have a “sufficiently” diversified portfolio is a subject of some debate,\(^{109}\) but it appears that once a portfolio of individual securities reaches thirty or so stocks, the marginal rate of risk reduction realized through increased diversification is offset by the marginal increase in transaction costs of adding an additional stock to the portfolio.\(^{110}\) Thus, for the purposes of this article, diversified investors refer to those investors whose portfolios are dominated by the securities of 10 to 30 firms.

Of course, the investors in any particular firm will each have different investment portfolios, and different preferences in terms of risk, income, etc. If firm management is to act in the best interests of shareholders and shareholders have different individual interests, how is management to act? Fortunately, there is a simple answer: the interests of diversified shareholders are maximized when management maximizes firm market value.\(^{111}\) This is so because individual shareholders lend or borrow against the increase in stock market value to realize their individual consumption or income preferences.\(^{112}\)

iii. Indexed shareholders

Most portfolio theory analysis proceeds on the assumption that stocks in an investor's portfolio are chosen randomly.\(^{113}\) However, whether securities are chosen randomly or are individually selected, it

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107. See, e.g., EASTERBROOK & FISCHER, supra note 17, at 119.
108. See, e.g., id. at 121.
110. Statman, supra note 109, at 359.
111. See, e.g., EASTERBROOK & FISCHER, supra note 17, at 35-39; Hu, supra note 7 at 288-90; Rehnert, supra note 20, at 1156.
112. See Rehnert, supra note 20, at 1156.
113. See, e.g., Statman, supra note 109, at 358; Evans & Archer, supra note 109, at 762. Of course, few investors truly pick their stocks randomly. Rather, they or their agents research firms in order to select the stocks that in theory best meet the investment criteria of the individual investor (in terms of growth potential, risk, income, etc.) when considered along with the other stocks in the investor's portfolio. Thus, the assumption of random picking, of course, can dramatically underestimate the transaction costs involved in adding an additional security to the portfolio.
is clear that with a portfolio of ten to thirty securities it is impossible to diversify both across industries (and thus reduce the risk of reduction of portfolio value due to the cyclical misfortunes of a particular industry) and within industries (and thus reduce the risk of reduction of portfolio value because of the misfortunes of a particular firm, even though that firm's industry is 'thriving').

True diversification both across and within industries requires indexing. Ideally, the indexed investor holds shares in all firms in the market in proportion to each firm's market value. Of course, the transaction costs of an individual investor compiling her own indexed portfolio would be extraordinarily high. Fortunately, low-cost approximations to indexed portfolios are available.114 Of course no index is a perfect proxy for an ideal market portfolio. Even if a fund were available that represented every firm publicly traded on a United States exchange115 or over the counter, the huge number of privately held and foreign firms would be unrepresented.116 Nevertheless, this article refers to investors with interests in large numbers of securities (500 or more) as indexed investors, and indexed investors will be assumed to be diversified both across and within industries.

Indexed investors represent a large and growing proportion of the market. Perhaps $300 billion was overtly indexed in 1990 and significantly more is effectively, though not overtly indexed.117 Wells Fargo

114. For example, the Vanguard Index Trust is a no-load (that is, a no entrance or exit fee) fund that tracks the Standard & Poor's (S&P) 500 Index. Although it is a no load fund the return on the Vanguard Index Trust and similar funds (the Wells Fargo Stagecoach Corporate Stock Fund is another such fund) is slightly lower than that of the S&P 500 due to transaction and administrative costs. During the years 1979 to 1984, for example, the Vanguard Index Trust rate of return was 0.49% less than that of the S&P 500. Statman, supra note 109, at 358-59.


116. By some estimates, an ideally diversified securities portfolio would have only about a quarter of its assets invested in United States firms.

117. Louis Lowenstein, Why Managements Should (And Should Not) Have Respect for Their Shareholders, 17 J. CORP. L. 1, 12 (1991). This figure is up from $50 billion in 1984, id., and is surely much higher today. Many large institutional investors are "effectively" indexed, due to the size of their funds. The growth of institutional investors in recent years and the potential benefits and concerns related with this growth has been well documented. See Mark J. Roe, The Modern Corporation and Private Pensions, 41 U.C.L.A. L. REV. 75, 76 (1993) (noting that "[a]lthough in 1970 pension funds owned only $78.2 billion in equity, less than nine percent of the stock market, by 1993, pensions owned $1.5 trillion of stock, accounting for nearly one-third of the stock market."); Agents Watching Agents, supra note 64; The Value of Institutional Investor Monitoring, supra note 64; John M. Conley & William M. O'Barr, The Culture of Capital: An Anthropological Investigation of Institutional Investment, 70 N.C. L. REV. 823 (1992); Coffee, supra note 87.
alone, for example, manages over $50 billion in indexed funds.\textsuperscript{118}

The interests of indexed shareholders are maximized in a slightly, though significantly, different way than diversified shareholders. While the fortunes of the holdings of a diversified shareholder may be assumed to be independent,\textsuperscript{119} the fortunes of an indexed portfolio are less so, particularly with respect to technological innovation. This is because a valuable new technological innovation will only increase the market value of some diversified portfolios (those exploiting the innovation) while it can be expected to increase the market value of all indexed portfolios. For this reason, indexed investors will want firm managers to make decisions that increase indexed portfolio values, rather than the market value of individual firms.\textsuperscript{120} As with the diversified investor, maximization of portfolio value maximizes indexed investor welfare regardless of the personal preferences of the individual shareholders, because the consumption preferences of any individual shareholder can be adjusted to match her particular preferences by borrowing or lending against the increased value of her portfolio.\textsuperscript{121}

\textit{b. Managers}

The central role of management\textsuperscript{122} in the success or failure of firms is unquestioned. Likewise, management plays a central role in determining the success or failure of a firm’s R&D efforts. This role goes beyond determining the magnitude of R&D expenditures—the character and quality of the R&D effort is to a great extent determined by a firm’s management.\textsuperscript{123}

Managers will make decisions so as to maximize the personal

\textsuperscript{118} See \textit{Wells Fargo Stagecoach Stock Fund}, \textit{supra} note 115.

\textsuperscript{119} This is strictly true only if the securities are randomly selected. Stock picking investors might purposely “hedge” their selection so that if one firm falters, it is expected that another firm in the portfolio would prosper. Hedging, however, is imperfect, and not necessarily the best strategy for reducing portfolio risk. Indeed, it is possible that hedging could introduce additional systematic risks relative to a randomly-picked portfolio. As a first-order approximation, the assumption of independence is a reasonable one.

\textsuperscript{120} It is, of course, quite another matter as to whether managers would be so instructed. Firm managers have little control over indexed portfolio values and thus to compensate them on the basis of portfolio performance would represent either a windfall or undeserved punishment for managers.

\textsuperscript{121} See, \textit{e.g.}, \textit{Easterbrook & Fischel}, \textit{supra} note 17, at 120 and sources cited therein.

\textsuperscript{122} Management refers to the corporate directors, officers and those employees whose primary responsibilities are decision-making rather than decision-implementing. See Roy Radner, \textit{Hierarchy: The Economics of Managing}, \textit{J. Econ. Ltr.}, Sept. 1992, at 1382, 1383 (defining managing as “figuring out what to do,” in contrast to “doing it”).

\textsuperscript{123} See, \textit{e.g.}, Kamien & Schwartz, \textit{supra} note 30, at 10 (noting that studies have shown that “emphasis on good management throughout the firm, with excellent working relationships and communications among the R&D, production, and marketing departments is a recurring theme in comparative studies of success and failure in innovations.”).
utility of the individual managers. While some managers may receive personal satisfaction from maximizing shareholder utility, most managers' personal utility is measured by more than firm market value. Such managers will seek to maximize their own pecuniary and psychic benefits.

Managers' investment in their firms is, unlike that of shareholders, nondiversifiable. The nondiversifiable nature of the manager's investment is due to several factors. The manager's job is typically her most important investment, providing disproportionately more income to the manager than any single investment brings the diversified investor. Because of their investment in firm-specific capital, managers are typically worth more to their present employers than they could demand on the external job market. A manager's investment in her employing firm is illiquid and non-fungible.

Just as the interests of diversified shareholders differ from those of indexed shareholders and underdiversified shareholders, the interests of middle managers differ from those of senior managers. For the purpose of this discussion, senior managers are defined somewhat loosely as those managers with firm-wide responsibility and authority. Thus, the board of directors, the officers, and perhaps other "senior executives" qualify as senior managers. Middle managers, then, are defined here as other management personnel with input to R&D investment decisions (they need not necessarily have supervisory responsibilities).

124. Such managers belong to a "noblesse oblige" school of management. But see Eisenberg, supra note 19, at 1473 (noting that while self-esteem will prevent most managers from shirking and unfair self-dealing, managers may not even recognize the existence of positional conflicts).

125. Pecuniary benefits include salary, benefits, and often most significantly, stock-based forms of compensation.

126. Psychic benefits include job security, prestige, power, etc.

127. See Coffee, supra note 87, at 17 (noting that "the manager's most important asset is his or her job"). That managers may receive a significant part, even the majority, of their compensation in some stock-based form does not diminish the importance of the job to the manager, nor, certainly, does it diversify her portfolio. Even directors who can sit on multiple boards can only achieve limited diversification.

128. Professor Coffee notes two other factors for a management overinvestment in the firms for which they serve: managers are often compensated in the form of nontransferable interests in their firms as a reducing agency costs, and managers' liability for corporate action may not be limited as is the case with shareholders. Id. at 18-19.

129. It is difficult for managers to exit firms and extract the full "value" of their investment.

130. The investment is personal in that managers are investing, in part, in their own reputations. Reputational concerns may cause managers to reject high-risk, high-payoff projects for lower-risk, lower-payoff projects. See Thakor, supra note 13, at 131. See also Fama, supra note 62, at 292 ("For the purposes of the managerial labor market, the previous associations of a manager with success and failure are information about his talents.").
The interests of senior managers are more closely aligned with those of underdiversified investors than with those of diversified or indexed investors, while middle managers' interests may more closely resemble those of diversified investors for several reasons. First, senior managers have generally invested a great deal of firm-specific personal capital in their firms, typically more than middle managers, due primarily to their greater length of time spent with the firm and the nature of the duties performed for the firm. Second, the portfolios of senior managers is likely to be less diverse than those of middle managers because the future income of the senior manager is generally more dependent on her current employer than that of middle managers. Finally, senior managers' compensation tends to be based more on firm quarterly or annual financial results than that of middle managers, who are compensated more on their individual or departmental performance.

The above discussion suggests that, as with underdiversified shareholders, senior managers will be more risk-averse, more concerned with appropriability, and have a shorter time horizon with respect to R&D investments than will middle managers. The differences in interests among managers, however, is probably not nearly as great as those among shareholders. Furthermore, because senior managers are, by definition, the firm policy-makers, their interests will have a greater effect on firm behavior than the interests of middle managers. For these reasons, the interests of senior managers in R&D spending is used as a proxy for the interests of managers generally for the remainder of this article.

2. R&D Characteristics and Interests

a. Risk

Risk is an important factor in any investment decision. Investors in the securities markets are concerned with two kinds of risk: systematic and diversifiable or firm-specific risk. Systematic risk is risk of an event that causes a shift in the overall securities markets—interest rate changes or political developments, for example, might move the entire market up or down. Diversifiable risk is risk of an event that causes a relative shift between a particular security or a particular

131. The value of senior managers to their employers is usually far greater than their value to other firms, though this is not always reflected in salaries.
132. This income may take the form of future ordinary salary, deferred earnings, pensions, stock options, and retirement benefits.
133. Middle managers are more likely to have other employers in their futures.
134. See Easterbrook & Fischel, supra note 17, at 121; Coffee, supra note 87, at 19.
135. See, e.g., Easterbrook & Fischel, supra note 17, at 121.
industry and the rest of the market.\textsuperscript{136} Holders of a diversified portfolio of securities are relatively unconcerned with diversifiable risk. The value of diversified portfolio will, on average, be unchanged by a diversifiable-risk event and a \textit{fully} diversified portfolio should \textit{never} be changed by such an event. The cost of portfolio diversification is so low\textsuperscript{137} that it can be assumed that underdiversified investors are not risk-averse.\textsuperscript{138}

The possibility of a merger proceeding at an unfair price is an example of diversifiable risk event.\textsuperscript{139} If the shareholders of a target get a bad deal, it follows that the shareholders of the bidder get a good deal. The fully diversified investor is indifferent to such an event since her portfolio value is unaffected.\textsuperscript{140}

As discussed earlier, R&D investments are inherently risky. These risks are of at least three types: (1) there is the technology risk that a particular R&D project will not be technically successful;\textsuperscript{141} (2) there is the market risk that a particular R&D project will be technically successful but will not result in a profit on the market for \textit{any} firm;\textsuperscript{142} and (3) there is the appropriability risk that a particular R&D project will result in a net profit on the market, but not necessarily for the sponsoring firm.\textsuperscript{143}

\textsuperscript{136} \textit{Id.}

\textsuperscript{137} Mutual funds are an inexpensive means to achieve diversification. Easterbrook and Fischel point out that the cost of diversification is actually lower than non-diversification because the diversified investor avoids the expense of selecting and monitoring stocks. \textsc{Easterbrook \& Fischel, supra note 17, at 122.}

\textsuperscript{138} \textit{See Easterbrook \& Fischel, supra note 17, at 30; Coffee, supra note 87, at 17 (noting that modern financial theory assumes that investors hold diversified portfolios). Professor Coffee suggests that the availability of diversification implies that some investors may even be risk preferrers, since a diversified investor may view equity investments as “high” risk and desire such risk to offset other, “low” risk investments. Coffee, supra note 87, at 19.}

\textsuperscript{139} \textit{See Easterbrook \& Fischel, supra note 17, at 122 (describing corporate control transactions as diversifiable risk events).}

\textsuperscript{140} Actually, this is a somewhat oversimplified account. Transaction costs (legal and investment banking fees, for example) might reduce the portfolio value, especially if the price were distorted so that assets were not moved to the higher valued use as between seller and buyer. Nevertheless, the example suffices for present purposes.

\textsuperscript{141} The technology risks are lower than many might believe. Research by Edwin Mansfield estimated that the average probability of technical success for R&D projects in the electronic equipment, proprietary drug, and chemical industry ranged from 0.52 to 0.68. \textsc{Scherer, Innovation and Growth, supra note 29, at 120 (citing Edwin Mansfield, Industrial Research and Technological Innovation 59 (1968), and Edwin Mansfield, et al., Research and Innovation in the Modern Corporation 35-36, 41-42 (1971)).}

\textsuperscript{142} There might just not be a significant market for the innovation. The market success rate is often lower than the technical success rate.

\textsuperscript{143} The other firm might have been successful first or might merely imitate the innovation of the first firm. This would be possible if the innovation were not patentable, or the patent were easily designed around, for example. Imitation is often a successful innovation strategy. \textit{See}
Research and development projects which are best characterized by their technology and market risk tend to reside near the basic research end of the R&D spectrum. At the outset of the project, it is unclear if the technology will work or if there is a market for the product. R&D projects which are best characterized by their appropriability risk, in contrast, tend toward the development end of the R&D spectrum. At the outset of the project there is an identifiable market and likely profit for some firm or firms, but no guarantee of commercial success for any particular firm.\textsuperscript{144}

\textit{i. Shareholders}

The different types of R&D risk correspond roughly to the different types of investment risk. Applied research and development, with its appropriability risk, is largely a diversifiable risk. By hypothesis, some firm will profit from the investment. To the indexed investor, it does not matter which firm profits and which firm loses. Basic research is a systematic risk. If unsuccessful,\textsuperscript{145} it represents a deadweight loss.\textsuperscript{146} There is no gain to other firms to compensate for the loss. Thus, it would follow that the risk aversion of indexed shareholders is greater with respect to basic research investments than with respect to applied research and development investments, and the risk aversion of indexed shareholders is less than that of diversified or underdiversified shareholders with respect to all types of R&D investments.

\textit{ii. Managers}

As discussed above, managers are inherently risk averse economic actors. Thus, managers will be more risk-averse than shareholders when making investment decisions, including R&D investment decisions, for the firm.\textsuperscript{147} As Professor Coffee points out, the risk-aversion of managers is not necessarily contrary to shareholder interests—the absence of any firm-specific risk-aversion might

\textsuperscript{144} At the time of this writing, investment in HDTV research today would appear to be an example of a diversifiable risk. Some standard will be adopted and many units eventually sold, but it is unclear at this time whose standard will be selected and which firms will eventually profit. As noted earlier, the technically successful firm will not necessarily be the most profitable.

\textsuperscript{145} "Unsuccessful" basic research here is defined from the perspective of the investor—i.e., it is research from which no revenues are generated.

\textsuperscript{146} This, of course, ignores the value of any knowledge gained through the failure.

\textsuperscript{147} See Coffee, supra note 87, at 19.
lead to management indifference as to the firm's fortunes. Thus, a differential risk-aversion as between shareholders and managers is not an agency cost unless this difference is reflected in a lower market price for the firm's securities.

The riskiness of R&D and the "risk-aversion differential" between managers and shareholders is a potential agency cost source. Managers' relative risk-aversion with respect to shareholders will constitute an agency cost if it causes managers to invest in R&D at less than the rate that optimizes firm market value. The general risk-aversion of managers may be amplified with respect to research and development investment decisions. Because American managers seldom have technology backgrounds, they have difficulty understanding the benefits of technology for products and processes and may

148. Id.
149. Could differential risk-aversion as between managers and investors then actually lead to "agency benefit" for shareholders? Of course. There are many forms of agency benefits (division of labor benefits were discussed earlier). Thus, the concern ought to be "do agency costs outweigh agency benefits," not "are there agency costs associated with the transaction." Similarly, reduction in agency benefits should be included in the agency cost minimization calculus.
151. Presumably, an owner would invest (or at least try to invest) in R&D at precisely the rate that optimized share market value.
152. See, e.g., PORTER, supra note 39, at 527. Porter notes that there is a steadily decreasing number of senior managers at American corporations with technical backgrounds, as opposed to the abundance of technically oriented managers in Germany and Japan, for example. Porter blames this in part on the diversion of talent in America from the technical fields into law, medicine and finance. Id. See also William J. Abernathy & Robert H. Hayes, Managing Our Way to Economic Decline, HARV. BUS. REV., July-Aug. 1980, at 67, 74-75 (attributing short-sighted investment policies of United States firms to the large number of corporate managers trained in law or finance rather than science or engineering).

Attempting to quantify assertions such as those of Porter and Abernathy and Hayes, F.M Scherer and Keun Huh examined the relationship between corporate officers' education and R&D investment in Top Managers' Education and R&D Investment, 21 Res. Pol'y 507 (1992). Scherer and Huh studied 308 R&D intensive corporations and the educational backgrounds of their two highest ranking officers during the period 1971-1987. They found that the percentage of firms to which at least one of the two top officers was trained in science or engineering slowly increased from 1971 to 1980, peaked, and has been in decline since. Id. at 508. The percentage of firms with a scientist or engineer in one of the two top spots has steadily increased and declined, respectively, during the 1971-1987 timeframe. Id. Over the 17 year period, the R&D intensity of the firms averaged 3.12 percent. Id. at 509. Scherer and Huh found that having a scientist or engineer in one of the two top positions added a statistically significant 0.30 percentage points (i.e., increased R&D intensity to 3.42 percent) and a lawyer added a statistically significant 0.24 percent, while an MBA actually decreased R&D intensity by 0.03 percentage points (though this last result was found not to be statistically significant). Id. The authors also looked at various combinations of education of the two top corporate officers. The combination of lawyer and engineer was most conducive to R&D intensity, adding a whopping 0.76 percentage points. The combination of lawyer and MBA the least conducive, decreasing R&D intensity by 0.12 percentage points (both statistically significant). Id. at 509-10.
lack the confidence and conviction to invest in it.\textsuperscript{153}

The management/R&D risk-aversion problem is further complicated by management hierarchies present at most large firms, particularly with respect to R&D decisions. For example, decisions concerning a change of control transaction might be discussed among only a few senior officers and the board of directors, but R&D decisions might be discussed among department managers, section managers, vice presidents, etc., in addition to the top decision makers. This additional decisional hierarchy is due to several factors. First, R&D ideas often percolate up from individual researchers rather than down from senior management.\textsuperscript{154} Second, as discussed above, management often has little or no technological expertise and thus may be more likely to defer to specialists than they would for "ordinary" business investment decisions.

One effect of the R&D decision-making hierarchy is to give more decision makers an opportunity to "just say no."\textsuperscript{155} There can be merit in this approach considering that decision makers further down the hierarchy will tend to have more technological expertise.\textsuperscript{156} But this expertise differential is accompanied by a risk-aversion differential as well. Even at large companies that can afford to fund a diversified portfolio of research projects, the career of a middle-level manager can depend on the outcome of a single project.\textsuperscript{157}

\begin{itemize}
\item \textsuperscript{153} This lack of technical expertise may lead to "herd" behavior by managers who make R&D investment decisions that do not deviate from the "norm." See Thakor, supra note 13, at 131 (citing David Schaferstein & Jeremy Stein, \textit{Herd Behavior and Investment}, MIT Sloan Working Paper # 2062-88).
\item \textsuperscript{154} It is not hard to imagine a junior scientist at a corporation suggesting that management invest in research in a particular area and that management would solicit her input. It is much more difficult to conceive of management interest in that scientist's (or for that matter a young accountant's) idea that the corporation merge with or acquire some other firm or sell a division of the firm to another corporation.
\item \textsuperscript{155} See, e.g., Scherer, \textit{Industrial Market Structure}, supra note 26, at 414 (noting that risk spreading decisions are made by individuals, not firms, so the theoretical ability of large firms to bear risk may not pan out—but the decision-making process in a large firm will involve more people and more individuals will have an opportunity to object to investment decisions).
\item \textsuperscript{156} The corporate Vice President for Research and Development is likely to be more technologically informed than the CEO, and the manager of the Compound Semiconductor Research department more informed than the VP in her area of expertise.
\item \textsuperscript{157} Passell, supra note 55. For a large firm that makes many R&D investments, "the firm itself, is a diversified portfolio." Coffee, supra note 87, at 20. Thus, a CEO might be indifferent to the failure of a single project (if sufficiently small), the Vice President of Research and Development might be somewhat risk-averse, and the department manager's career might depend upon a successful outcome.
\end{itemize}

Management risk aversion may not only result in sub-optimal R&D investment levels, it can also result in management choosing the wrong R&D projects from among the options available to it. For example, when presented with a choice between two projects with the same expected value and different downside risks (i.e., costs of failure), most managers would instinctively
b. Time horizon

The fundamental premise underlying the myopic market model is that shareholders, particularly institutional shareholders, have a very short investment time horizon. As an initial observation, there is little question that some institutional investors adopt a fairly short-term outlook with respect to their stock positions. For example, in 1987 institutional investors held approximately one third of all corporate stock and yet accounted for some seventy percent of all trades on the New York Stock Exchange. Mutual fund managers and investment advisors turn over sixty to sixty-five percent of their portfolios each year. Critics claim that short-term trading such as this forces managers to adopt a short-term outlook as well, focusing exclusively on the current quarter's earnings at the expense of long-term investment, including research and development.

i. Shareholders

Despite the short-term time horizon in terms of securities positions, however, there is little statistical evidence showing that shareholders are averse to long-term investment by the underlying firms. Rather, the available evidence indicates that the market is fully capable of setting share prices based on both short-term and long-term earnings prospects: "the stock market discounts the firm's expected future profits into a price that accurately reflects expectations of the
firm's true value." For example, start-up companies with no current earnings and no realistic prospect of earnings in the near future are able to raise investment capital by selling equity in the market. Further, differing market expectations for long-term earnings are evidenced in the wide variation of price-to-earnings ratios seen among listed stocks.166

ii. Managers

The investment time horizon of utility-maximizing senior corporate managers tends to be short. Senior corporate managers tend to have relatively short tenures in their positions, as such managers often accede to their positions late in their careers and keep these positions for only a few years. More junior managers often move from position to position within the firms (or worse, from firm to firm). Thus, few managers who invest in long-term research and development projects will be around to reap any benefits from such investments.169

Management, particularly senior management, often receives a significant portion of its compensation in the form of bonuses based on annual or quarterly results. There is little incentive for these managers to reduce the current year's bonus in the hope of a higher one in future years, due to their short tenure in office.171

165. Id. at 181-82 (statement of Joseph R. Wright).
166. GREGG A. JARRETT ET AL., SECURITIES AND EXCHANGE COMMISSION, INSTITUTIONAL OWNERSHIP, TENDER OFFERS, AND LONG-TERM INVESTMENTS 1985 [hereinafter SEC REPORT] reprinted in Corporate Takeovers, supra note 164, at 382. On a typical day the price to earnings (P/E) ratio of shares listed on the New York Stock Exchange (NYSE), for example, will vary from about 1 up to nearly 100. Price to earnings ratios of 15-20 and above reflect the market's expectation that a firm will be more profitable in the future than it is today. Corporate Takeovers, supra note 164, at 367 (statement of Charles F. Rule).
167. See, e.g., Eisenberg, supra note 19, at 1495.
168. Id.
169. See, e.g., Richard H. Leet, How Top Management Sees R&D, RES. TECH. MANAGEMENT, Jan.-Feb. 1991, at 15 ("Senior managers are tempted to reduce 'research' effort because, after all, new cutting-edge technology is probably not going to affect the company during their careers. (As a matter of fact, it probably will affect them—it may cause reduced profits and rates of return.").
171. PORTER, supra note 39, at 528-29. Some commentators have noted that shareholders can see through management over-emphasis on short-term returns at the expense of long-term investments, and that managers will not be rewarded for an attractive bottom line achieved at the expense of the future profitability of the corporations. See, e.g., John C. Anjier, Comment, Anti-
The short investment time horizon of managers is likely to have the greatest impact on the length of the longest term research and development investments. Thus, among R&D investments, managers are likely to be least disposed towards investments in basic research and most disposed towards applied research and development.

c. Appropriability

Appropriability refers to the ability of the sponsoring company to collect quasi-rents from its innovation. Returns from R&D investments are less appropriable than other kinds of investments due to the "public goods" aspects of inventions and innovations. Patenable innovations, for example, may enjoy greater appropriability than non-patentable innovations, since no exclusive right to make, use, or sell attaches to the latter. On the other hand, many patents can be designed around quickly enough and at modest enough cost to overcome the "first-to-market" advantage of the innovator.

i. Shareholders

As alluded to earlier in the discussion of shareholder risk aversion, diversified shareholders would be indifferent to the appropriability of results of research and development investments. As long as profits are made, it matters little to the diversified investor which firm makes the profits. The diversified investor should appropriate her share of all of the profits. In fact, it is possible that diversified investors would prefer to see no appropriability, since in such a

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172. A quasi-rent is a return on an asset that exceeds its current costs of use. See Armen A. Alchian, Rent, in THE NEW PALGRAVE: THE WORLD OF ECONOMICS 591, 592-93 (John Eatwell et al., eds. 1987).
173. See, e.g., Jorde & Teece, supra note 36, at 6.
174. One measure of the low appropriability of R&D investment are the high rates of social returns—returns to society as a whole—from private investments in R&D. These returns are estimated at anywhere from 50 to 200 percent. See Edwin Mansfield, Social Returns from R&D: Findings, Methods and Limitations, RES. TECH. MANAGEMENT, Nov.-Dec. 1991, at 24.
175. See David J. Teece, Capturing the Financial Benefits from Technological Innovation, in TECHNOLOGY AND THE WEALTH OF NATIONS, supra note 7, at 175, 177. Indeed, the patent system is intended in part to provide incentives for innovators to invent-around adversely held patents. See, e.g., Texas Instruments v. U.S. Intern. Trade Comm’n, 804 F.2d 1558, 1572 (Fed. Cir. 1986).
176. See supra notes 145 to 146 and accompanying text.
177. Martin Baily, a University of Maryland economist, estimates that, due to the difficulty of appropriating rents, society's overall returns on research and development is at least double the private return. Passell, supra note 55.
regime the most efficient producers will prevail and transaction costs will be minimized.

Shareholder antipathy towards strong appropriability of intellectual property has recently been the subject of an empirical study. This study sought to determine the value of patents to the securities markets by studying the abnormal returns on a corporation's stock following a judicial finding of patent invalidity.\(^{178}\) The study examined the market behavior of 108 securities for a period of 5 days prior to and 15 days following findings of patent invalidity (at both trial and appellate level).\(^{179}\) The study concluded that, on average, the patent invalidity judgments did not adversely affect the abnormal (i.e., net of market) return performance of the securities studied.\(^{180}\) The implication is that, accepting the efficient capital markets hypothesis,\(^{181}\) shareholders are indifferent to the news that the courts have found a firm's patent invalid.

\(\text{ii. Managers}\)

Because managers' investment portfolios are so firm-specific, they will favor investments with a high degree of appropriability. They can receive little or no benefit from other firms that appropriate gains from their firm's investment. These managers would prefer to invest in tangible assets, such as a new plant or perhaps better yet, a new corporate jet or other perquisite.\(^{182}\)

3. Summary of the Model

The above description of an agency cost model for corporate R&D investment is summarized below in Table 1. One of the more useful parameters shown in Table 1, and one that is referred to frequently in the empirical studies discussed in part III, is R&D intensity.

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\(^{178}\) Page M. Kaufman, An Empirical Study of the Effect of Patent Invalidity Judgments on the Abnormal Returns of Publicly Traded Securities, 19 AIPLA Q.J. 282 (1991). Abnormal returns analysis is used in an attempt to isolate the effect of a given piece of information (here, the patent invalidity) on the securities market. \(\text{Id. at 286-87.}\)

\(^{179}\) \(\text{Id. at 292.}\)

\(^{180}\) \(\text{Id. at 308.}\) Of course, in certain high-profile "bet your company" cases, rulings on intellectual property rights can have spectacular effects on share prices. \(\text{See, e.g., Don Clark, AMD Rushes Into Intel's Turf, S.F. Chron., April 20, 1993 at C1 (reporting that the stock of Intel lost 11 percent of its value and the stock of AMD increased by 12 percent of its value on the day following a ruling adverse to Intel in the long-running copyright dispute between the two firms).}\)


\(^{182}\) \(\text{See, e.g., Brian Burrows and John Healy, Barbarians at the Gate: The Fall of RJR Nabisco 94 (1990) (describing RJR Nabisco CEO Ross Johnson's fleet of corporate jets and specially commissioned "Taj Mahal of corporate hangars").}\)
Research and development intensity simply refers to total R&D spending by a firm as a percent of sales.\textsuperscript{183} R&D intensity is an effective way to measure the level of R&D activity at firms because it allows year-to-year comparisons without adjusting for inflation and it allows for comparisons of firms of disparate size.\textsuperscript{184}

**TABLE 1: THE DIVERGENT INTERESTS OF SHAREHOLDERS AND MANAGERS IN R&D SPENDING**

<table>
<thead>
<tr>
<th></th>
<th>Underdiversified Shareholders</th>
<th>Diversified Shareholders</th>
<th>Indexed Shareholders</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximand</td>
<td>firm</td>
<td>market</td>
<td>index</td>
<td>personal</td>
</tr>
<tr>
<td></td>
<td>market value</td>
<td>market value</td>
<td>index value</td>
<td>utility</td>
</tr>
<tr>
<td>Risk Aversion</td>
<td>extreme</td>
<td>moderate</td>
<td>low</td>
<td>extreme</td>
</tr>
<tr>
<td>Investment Characteristics</td>
<td>important</td>
<td>important</td>
<td>not important</td>
<td>important</td>
</tr>
<tr>
<td>* appropriability</td>
<td>short</td>
<td>medium</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>* time horizon</td>
<td>disfavored</td>
<td>disfavored</td>
<td>disfavored</td>
<td>disfavored</td>
</tr>
<tr>
<td>* basic research</td>
<td>low</td>
<td>medium</td>
<td>high</td>
<td>low</td>
</tr>
</tbody>
</table>

Table 1 demonstrates why it is important to break down shareholders into their constituent components when looking at agency costs in corporate R&D investment decisions. In fact, rather than simple opposing interests of shareholders and managers, it is seen that there are groups of shareholders whose interests are closely aligned with those of managers (underdiversified shareholders, who prefer low R&D intensity) and those whose interests diverge substantially from managers (indexed shareholders, who prefer high R&D intensity).

The fact that different categories of shareholders have different interests with respect to R&D investment greatly complicates any agency cost analysis. Indeed, the divergence of interests among different categories of shareholders may itself be a form of agency cost. The remainder of this article, however, focuses on the divergent interests of indexed investors and managers. As discussed earlier, indexed investors represent a large and rapidly growing percentage of all shareholders.\textsuperscript{185} This is so for several reasons. Underdiversified and diversified investors can easily index if they so choose, due to the low cost of investment in indexed funds. Perhaps most importantly, the

\textsuperscript{183} See, e.g., Kamien & Schwartz, supra note 30, at 16.
\textsuperscript{184} This is because this measure of R&D activity is self-normalizing.
\textsuperscript{185} See supra notes 117 to 118 and accompanying text.
interests of indexed investors are more closely aligned with societal interests than are those of non-indexed investors. The perfectly indexed investor is interested only in the growth of the overall economy and is unconcerned with whether individual firms are "winners" or "losers". Similarly, overall economic growth is, as a general proposition, the economic goal of society rather than the success or failure of individual firms.

Table 1 indicates that shareholders and managers would appear to agree on one aspect of R&D investment: both disfavor basic research and prefer applied research and development. Thus, the relative low level of spending on basic research is not properly characterized as an agency cost. The almost purely public good aspect of basic research may make this an area that is poorly suited for performance by the private sector.

III. Testing the Model: Some Empirical Results

Part II presented an agency-cost-based alternative to the "myopic" market explanation for corporate underinvestment in R&D. The remainder of this article examines the available empirical data on corporate R&D to see if the underlying premises upon which the agency cost model is based are sound, and to see if the agency cost model can explain phenomena unaccounted for in the myopic market model.

A. Market Responses to Firm R&D Spending

The divergent interests of shareholders and managers in corporate R&D investment have been discussed above in theoretical terms. Shareholders, seeking to maximize the portfolio market, are risk-neutral, unconcerned with appropriability, and have long-term time horizons. Shareholders thus favor a high level of R&D investment intensity. Managers' interests diverge considerably from those of shareholders. They seek to maximize personal utility and are thus risk-averse. Managers prefer investments that are low risk, have a high degree of appropriability, and have a relatively short time horizon. Managers, thus, favor a low level of R&D intensity. Is this theory supported by empirical data? While the answer is not conclusive, the data certainly suggests that agency costs are a better explanation for corporate underinvestment than are myopic markets. This section presents data in support of the premise that shareholders favor a high level of R&D intensity. The next section will present data in support of the proposition that management favors a low level of R&D investment.

Although the anecdotal evidence concerning shareholder views
as to R&D spending by firms is mixed,\textsuperscript{186} statistical studies have shown that stock prices react positively to news of research and development investment. The Securities Exchange Commission (SEC), for example, studied the market reaction to announcements of new R&D projects at 62 firms between 1973 and 1983, and found that on announcement day, firms experienced a statistically significant 0.45% positive abnormal (net of market) return,\textsuperscript{187} followed by an additional 0.35% positive abnormal return the next trading day.\textsuperscript{188} After 20 trading days, the cumulative positive abnormal returns were 1.80%.\textsuperscript{189}

Another study, this one by economist Ariel Pakes, showed significant correlation of stock prices with unexpected changes (i.e., changes that could not be predicted from past values) in R&D investment.\textsuperscript{190} Pakes discovered that, on average, an unexpected increase of $100 in R&D expenditures is associated with a $1,870 increase in the value of the firm.\textsuperscript{191} Some of the exotic formulae used by certain

\begin{footnotesize}
\begin{itemize}
  \item \textsuperscript{186} There are any number of examples of stocks realizing dramatic jumps upon announcements of results of research and development activities, especially for technology stocks. One day in November 1992, for example, saw Synergen's stock rise by 5 percent on an announcement that it had finished one stage of drug testing and was about to begin another, and Genentech Pharmaceuticals' shares jumped 10 percent upon the news that it would file for approval to market a new drug. Joan O'C. Hamilton, \textit{Biotech May Be Flying too Near the Sun Again}, Bus. Wk., Nov. 23, 1992, at 110.

  There is, of course, also plenty of anecdotal evidence to support an assertion of shareholder antipathy towards corporate research and development spending as well. For example, analysts recently applauded Eastman Kodak's decision to bring in a new chief financial officer noted for cutting long-term investments in order to improve short-term cash flow. The analysts stated that Kodak needed to cut back on research and development spending and that layoffs of a substantial number of research and development personnel would "not hurt Kodak's reputation with investors . . . [who would not] be terrified if Kodak cut back on R&D." Ellen Freilich, \textit{Talking Point/ Eastman Kodak}, Reuters, Jan. 11, 1993. Consider also William Broad's report of one investment advisor's 1990 admonition to corporate researchers:

  "All of you are a variable expense," a Wall Street advisor told corporate research chiefs in 1990 at a meeting of the Industrial Research Institute. "Let me repeat," he said, wagging his finger at the audience, "you are all a variable overhead expense."

  \textit{Ridden With Debt}, supra note 45.

\end{itemize}
\end{footnotesize}
analysts to pick undervalued technology stocks, such as market-capitalization-to-R&D-spending and market-capitalization-to-R&D-employees ratios, are further indication of market approval of R&D spending.\textsuperscript{192}

There is also evidence indicating that institutional investors specifically favor increased R&D investment by firms. For example, an SEC study of 324 firms found that institutional ownership increased from 30\% in 1980 to 38\% in 1984 at the same time that R&D intensity was increasing from 3.3\% to 4.03\%.\textsuperscript{193} A regression analysis of this data determined that there was a "direct and statistically significant relationship between institutional ownership and R&D expenditures."\textsuperscript{194}

\textbf{B. Firm Size and R&D Intensity}

It is more difficult to measure management disfavor of high R&D intensity than shareholders' attraction to it. Investors indicate their approval or disapproval of corporate actions by the millions of buy and sell decisions they collectively make each day.\textsuperscript{195} These buy and sell decisions in turn raise or lower firms' share prices. Thus, the market's reaction to R&D investment decisions is easily measurable, provided that share price movement attributable to R&D investment decisions can be isolated from other factors affecting a firm's share price.

No such analysis tool is readily available to measure management attitudes towards R&D spending. Management, by its nature, decides how much to invest in R&D rather than reacts to such decisions. For this reason, this section will explore management attitudes towards R&D spending in an indirect manner: by exploring the relationship between firm size and R&D spending.


\textsuperscript{193.} SEC REPORT, reprinted in Corporate Takeovers, supra note 164, at 387.

\textsuperscript{194.} \textit{Id.} at 387-88. The SEC cautions that this relationship does not carry any causal implications. In fact, the SEC report presented data indicating no causal relationship between institutional ownership and R&D spending. Firms that experienced increased institutional ownership during the study period increased R&D spending by 0.65\% while those that experienced decreased institutional ownership increased R&D spending by 0.67\%. \textit{Id.} at 389. Despite the lack of a causal relationship, the data indicate that institutional investors are at the least not deterred from investing in firms with high R&D expenditures. \textit{Id.} at 388.

\textsuperscript{195.} This is referred to as the "Wall Street rule" for expressing approval or disapproval of a firm's policies and performance.
The relationship between market structure and R&D investment has been debated in the literature for many years. The debate questions which competitive market conditions are optimal for R&D investment. Traditional theory held that competitive markets were best, since firms invested in R&D in the hope of obtaining monopoly profits. Schumpeter challenged the traditional theory by proposing that an existing monopoly position was most conducive for R&D investment, since firms with monopoly positions could most easily appropriate the returns from such investments. Yet a third school, perhaps in the spirit of compromise, argued that an oligopoly structure was best.

The agency cost model outlined above is consistent with the Schumpterian approach. Corporate managers with monopoly positions are likely to be less risk-averse, less concerned with firm-specificity and appropriability, and thus have a longer time horizon than managers in competitive industries.

A related but different and less studied question concerns the relationship between firm size and R&D. On the one hand, some commentators stress that the high costs and risks of modern technology favor large firms. On the other hand, commentators also note the disadvantages of large firms.
with respect to R&D. While many of these disadvantages might be characterized as agency costs, many go to the quality of the R&D effort rather than the quantity of the R&D investment (or the R&D intensity, in the terminology of this paper).

Organizations with large management bureaucracies will, as a general proposition, have higher agency costs than smaller organizations. This effect may be attenuated in management R&D investment decisions. The agency cost model of R&D investment discussed above does not predict a strong dependence of R&D activity on firm size. The risk-aversion of managers at small firms would be likely to vary with firm size, since a single expensive failure could mean insolvency for the firm. However, once a firm was large enough to support several R&D projects, none of which could "break" the firm, the risk-aversion and time horizon of management with respect to R&D intensity would not appear to be a strong function of firm size.

One factor discussed in the research and development investment agency cost model would vary with firm size: the additional levels of decisional hierarchy that make it more difficult to get R&D funding proposals approved. This factor, however, is expected to be a fairly weak function of firm size. This is because, while numbers of managers would be expected to increase somewhat more than linearly with firm size, levels of management will increase less than linearly.

204. Large corporations, for example, are often characterized by huge management bureaucracies. By one estimate, as many as one third of the employees of a large firm may be working full time in activities that are part of, or support, the management process. Radner, supra note 122, at 1383. This compares to a figure of about 1 in 10 employees that were part of, or supported management in 1900. Id. at 1387.

205. For example, commentators have noted that innovations at larger firms tend not to be as imaginative or revolutionary as at smaller firms. See Scherer, INDUSTRIAL MARKET STRUCTURE, supra note 26, at 414 (noting the "bias away from really imaginative innovations in the laboratories of large firms). There is also a tendency in large corporate laboratories, as in all bureaucracies, to be "over-organized," with researchers spending a significant amount of their time writing reports and memoranda rather than performing actual research. See id. at 414-15. Finally, in order to advance in most R&D organizations, researchers must give up individual research and pursue careers in management. The "dual ladder" organizations offered at some firms have not been effective at combating this phenomena: "it is still commonplace to find the most able people in a laboratory devoting nearly all their time to supervising a swarm of drones. This is not the way truly creative work gets done." Id. at 415.

206. In fact, largeness may itself be an agency cost, with management "growing" the firm at shareholders' expense in order to increase their own amenities. See Harold Demsetz, The Structure of Ownership and the Theory of the Firm, 26 J.L. & Econ. 375, 377 (1983); Coffee, supra note 87, at 29 (referring to the "managerialist" model of the firm where managers use the residual funds left over after satisfying external constraints to expand the size of the firm, thereby assuring themselves "greater compensation, greater psychic income, and greater security").

207. This assumes that larger firms will have more levels of management hierarchy.

208. Consider the following extremely simplified model of firm management: every manager has 7 "direct reports." Thus, the CEO has 7 people reporting to her, each of whom has
Thus, an agency cost model of R&D investment decision making would predict increasing R&D intensity up to a certain firm size, followed by flat or slightly decreasing R&D intensity with increasing firm size. In fact, empirical evidence appears to show exactly this effect. Scherer, for example, reports that regression analysis has indicated that "research and development employment or spending rose either just proportionately or less than proportionately (i.e., exhibiting diminishing returns) with firm size, especially after some size threshold near the bottom range of Fortune's 500 industrials was reached." Scherer and others found that the relationship between firm size and R&D investment had an "inflection point," with R&D spending increasing faster than firm size among smaller firms but more slowly among larger firms, perhaps even falling with size among the largest firms in some industries.

seven people reporting to her, etc. This is known as a "branching hierarchy" and is the predominant structure of large organizations. See Robert C. Clark, Corporations 812-815 (1986). Everyone except those at the bottom-most level is considered a manager. The levels of management in the firm is then the number of steps up the corporation organizational chart from the lowest-level employee to the CEO. Under this model, numbers of managers and levels of management vary with firm size as follows:

<table>
<thead>
<tr>
<th>Firm Size</th>
<th>Managers</th>
<th>Levels of Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>57</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>400</td>
<td>57</td>
<td>3</td>
</tr>
<tr>
<td>2,801</td>
<td>400</td>
<td>4</td>
</tr>
<tr>
<td>19,608</td>
<td>2,810</td>
<td>5</td>
</tr>
<tr>
<td>137,257</td>
<td>19,608</td>
<td>6</td>
</tr>
</tbody>
</table>

Thus, for example, as firm size increases from 19,608 to 137,257 (approximately a factor of 7), the number of managers increases from 2,801 to 19,608 (also approximately a factor of 7). However, the levels of management increase only from 5 to 6.

Small firms may spend a larger percentage of revenues on R&D because they are young, growing concerns. See, e.g., Venture Industry Sponsors Study for Leverage on Hill, Corp. Financ. Wk., Sept. 16, 1991, at 6 (reporting that a study of 235 venture portfolio companies five years old or younger conducted by Coopers & Lybrand and Venture Economics for the National Venture Capital Association in 1991 showed that venture-financed companies invest nearly four times as much in R&D as Fortune 500 companies).

Scherer, Industrial Market Structure, supra note 26, at 420 tbl. 15.2. See also Wesley A. Cann, Jr., Section 7 of the Clayton Act and the Pursuit of Economic "Objectivity": Is There Any Role for Social and Political Values in Merger Policy?, 60 Notre Dame L. Rev. 273, 302 n.206 (1985) ("As firm size increases from large to giant, research and development effort does not increase proportionately. . . ." (quoting Michael P. Fertschuk & Kenneth M. Davidson, What's Wrong With Conglomerated Mergers?, 48 Fordham L. Rev. 1 (1979)).

By and large, there are no economies of scale with respect to firm size in the invention process. The bulk of the evidence indicates that, among firms engaged in R&D, relative effort tends to increase with size up to a point and then decline, with middle size firms devoting the most effort relative to their size.

Kamien & Schwartz, supra note 30, at 3, 17-18.
Similar results are obtained from an analysis of a recent *Business Week* "R&D Scoreboard," an annual feature that tabulates R&D expenditures as well as basic financial statistics for over 800 United States firms.\(^{212}\) Figure 1, compiled from the *Business Week* raw data, shows R&D intensity plotted against firm revenues. It is seen that large numbers of smaller firms (under $400 million in revenues) have high R&D intensity levels, many in excess of fifteen percent.\(^{213}\) Larger firms spend proportionately less. The dark, bold line shows average R&D intensity by firm size. Thus, firms with annual revenues of less than $1 billion average 5.0% R&D intensity, firms with $1-3 billion annual revenues average 3.6% R&D intensity, and firms with greater than $3 billion annual revenues average 3.4% R&D intensity. This is the sort of "weak" dependence of R&D intensity upon firm size predicted by the agency cost model.

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\(^{212}\) 1991 R&D Scoreboard, *supra* note 46. The 1991 edition reported on 890 firms with sales of at least $45 million and R&D expenditures of at least $1 million or at least one percent of sales. *Id.* at 107. *Business Week* obtains the data from the 10-K forms filed by the firms. *Id.*

\(^{213}\) In fact, there are data points in excess of 100%, though not shown on the plot. These were biotechnology firms with low sales but a great deal of equity and large R&D budgets. Additionally, the data for the extremely large firms (greater than $10 billion) was not plotted since this tended to obscure the data at the low end. Firm R&D spending behavior does not change very much between $10 billion and $100 billion, though it trends downward somewhat.
It is clear from Figure 1 that, for all firm sizes, there is a wide variation of R&D intensities. To see how R&D intensity varied with firm size, the 890 firms were divided into nine “slices” (consisting of the smallest 100 firms, the next 100, etc., up to the largest 90 firms). Figure 2 is a 3-dimensional histogram that graphically displays how the R&D intensity varied in the nine “slices.”
Some interesting information about firm size and R&D intensity is revealed by Figure 2. First, notice that rather than cluster about the mean R&D intensity (3.4% in 1991), firms at all sizes tend toward either very low (less than one percent) or very high (greater than ten percent) levels. This may be indicative of firms that have weak or strong monitoring, respectively.214

Second, Figure 2 shows that the relative frequency of occurrence of low R&D intensity increases significantly with increasing firm size, while the relative frequency of high R&D intensity firms de-

214. Alternatively, of course, it may be driven by industry type. That is, industries tend towards very high or very low R&D intensities.
increases with increasing firm size. This behavior is consistent with the agency cost model for R&D investment.

C. Corporate Restructuring and R&D Spending

A frequently articulated criticism of the intense merger and acquisition activity of the 1980s was their supposedly adverse effect on industrial investment in R&D.\textsuperscript{215} These critics blamed the "myopia" of both investors and managers. The criticisms generally adopted some variation of the following reasoning:

\textit{Myopic investors (primarily institutional investors) facilitate hostile tender offers by standing ready to tender their shares to anyone offering the slimmest of premia over the market price. These tender offers, successful or not, result in corporate restructuring that cause funds that would otherwise be invested in R&D to be spent servicing debt.\textsuperscript{216} Acquiring firms spend their cash on acquisitions (thus purchasing then known results of another firm's R&D investment) rather than investing in an internal R&D program.\textsuperscript{217} The acquired firms are then treated as "cash cows," to service the debt used to finance the acquisition.\textsuperscript{218} Even if a takeover attempt is unsuccessful, the huge debts often taken on by targets can divert funds from R&D.\textsuperscript{219} Finally, the mere prospect of a takeover can...}
curtail R&D spending, even before any buyer appears upon the scene. This prospect can divert management’s attention from the long-term investments to short-term performance:220 “to stave off hostile takeover attempts, corporate managers . . . try to prop up stock prices by increasing short-term earnings, even at the expense of abandoning otherwise profitable long-term investment projects.”221

The view, described above, that corporate restructuring has a detrimental effect on R&D investment, is largely at odds with the agency cost approach presented in this paper for two reasons. First, it has been argued here that investors should not be and, in fact, are not myopic. The market is perfectly capable of valuing and does value long-term investment decisions by firms. Second, restructuring is typically believed to reduce, not increase, agency costs222—in fact, this is one of the reasons why purchasers are willing to pay a premium over market price.223 Restructuring can decrease agency costs in acquired and acquiring firms and unacquired targets because the increased debt constrains the non-profit maximizing activities of managers224 and can even constrain excessive risk-avoidance of managers.225

quire Phillips, the firm operated “the leading American oil company research laboratory,” Ridden with Debt, supra note 45. Phillips borrowed billions of dollars to finance a defensive stock repurchase plan. Id. As a result, scientific research was cut in half. Id. Similarly, Goodyear took on $4 billion in debt to fight off Goldsmith. Corporate Restructuring, supra note 215, at 122 (statement of Nathan H. Hart). In the immediate aftermath, the corporate R&D budget was slashed from $350 million to $150 million. Id. Worse yet, the company adopted a policy to discontinue any R&D program that would not show a payoff within 2 years. Id.

220. See Corporate Takeovers, supra note 164, at 367 (statement of Charles F. Rule) (acknowledging that the argument is often made, though Rule himself disputes it).

221. SEC REPORT, reprinted in Corporate Takeovers, supra note 164, at 383.

222. See Easterbrook & Fischel, supra note 17, at 112-117, 171-74 (describing their agency cost model of tender offers). Easterbrook & Fischel note that “the gains (if any) [from successful tender offers] come from the subsequent changes in the corporate structure and operations.” Id. at 163.

223. Reductions in agency costs are perhaps most often cited with respect to leveraged buyouts, transactions that, as will be discussed infra, have been subject to particularly harsh criticism for their R&D reducing effects. See, e.g., John C. Coffee, Market Failure and the Economic Case for a Mandatory Disclosure System, 70 VA. L. Rev. 717, 740 n.72 (1984) (“LBO’s reduce agency costs, which may increase the value of the firm in the hands of its shareholders”); Henry N. Butler & Larry E. Ribstein, Opting Out of Fiduciary Duties: A Response to the Anti-Contractarians, 65 WASH. L. Rev. 1, 22 n.88 (1990) (noting a reduction-of-agency-cost explanation for premia paid in LBOs); Ronald J. Gilson, Evaluating Dual Class Common Stock: The Relevance of Substitutes, 73 VA. L. Rev. 807, 840 (1987) (noting that firms undergo LBOs because of the presence of agency costs).

224. For example, former RJR Nabisco CEO Ross Johnson, concerned about the high debt required by a contemplated LBO, responded: “I’m telling you, we’re not going to start running a pushcart operation here. I don’t want a bunch of your [the LBO firm, e.g., the prospective new “owners”] guys coming around saying we should have five jets instead of six, that sort of thing,” Burrows & Helyar, supra note 182, at 166.

225. See Butler & Ribstein, supra note 223, 22 (1990) (“A debt-heavy structure, on the
The available data on the effect of corporate restructuring on R&D investment is somewhat mixed, but the preponderance of the evidence points to the conclusion that restructuring has not had the adverse effect commonly attributed to such transactions.

Of course, there is no lack of anecdotal evidence of the adverse effects of successful and unsuccessful takeovers such as those of Philips Petroleum and Goodyear. One of the few studies of large numbers of firms that has found an adverse relationship between corporate restructuring and R&D investment was performed by the National Science Foundation (NSF). The NSF studied the 200 firms with the largest R&D budgets during the 1984-86 period. Thirty-three of these firms merged into sixteen resulting firms and eight additional firms were restructured through leveraged buy outs (LBOs) or stock buy-backs. The twenty-four restructured firms reduced R&D spending by a combined 8.3% in real terms between 1986 and 1987, while the 176 non-restructured firms reported a 5.4% increase in R&D spending during the same period.

Although the NSF study offers grounds for concern, numerous other investigations have concluded that corporate restructurings are not accompanied by a reduction in R&D investment. For example, Professor Bronwyn Hall, a University of California at Berkeley economist, compiled a database of 2519 publicly held United States manufacturing firms over the 1976-85 period, during which time some 600 firms were acquired. Hall found "little evidence of a significant

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228. Id. These 200 firms accounted for 90% of the total private R&D spending during the time period of the study. Id. at 25.

229. Id.

230. Id. The study is careful to note that some of the reduction in spending may represent the elimination of duplication and inefficiency. Id. at 26. The study also notes that the data does not permit an assessment of any long-term effects of mergers and acquisitions on company-sponsored R&D activities. Id. at 32.

231. Hall, supra note 217, at 77.
difference in the mean growth rates of R&D intensity between firms involved in acquisitions and nonacquiring firms. In an update to this study, Hall reported that "the average post-acquisition R&D intensity [of firms] rose from 1.6% to 1.8% in the two years following the acquisition;" the same rate of increase seen by non-acquisition firms. Thus, Professor Hall concludes that "corporate restructuring per se is not a risk to the industrial R&D process." The Hall results are consistent with most other studies that have been performed on corporate restructuring and R&D.

Although the Hall results appear to contradict the NSF study, the two are actually measuring different phenomena. The NSF study looked at the total level of R&D funding while Hall looked at R&D intensity—R&D as a percentage of sales. Thus, a firm that became smaller through restructuring and reduced its R&D budget proportionately would show up as a decrease in R&D spending in the NSF study and as unchanged in R&D intensity in the Hall study.

A study by the Chief Economist of the SEC looked at the flip side of the NSF and Hall studies—namely, what is the effect of R&D investment on a firm’s likelihood of being acquired. The myopic argument supra postulated that managers reduce or minimize R&D investments in an attempt to prop-up short-term profits and stock prices and thus avoid acquisition. The SEC report suggests that such behavior on the part of management is misguided. The study looked at 217 firms that were targets of successful tender offers between 1981 and 1984. Of these, 160 firms reported no significant R&D expenditures prior to the tender offer, suggesting that it is incorrect to assume that large R&D expenditures make a company susceptible to tender offers. Of the remaining 57 firms, R&D intensity was less than one-half that of industry control groups (0.77% vs. 1.66%) in the year immediately preceding the tender offer and about half in the three preceding years (0.75% vs. 1.49%). This data strongly suggests

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232. Id. at 83.
234. Id. at 49.
235. See, e.g., Corporate Restructuring, supra note 215, at 52-57 (statement of William F. Long). Long summarized the results of nine studies of the impact of restructuring or of LBOs on R&D investment, including those of Hall and the NSF, and concluded that "[c]learly the average finding, the typical finding, . . . is that there's no effect of mergers and acquisitions generally or of leveraged buy-outs in particular on R&D performance." Id. at 53.
236. Professor Hall herself offered this explanation for the different results. See Corporate Restructuring, supra note 215, at 44 (statement of Bronwyn Hall).
237. SEC REPORT, reprinted in Corporate Takeovers, supra note 164, at 382.
238. Id. at 389-390.
239. Id. at 390.
240. Id.
that R&D spending does not make a firm vulnerable to a takeover.

A recent study by Lisa Meulbroek, et al., provides some of the best direct empirical evidence refuting the myopic market hypothesis. Meulbroek examined the R&D spending of 203 firms that adopted shark repellent measures between January 1977 and May 1985. Spending on R&D was compared for the year prior to and the three years following the adoption of the shark repellent measures. The myopic market theory would predict that R&D intensity would increase following the adoption of shark repellent measures, as managers are freed from the threat of hostile takeovers and able to focus on longer-term investments.

Contrary to the results predicted by the myopic market model, Meulbroek found that, after adjusting for market-wide and industry-wide increases in R&D spending, R&D intensity decreased significantly following a firm's implementation of a shark repellent. For example, as compared to the year prior to the implementation of a shark repellent, market adjusted R&D intensity decreased by a statistically significant cumulative 15.42, 25.29, and 37.25% in the first year, first two years, and first three years following the adoption of a shark repellent, respectively. The industry-adjusted numbers were 5.99, 11.46, and 12.04%, all statistically significant. Meulbroek and her colleagues speculate that the decrease in R&D spending following the implementation of anti-takeover measurements might be explained by entrenched management, freed from the discipline of the market for corporate control, acting in its own self-interest rather than the long-term interests of the firm and its shareholders.

242. Shark repellents are provisions in a firm's charter or bylaws that are intended to delay or discourage unsolicited takeover bids. See David S. Freeman, Shark Repellent Charter and Bylaw Provisions, 16 J. Corp. L. 491, 494 (1991).
243. Meulbroek et al., supra note 13, at 1116.
244. Id. at 1111-16.
245. Id. at 1114.
246. Id.
CONCLUSION

There is wide agreement that American industry underinvests in R&D. Many commentators blame this underinvestment on "myopic" investors who are interested in short-term profits at the expense of long-term investment and who force managers to adopt short-term strategies. This article has disputed the myopic investor explanation, both theoretically and empirically, and suggested in its place an agency cost model in which investors favor long-term investment in R&D but managers, in their own self-interest, maximize short-term profits and sacrifice risky, long-term R&D investments.

The focus of this article has been on describing and explaining the problem of corporate underinvestment in R&D, rather than in proposing solutions. However, the model one chooses to describe the problem has important public policy implications. The myopic market model suggests adoption of strong anti-takeover legislation, for example, while the agency cost model would reject such measures and encourage a vigorous market for corporate control. This debate over corporate restructuring and R&D spending has been presented above, and the data strongly suggest that the agency cost model provides the better explanation for the available data. Similar implications are involved for such questions as tax policy,\textsuperscript{248} patent policy,\textsuperscript{249} executive compensation,\textsuperscript{250} and even insider trading.\textsuperscript{251}


\textsuperscript{250} See supra notes 77-83 and accompanying text.