



Costly trade, managerial myopia, and long-term investment

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ABSTRACT

The costly trade theory predicts that it is much more difficult to exploit long-term private information than short-term. Thus, there is less long-term information impounded in prices. The managerial myopia theory predicts that a variety of short-term pressures, including inadequate information on long-term projects, cause asymmetrically-informed corporate managers to underinvest in long-term projects. The introduction of long-term options called LEAPS provides a natural experiment to jointly test both theories, which are otherwise difficult to test. We conduct an event study around the introduction of LEAPS for a given stock and test whether corporate investment in long-term R&D/sales increases in the years following the introduction. We find that over a two year period of time LEAPS firms increase their R&D/sales between 23% and 28% (\$125–\$152 million annually) compared to matching non-LEAPS firms. The difference depends on the matching technique used. Two other proxies for long-term investment find similar increases. We find that the increase is positively related to LEAPS volume. We also find that the increase is larger in firms where R&D plays a larger and more strategic role. We test if a firm becomes less likely to beat analyst's quarterly earnings forecasts after LEAPS are introduced and find support for the hypothesis. These results provide both statistically and economically significant support for the costly trade and managerial myopia theories.

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1. Introduction

Shleifer and Vishny (1990) develop a “Costly Trade” theory that predicts that it is more difficult to exploit information whose public resolution is long-term rather than short-term. They develop a model of asymmetric information about the trading ability of an informed trader, which causes capital providers to ration capital availability to informed traders and charge a high cost of capital. This high cost of capital makes it especially difficult to exploit long-term private information rather short-term private information. With endogenous information acquisition, this difficulty in exploiting long-term private information causes stocks to impound less long-term information than short-term.² Stein (1988) develops a “Managerial Myopia” theory under which managers have an incentive to focus on short-run actions to prop up the current stock price in order to reduce the likelihood of a takeover and this leads them to underinvest in long-term projects. A wide variety of short-term pressures have been suggested as contributors to managerial myopia, including short-term trading by institutional traders, the short-term focus of security analysts, and the issue we consider, very little information being impounded into security prices about long-run projects.³ We use the introduction of long-term options called LEAPS as a natural experiment to jointly test both theories, which are otherwise difficult to test.

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² Holden and Subrahmanyam (1996) develop a complementary version of the Costly Trade theory. In their model, long-term private information is more risky to exploit than short-term information. For high enough values of risk aversion, this causes risk averse informed traders to choose to acquire short-term information only. That is, they forego trading in long-term information, because the utility cost is too high.

³ The extensive literature on managerial myopia includes Narayanan (1985, 1996), Stein (1988, 1989), Thakor (1980), Bizjak, Brickley, and Coles (1993), Bebchuk and Stole (1993), Chemla (2004, 2005), among others.

It is difficult to empirically test the Costly Trade and Managerial Myopia theories because it is difficult to separate long-term informational events and long-term management actions from short-term events and short-term management actions. An opportunity to make this separation is presented by the Chicago Board Options Exchange (CBOE) introduction of long-term options. They are called Long Term Equity Appreciation Securities (LEAPS). LEAPS are American-style, standardized, exchange-listed options on individual stocks. They are similar in every way to short-term options except that their maximum time to maturity (39 months) is nearly four times greater than short-term options. LEAPS lower the cost of trading on long-term information because of the implicit leverage in options compared to the underlying stocks. That is, an investment in LEAPS allows one to make a much larger long-term bet than the same dollar investment in the underlying stocks. In theory, a lower cost of long-term trading should lead to more long-term informational efficiency and thus increase the incentive for management to invest in long-term projects.

This paper tests this theoretical prediction by performing an event study around the introduction of LEAPS trading on a given stock. We look at three proxies for long-term investment: (1) R&D expenditures as a percentage of sales, (2) R&D as percent of assets, and (3) the ratio of net property, plant and equipment divided by current assets (hereafter PP&E/CA). Under the null hypothesis, there would be no increase in the three proxies in the years following the introduction of LEAPS. Under the alternative hypothesis, there would be an increase in the three proxies following the introduction. The CBOE exercises sole discretion over the selection of firms upon which to introduce LEAPS. The firms themselves have no influence over this selection process. We use matching samples formed in a variety of ways. Our results are robust to the alternative matching techniques we use.

We find that over a two year period of time LEAPS firms increase their R&D/sales between 23% and 28% (annual R&D spending increases by a total of \$125–\$152 million) compared to matching non-LEAPS firms. Similarly, LEAPS firms increase their R&D/assets between 20% and 22% compared to matching non-LEAPS firms. Also, LEAPS firms increase their PP&E/CA between 27% and 35% compared to matching non-LEAPS firms. The range of results depends upon the matching technique used. Our results are statistically significant in rejecting the null hypothesis and supporting the alternative. We find both statistically and economically significant support for the Costly Trade and Managerial Myopia theories.

For the subset of firms with high prior R&D spending (>3% of sales), we find that higher LEAPS volume in the year of introduction leads to greater increases in R&D/sales intensity down the road. This supports the theory that a higher volume of long-term options should lead to more long-term information being impounded into the price, which should lead to a greater increase in R&D intensity.

We also find that firms with high prior R&D spending (>3% of sales) have a larger subsequent increase in R&D spending than firms with low prior R&D spending (<3% of sales). This supports the idea that LEAPS have a greater impact on firms where R&D plays a larger and more strategic role than they do on firms where R&D is smaller and more peripheral.

Graham et al. (2005) documents additional myopic behavior. They find that a large fraction of managers focus myopically upon beating the analyst's quarterly earnings forecasts. In other words, some managers are willing to sacrifice long-term payoffs to beat short-term earnings forecasts. We test the hypothesis that a firm becomes less likely to beat analyst's quarterly earnings forecasts after LEAPS are introduced and find support for the hypothesis.

Our findings have important implications for boards, option exchanges, investors, and policy makers. Boards might encourage options exchanges to introduce long-term options. Options exchanges can use the results of this paper to better understand existing long-term options and to help design new derivative securities. Investors should update their security valuations based on the trade imbalance (buys minus sells) in LEAPS. Policymakers should consider that policy changes that encourage/discourage LEAPS introductions will have a corresponding impact on long-term corporate investment.

The existing empirical literature on the introduction of option trading investigates whether the introduction of option trade increases the firm's share price efficiency by increasing incentives to collect private information and trade on it. Jennings and Starks (1986) find that market prices adjust more rapidly to new information for firms that have exchange-listed options than for those firms without option trade. Damodaran and Lim (1991) find that prices adjust more rapidly to new information after options are listed. Skinner (1989) finds that the reaction to earnings reports is smaller after options are listed. Manaster and Rendleman (1982) suggest that the benefits of trading options include leverage, lower transactions costs, and fewer short-sale restrictions. They tested the hypothesis that the informed trader prefers trading options on stocks to trading stocks. They found that option price changes help predict stock price changes, consistent with the hypothesis that arbitrageurs force the firm's stock price to adjust to information in option prices. Their results imply that the introduction of a long-term option would be associated with an increase in the quantity and precision of long-term information impounded into current share price. All of these findings are consistent with the hypothesis that option trade increases the incentive to invest in information about the firm. We contribute by testing the logical extension of this literature that the introduction of trade on a long-term option should increase the efficiency of stock price with respect to long-term information.

The extant empirical literature on managerial myopia investigates whether managerial myopia results in managers choosing to meet earnings forecasts at the cost of value-maximizing R&D spending. Graham et al. (2005) report that their analysis of their survey of financial executives finds that the majority of managers would avoid a positive NPV project if it meant missing the current quarter's consensus earnings forecast, and furthermore, three-quarters would give up economic value in exchange for smooth earnings. Bhojraj and Libby (2005) test whether, in an experimental setting, experienced managers exhibit signs of myopia when capital market pressure increases. They conclude that when choosing between projects where there exists a conflict between near-term earnings and total cash flow, experienced managers will often sub-optimally choose projects that maximize short-term earnings at the cost of value maximization.

Using firm-level data Dechow and Sloan (1991) and Baber et al. (1991) find results consistent with managerial myopia in the case of CEO's near retirement, and in the case of money-losing firms, respectively. Furthermore, Roychowdhury (2006) reports

evidence of earnings management by examining real activities (including a reduction of discretionary expenditures) to meet analyst's earnings forecasts. Bushee (1998) finds myopia exacerbated in those firms held by transient institutional investors.

Cheng et al. (2005) test whether the evidence that managers will forgo value-maximizing projects to meet earnings targets, as reported in Graham et al.'s survey analysis, and corroborated by Bhojraj and Libby in an experimental setting, are supported by firm-level historical earnings and R&D data. Cheng et al. examine the frequency with which firm's offer earnings guidance, and find that firms that offer more frequent earnings guidance also spend less on R&D and they also meet analyst consensus more frequently. They conclude that results are consistent with more frequent earnings guidance being associated with myopic R&D spending. In other words, they conclude that the historical empirical evidence is consistent with the contention that managers myopically forgo value-maximizing projects in favor of meeting short-term earnings targets.

The extant empirical literature on managerial myopia finds that managerial myopia results in managers choosing to meet earnings forecasts at the cost of value-maximizing R&D spending. We contribute by testing the logical extension of this literature, that less managerial myopia is observed as a result of the reduction in capital market pressures that result from LEAPS introduction. We do this by testing whether less managerial myopia is observed subsequent to LEAPS introduction by examining both R&D spending and the frequency with which LEAPS firms meet analyst earnings forecasts.

The paper proceeds as follows. Section 2 discusses the introduction of LEAPS. Section 3 presents the empirical specification. Section 4 presents the sample and descriptive statistics. Section 5 presents the main results. Section 6 examines the relation between LEAPS volume and changes in R&D intensity. Section 7 presents an additional robustness check. Section 8 examines changes associated with LEAPS introduction in the firm's propensity to meet earnings forecasts. Section 9 concludes.

2. The introduction of LEAPS

Prior to 1973, options could only be traded in the over the counter market. In 1973, the Chicago Board Options Exchange (CBOE) became the first exchange to list and trade short-term options with a maximum of 12 months maturity. Today, short-term options are listed on six U.S. exchanges and dozens of exchanges around the world.

In 1990, the CBOE introduced long-term options (LEAPS) with a maximum of 39 months expiry. The CBOE stated rationale was that LEAPS would result in lower trade costs because of the leverage that they offer. It was also suggested that LEAPS would appeal to investors with longer horizons.⁴ Long-term options can be replicated with a complex combination of short-term options and money-market securities, but Choie and Novomestky (1989) find that replication is expensive in terms of transaction costs. To date, LEAPS have only been introduced on firms upon which exchange-listed short-term options are currently trading.

The decision to introduce LEAPS trade on a particular stock is made by the CBOE. It may be thought of as largely an exogenous shock. Kim and Young (1991) note that the decision to introduce either a short-term option or LEAPS on the exchange is not made by the manager of the firm on which the option trades and thus cannot be a signal. Furthermore, Jennings and Starks (1986) note that the introduction of option trade is not random, but rather the decision to introduce short-term option trade depends upon investor interest, stock trading activity and stock price volatility. Kim and Young (1991) and Holland and Wingender (1997) find zero abnormal announcement return on short-term option and LEAPS introductions, respectively. This is not surprising since the criteria and the data that the CBOE uses to decide on the introduction of short-term option and LEAPS introductions is publicly available.

While it has always been possible to buy over-the-counter, long-term options on individual stocks, trade in standardized exchange-listed LEAPS should be less costly than trading a similar, private contract. For LEAPS to increase the efficiency of stock price of firms with long-term cash flows, they need only reduce the trade cost differential between short- and long-term information enough so that the informed trader can realize an increase in their profits by trading long-term information. By reducing the costs of informed trade on long-term information, LEAPS should result in positive externalities for the firm. Specifically, the Costly Trade and Managerial Myopia theories imply an increase in investment in long-term projects when LEAPS are introduced. The null hypothesis follows.

H1. The firm's investment in projects with long-term cash flows does not increase when LEAPS are introduced on the firm's shares.

3. Empirical specification

Following the initial introduction of LEAPS trade on a limited number of stocks in 1990, LEAPS were introduced on additional stocks in the following years. A sample of firms upon which LEAPS were introduced is collected and referred to as the "Introduction Sample". The percent change in the firm's annual investments in projects with long-term cash flows is examined around the year in which LEAPS trade was introduced.

Research and Development expense is used as the empirical proxy for investment in long-term projects for three reasons. First, theoretical work on corporate long-term investment by Stein (1989), Noe and Rebello (1997) and Bebchuk and Stole (1993) explicitly suggests the use of Research and Development expense to measure investment in long-term projects. Second, the prior empirical work of Meulbroek and Mitchell (1990), Knoeber (1986), Bushee (1998) and Dechow and Sloan (1991) use of Research and Development expenses to examine corporate investment in long-term projects. Third, the long-term time lag between the investment decision and the associated returns for Research and Development expenditures makes it a good proxy for investment in long-term projects.

The percentage change in the firm's annual R&D is divided by sales to control for size effects. R&D/sales is referred to as the "R&D Intensity" in what follows. The year in which the LEAPS trade is introduced is referred to as year zero. A (-1,1) window is used to

⁴ The Financial Times, September 12, 1990, p.31.

measure the change in R&D intensity from 1 year prior to the introduction to the year following the introduction to examine the percentage change in R&D intensity. As firms may be slow to adjust R&D in response to an introduction, an alternative (-1,2) window is used. This measures the change in R&D intensity from the year preceding the introduction to the second year following the introduction. The hypothesis, H1, that R&D intensity does not increase when LEAPS trade is introduced on the firm's shares is tested using a one-tailed *T*-test.

A set of control firms is used to control for other sources of variation in the firm's R&D intensity. The control firms are identified by matching the sample firms on: (1) industry, (2) market-to-book equity, and (3) cash divided by assets. Market-to-book proxies for the level of growth opportunities faced by the firm. Cash divided by assets proxies for the ability of the firm to make R&D investments without accessing the capital market. A firm with greater investment opportunities and/or more cash may, all else equal, increase R&D for reasons unrelated to the LEAPS introduction.

Data on financial statement items including market-to-book equity, cash, assets, and SIC code are obtained from the Compustat annual files. Each LEAPS firm is matched with a control firm in year -1. Therefore the match occurs prior to the LEAPS introduction.

The matching technology employed by Huang and Stoll (1996) is utilized to select a match firm. Each firm in the LEAPS introduction sample is matched with all potential match firms in the same 4-digit SIC code. For each matched pair, the following match score *S* is calculated as

$$S = \left(\frac{MtB_i^{LEAPS} - MtB_i^{NoLEAPS}}{(MtB_i^{LEAPS} + MtB_i^{NoLEAPS})/2} \right)^2 + \left(\frac{Cash/Assets_i^{LEAPS} - Cash/Assets_i^{NoLEAPS}}{(Cash/Assets_i^{LEAPS} + Cash/Assets_i^{NoLEAPS})/2} \right)^2, \quad (1)$$

where *MtB* is market-to-book equity, *LEAPS* refers to a firm in the LEAPS sample, *i* indexes *LEAPS* sample firms and *NoLEAPS* refers to a matching firm in the same SIC code. The matching firm with the smallest matching score is chosen.

As a robustness check, an alternative control set is constructed by matching on industry as defined at a 3-digit SIC code level. The *S* score matching procedure is repeated at the 3-digit SIC code level. The percentage change in R&D intensity net of the match firm is calculated for both SIC code levels.

In addition to examining the percentage change in R&D spending net of a match firm, we examine the percentage change net of that of a portfolio of match firms. Control portfolios are identified at both the 4-digit and 3-digit SIC code levels. The control portfolio is defined as all firms in the firm's SIC code, for which either market-to-book or cash/total assets are within 20% of the value of either variable for the LEAPS firm.

4. Sample and descriptive statistics

The sample of LEAPS introductions is drawn from the period that begins with the first introduction of LEAPS, in October 1990, and ends in 2002. We begin with a sample of 378 firms upon which the Chicago Board Options Exchange has introduced these long-term options. The date for each LEAPS introduction is located on either Lexus-Nexus or Dow Jones Interactive.

Table 1 presents the sample. We start with 378 LEAPS introductions from 1990 to 2002. The LEAPS sample excludes firms that do not report R&D expenditures during the years immediately adjacent to the introduction year. There is sufficient data to examine 94 of the introductions. Data losses include 72 introductions for which no introduction date is available and 187 introductions on firms for which sufficient data are not available on Compustat to complete the analysis and 25 for which data is not yet available on COMPUSTAT for the end of the second year subsequent to introduction. Panel A of Table 1 presents the distribution of introductions over time. The distribution of LEAPS introductions is: 9 in 1990, 4 in 1991, 10 in 1992, 11 in 1993, 17 in 1995, 5 in 1996, 12 in 1997, 4 in 1998, 21 in 2001 and 1 in 2002.

Panel B presents the LEAPS volume compared to Total Equity Option Volume. LEAPS volume and total equity option volume are gathered manually from the Annual Market Statistic books published by the Chicago Board Options Exchange. The volume proxy is LEAPS annualized LEAPS volume as a percentage to total equity option volume. Volume is annualized by multiplying the average daily volume calculated by a standard number of trading days per year, 252. During the introduction year, year 0, the average daily volume is calculated only over those trade days from the date of introduction to year end.

For any level of LEAPS annualized volume, the LEAPS volume may be more important to the resolution of information problems for a firm that has a lower level of equity option trade than to a firm with higher levels of ordinary option trade. The LEAPS volume percentage attempts to control for the LEAPS volume relative to total equity option volume.

Each of the proxies is collected for years 0, 1 and 2. The average LEAPS security trades 10,554 contracts a year in year 0, 24,890 contracts in year 1 and 31,607 contracts in year 2. As a percentage of annual equity option volume, annualized LEAPS volume makes up 4.2% of equity option volume in year 0, 13.0% in year 1 and 8.6% in year 2.

Panel C of Table 1 presents the year -1 parameters on which LEAPS firms are matched with the control firms. The control sample is matched on cash/assets and market-to-book. A variety of percentile values for the match variables are presented here. We find that the introduction of LEAPS is concentrated in three industries: 20 in Chemicals and Allied Products (SIC 28), 19 in Electronic and other electrical equipment, except computer equipment (SIC 36), and 14 in Business Services (SIC 73). Apparent industry concentration suggests that an industry control may be important in examining LEAPS affects.

The median number of firms operating in the firm's industry defined by its 4-digit SIC code is 43. The average matching score calculated at the 3-digit levels is smaller than the average matching score calculated at the 4-digit level. While the 4-digit matching firm may not have the smallest score, it may be in a line of business that is more similar than is the 3-digit match firm.

Table 1
Descriptive statistics

Panel A: Sample introductions by year. The annual number of sample LEAPS introductions by calendar year.												
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	2001	2002	Total
Introductions	9	4	10	11	0	17	5	12	4	21	1	94

Panel B: LEAPS volume compared with total equity options volume. Annual volume is the annualized volume for the LEAPS firms. Total equity options annual volume (contracts) is the total of annualized LEAPS and ordinary equity option trade volume. Annualized volume is the average daily volume for all the days during the year of introduction, times 252 standardized trading days per year. LEAPS/total equity options is the annualized LEAPS volume divided by total equity options volume.			
Variables	Year 0	Year + 1	Year + 2
LEAPS annual volume (contracts)	10,554	24,890	31,607
Total equity options annual volume (contracts)	441,526	388,661	482,936
LEAPS/total equity options	4.2%	13.0%	8.6%

Panel C: Comparison of LEAPS sample and control firms in year – 1. Descriptive statistics are for the year before the introduction year (year – 1) for the 94 sample firms on which Long-term Equity Appreciation Securities (LEAPS) were introduced during the 1990–2002 period, and for which data is available to analyze the change in R&D in the subsequent years. Income statement, balance sheet and market value data are for the year end immediately preceding the date on which LEAPS were introduced. Annual share trade volume is for the fiscal year end immediately preceding the date on which LEAPS were introduced. Market-to-book equity is market value of equity divided by book value of equity. Cash/total assets is cash divided by total assets. LEAPS firms are the sample of firms on which LEAPS were introduced. Control firms are matched on industry, market-to-book equity and cash/total assets. Best match firms are identified by matching on Market-to-book equity and cash/total assets.					
Variables	10th Percentile	25th	50th Percentile	75th Percentile	90th Percentile
<i>Market-to-book equity</i>					
LEAPS sample	1.46	2.17	3.41	6.62	11.34
Control firms:					
● Best match in 4-digit industry	1.14	2.05	3.04	5.64	9.31
● Portfolio in 4-digit industry	1.28	1.84	3.16	4.45	6.56
● Best match in 3-digit industry	1.26	2.04	3.28	5.80	9.57
● Portfolio in 3-digit industry	1.47	2.01	2.99	4.10	6.54
<i>Cash/total assets</i>					
LEAPS sample	0.02	0.05	0.15	0.37	0.51
Control firms:					
● Best match in 4-digit industry	0.02	0.05	0.16	0.34	0.57
● Portfolio in 4-digit industry	0.04	0.10	0.24	0.36	0.45
● Best match in 3-digit industry	0.02	0.05	0.14	0.34	0.57
● Portfolio in 3-digit industry	0.03	0.12	0.22	0.33	0.45

The industry concentration of LEAPS introductions discussed above suggests that industry controls may be important when isolating the effects of LEAPS.

5. Main results

5.1. Dollars of R&D

We examine dollar change in R&D over two windows surrounding year 0. The two windows are denoted as $(-1,1)$ and $(-1,2)$. The $(-1,1)$ window measures the dollar change in the firm's annual R&D from the fiscal year prior to the introduction to the fiscal year immediately subsequent to the fiscal year during which the introduction occurred. The $(-1,2)$ window is defined analogously and ends in year 2.

Table 2, Panel A, presents the mean dollar change in R&D. For the LEAPS firm R&D increase \$115.40 million and \$142.69 million over the $(-1,1)$ and $(-1,2)$ windows, respectively. The mean dollar changes for the control firms for $(-1,1)$ are an order of magnitude lower than the LEAPS firms, and range from \$9.38 million to \$43.34 million. The same pattern holds for the medians, but a somewhat lower level than the means. Median growth in dollars of R&D are \$36.89 and \$42.35 million over the two windows. The median dollar changes for the control firms are also an order of magnitude lower than the LEAPS firms, ranging from \$1.83 million to \$13.33 million. Considering both the mean and median results, the strong difference between LEAPS and controls firms holds across the board.

5.2. R&D/sales

Next, we examine the percent change in R&D/sales. Results are presented in Panel A, the mean percent change in R&D/sales for LEAPS firms is 22.32% over $(-1,1)$ and 21.19% over $(-1,2)$. The mean percent change for the control firms are all negative, ranging from -6.25% to -2.38%. The same pattern holds for the medians, but at a lower level.

Table 2
Alternative measures of long-term investment for LEAPS sample and control firms

The (−1,1) window measures the change in the variable from the fiscal year prior to the introduction of LEAPS to the fiscal year immediately subsequent to the fiscal year during which the introduction occurred. The (−1,2) window is defined analogously. R&D is Research and Development expense, PP&E is the net property plant and equipment divided by current assets. Balance sheet values are from year end, and sales and R&D are annual. For dollar amount of R&D the change is in millions of dollars, for the other variables the change is the percentage change in the ratio. *p*-values are for the two-tailed test of the null hypothesis that the change in the variable is equal to zero. LEAPS sample is the sample of 94 LEAPS firms from 1990–2002. Best match in 4-digit (3-digit) industry is the single firm that matches the closest and the portfolio in 4-digit (3-digit) industry is a portfolio of control firms within a bracket of the LEAPS firm. Sample size is 94 on RD dollars, R&D/sales, R&D/assets and 88 on PP&E/CA.

Panel A								
Variables	Mean (−1,1)	<i>p</i> -value of <i>T</i> -test	Mean (−1,2)	<i>p</i> -value of <i>T</i> -test	Median (−1,1)	<i>p</i> -value of sign-rank	Median (−1,2)	<i>p</i> -value of sign-rank
<i>Dollar change in R&D</i>								
LEAPS sample	\$115.40	(0.0001)	\$142.69	(0.0002)	\$36.89	(0.0001)	\$42.35	(0.0001)
Control firms:								
● Best match in 4-digit industry	\$10.17	(0.1128)	\$22.98	(0.0433)	\$1.83	(0.0001)	\$9.27	(0.0001)
● Portfolio in 4-digit industry	\$14.84	(0.0512)	\$9.95	(0.1739)	\$6.52	(0.0001)	\$2.32	(0.0001)
● Best match in 3-digit industry	\$9.38	(0.1232)	\$43.34	(0.0870)	\$1.88	(0.0001)	\$2.63	(0.0001)
● Portfolio in 3-digit industry	\$13.37	(0.0153)	\$23.08	(0.0007)	\$5.36	(0.0001)	\$13.33	(0.0001)
<i>% Change in R&D/sales</i>								
LEAPS sample	22.32	(0.0037)	21.19	(0.0044)	7.33	(0.0031)	5.14	(0.0141)
Control firms:								
● Best match in 4-digit industry	−2.78	(0.5510)	−2.38	(0.5493)	−0.56	(0.7948)	0.16	(0.9181)
● Portfolio in 4-digit industry	−3.25	(0.1534)	−4.44	(0.0787)	−6.22	(0.1840)	−7.89	(0.0002)
● Best match in 3-digit industry	−2.86	(0.4736)	−6.61	(0.0794)	−1.61	(0.5038)	−6.50	(0.0523)
● Portfolio in 3-digit industry	−4.53	(0.0159)	−6.25	(0.0035)	−3.92	(0.0212)	−8.30	(0.0001)
<i>% Change in R&D/assets</i>								
LEAPS sample	12.59	(0.0101)	16.28	(0.0329)	4.35	(0.0785)	10.62	(0.2452)
Control firms:								
● Best match in 4-digit industry	2.13	(0.6093)	−6.19	(0.1116)	−0.18	(0.4990)	−5.32	(0.1204)
● Portfolio in 4-digit industry	−0.25	(0.9053)	−4.13	(0.0667)	−1.28	(0.9389)	−4.58	(0.1241)
● Best match in 3-digit industry	−6.75	(0.0950)	−5.80	(0.1245)	−4.30	(0.0969)	−4.86	(0.0533)
● Portfolio in 3-digit industry	−0.58	(0.7417)	−5.65	(0.0038)	−0.03	(0.9717)	−4.21	(0.0015)
<i>% Change in PP&E/current assets</i>								
LEAPS sample	20.40	(0.0045)	29.99	(0.0087)	2.37	(0.1233)	−3.35	(0.3009)
Control firms:								
● Best match in 4-digit industry	−0.91	(0.8413)	−2.46	(0.6092)	−0.21	(0.6677)	−5.65	(0.4773)
● Portfolio in 4-digit industry	2.64	(0.1816)	−5.40	(0.0274)	0.32	(0.1361)	−10.94	(0.0125)
● Best match in 3-digit industry	0.68	(0.8802)	3.27	(0.4750)	−0.64	(0.7227)	−1.08	(0.8527)
● Portfolio in 3-digit industry	2.70	(0.1080)	−5.05	(0.0153)	−0.67	(0.1005)	−4.71	(0.0004)

Panel B: Differences in percent change of alternative measures of long-term investment. Difference in % change is the difference between the LEAPS firm's percentage change and the best match firm's percentage change. The difference is defined analogously for LEAPS–Portfolio in 4-digit industry, with the average value of the portfolio of control firms for each LEAPS firm replacing the best match firm in the previous definition. Sample size is 94 on R&D/sales and R&D/assets and 88 observations on PPE/CA. *p*-values are for the two-tailed test of the hypothesis that the difference in % change is equal to zero.

Variables	Mean (−1,1)	<i>p</i> -value of <i>T</i> -test	Mean (−1,2)	<i>p</i> -value of <i>T</i> -test	Median (−1,1)	<i>p</i> -value of sign-rank	Median (−1,2)	<i>p</i> -value of sign-rank
<i>Difference in % change in R&D/sales</i>								
LEAPS–Best match in 4-digit industry	25.10	(0.0062)	23.57	(0.0040)	5.07	(0.0613)	4.87	(0.0319)
LEAPS–Portfolio in 4-digit industry	25.57	(0.0010)	25.63	(0.0004)	13.54	(0.0007)	13.04	(0.0002)
LEAPS–Best match in 3-digit industry	25.17	(0.0033)	27.80	(0.0009)	10.80	(0.0195)	16.17	(0.0020)
LEAPS–Portfolio in 3-digit industry	26.84	(0.0007)	27.44	(0.0003)	12.61	(0.0002)	12.27	(0.0001)
<i>Difference in % change in R&D/assets</i>								
LEAPS–Best match in 4-digit industry	10.46	(0.0957)	22.47	(0.0116)	1.04	(0.3938)	9.81	(0.0106)
LEAPS–Portfolio in 4-digit industry	12.84	(0.0128)	20.41	(0.0088)	5.63	(0.0740)	6.57	(0.0138)
LEAPS–Best match in 3-digit industry	19.34	(0.0015)	22.08	(0.0054)	9.61	(0.0091)	10.62	(0.0171)
LEAPS–Portfolio in 3-digit industry	13.17	(0.0103)	21.93	(0.0045)	3.73	(0.0778)	7.13	(0.0062)
<i>Difference in % change in PP&E/CA</i>								
LEAPS–Best match in 4-digit industry	21.31	(0.0089)	32.44	(0.0145)	4.58	(0.0263)	8.22	(0.0213)
LEAPS–Portfolio in 4-digit industry	23.04	(0.0014)	35.39	(0.0030)	2.05	(0.0345)	7.60	(0.0391)
LEAPS–Best match in 3-digit industry	21.08	(0.0060)	26.72	(0.0255)	3.29	(0.0375)	5.38	(0.2395)
LEAPS–Portfolio in 3-digit industry	23.10	(0.0014)	35.04	(0.0030)	3.48	(0.0179)	7.06	(0.0541)

Panel B reports the differences in percent changes of alternative measures of long-term investment. For (−1,1), the difference in percent change of R&D/sales net of the 4-digit control firm is 25.10% (*p*-value < 0.0062), and 25.57% (*p*-value < 0.0010) net of the 4-digit portfolio. Results net of the 3-digit control firm and control portfolio are qualitatively similar.

For $(-1,2)$, the difference in percent change of R&D/sales net of the 4-digit control firm is 23.57% (p -value < 0.0040), and 25.63% (p -value < 0.0004) net of the 4-digit control portfolio. Results net of the 3-digit control firm and control portfolio are qualitatively similar. The results of examining median differences in percent changes are qualitatively the same although of smaller magnitude and nearly all are significant at the 5% level in the signed-rank test.

Overall, these results reject H1 and provide strong support of the joint theories of Costly Trade and Managerial Myopia. We conclude that the increase for LEAPS is significantly and robustly greater than the control firms, however defined.

5.3. R&D/assets

For additional robustness, we examine R&D scaled by assets rather than by sales. In Panel A, the mean percent change in R&D/assets for LEAPS firms is 12.59% over $(-1,1)$ and 16.28% over $(-1,2)$. The mean percent change for the control firms are nearly all negative, ranging from -6.75% to 2.13% . The same pattern holds for the medians, but at a lower level.

Panel B reports the differences in percent changes of alternative measures of long-term investment. For $(-1,1)$, the difference in percent change of R&D/sales net of the 4-digit control firm is 10.46% (p -value < 0.0957), and 12.84% (p -value < 0.0128) net of the 4-digit portfolio. For $(-1,2)$, the differences are 22.47% (p -value < 0.0116), and 20.41% (p -value < 0.0088), respectively. Results net of the 3-digit control firm and control portfolio are qualitatively similar. The results of examining median differences in percent changes are qualitatively the same although of smaller magnitude and nearly all are significant at the 5% level using the signed-rank test.

Overall, these results provide robust confirmation of rejecting H1 and supporting the joint theories of Costly Trade and Managerial Myopia.

5.4. PP&E/CA

We construct another proxy for the firm's relative choice of long-term investment to short-term investment using the ratio of net property, plant and equipment divided by current assets (hereafter PP&E/CA). If subsequent to LEAPS introduction firms shift their assets more towards the long-term, we expect to see this ratio increase. We examine the change in this ratio around LEAPS introduction.

For $(-1,1)$, the difference in percent change of PP&E/CA net of the 4-digit control firm is 21.31% (p -value < 0.0089), and 23.04% (p -value < 0.0014) net of the 4-digit portfolio. For $(-1,2)$, the differences are 32.44% (p -value < 0.0145), and increases 35.39% (p -value < 0.0030), respectively. Results for the 3-digit control firm and control portfolio are qualitatively similar. Tests of median changes are qualitatively similar but of smaller magnitude.

Overall, these results provide additional robust confirmation of rejecting H1 and supporting the joint theories of Costly Trade and Managerial Myopia.

6. The relationship between R&D intensity changes and LEAPS volume

Theoretically, greater volume of long-term options should lead to more long-term information being impounded into the price, which should lead to a greater increase in R&D intensity. We test this theoretical prediction by analyzing the cross-sectional relationship between the “longness” of option volume and the change in R&D intensity. Our proxy for the longness of option volume is annualized LEAPS volume in year 0 as a percentage of total equity option volume in year 0.

Previous research on managerial myopia, using R&D, has often screened out firms with lower levels of R&D to focus on those with a more economically significant level of R&D spending. It is possible that LEAPS volume is related to the change in R&D intensity for those firms for which the level of R&D is more economically significant. Dechow and Sloan (1991) and Lundstrum (2002) both examine changes in R&D/sales to test theories of managerial myopia and both require that R&D/sales meet some industry minimum levels of R&D intensity.

Dechow and Sloan implement a 5% R&D/sales minimum while Lundstrum uses a 3% minimum. Dechow and Sloan use the minimum intensity “...to identify industries in which large Research and Development expenditures are common”. Lundstrum argues for the 3% minimum to be sure that “...the level of R&D expenditures are significant in the industry-year”. A minimum R&D intensity screen is an appropriate screen here as any potential mis-pricing associated with R&D spending is more likely to be more important to the manager when the level of spending exceeds some economically significant level.

We examine the relationship between the change in R&D intensity and LEAPS volume after controlling for year effects and the level of R&D intensity in year -1 . R&D intensity in year -1 of 3% corresponds to approximately the twentieth sample percentile of R&D intensity. Screening out those observations for which year -1 R&D/sales does not exceed 3% of sales leaves a sample of 70 observations. We estimate the following regression including only those firms for which R&D/sales exceeds 3%.

$$\Delta R\&D/sales(-1,1)_{i,t} = \alpha + \gamma_1 Lvolume + \gamma_2 R\&D/sales_{-1} + \varepsilon_{i,t}, \quad (2)$$

$$\begin{array}{ccc} 0.0811 & 11.0110 & 0.10015 \\ (0.7554) & (0.0232) & (0.0001) \end{array}$$

where $\Delta R\&D/sales(-1,1)$ is the LEAPS change in R&D intensity, $Lvolume$ is the LEAPS annualized volume percentage in year 0, $R\&D/sales_{-1}$ is the firm's R&D intensity in year negative 1. Year indicator variables are also included in the estimation but are not shown. The coefficient estimates are presented beneath the parameters with p -values for the two-tailed T -test of the hypothesis that the coefficient is equal to zero displayed in parenthesis beneath the coefficient estimate.

Table 3
Regressions of R&D/sales (–1,1) intensity change on LEAPS volume for firms with R&D/sales > 3%

Dependent variable	Independent variable: LEAPS volume in year 0 as a percentage of total equity option volume	
	Regression coefficient	<i>p</i> -value
% Change in R&D/sales		
LEAPS–Best match in 4-digit industry	11.4648	(0.0279)
LEAPS–Portfolio in 4-digit industry	11.6183	(0.0153)
LEAPS–Best match in 3-digit industry	9.2289	(0.0602)
LEAPS–Portfolio in 3-digit industry	11.5331	(0.0170)

Coefficient estimates and *p*-values for the two-tailed test of the null hypothesis that the coefficient is equal to zero. Coefficients estimated using Ordinary Least Squares. The R&D Intensity change proxy is the dependent variable in the regression, and proxies are as described previously. The Independent variable in year 0 is the annualized LEAPS volume as a percentage of total annual equity option volume. Annualized volume is the average daily volume (computed from all the days during the year of introduction), times 252 trading days per year. Total annual equity option volume is the sum of annualized LEAPS volume plus the ordinary annual option volume. Coefficients are also estimated on R&D/sales in year –1 and year dummies, but not reported here. *p*-values are for the two-tailed test of the hypothesis that the coefficient is equal to zero, and are displayed in parenthesis. Sample includes only those firms for which R&D/sales in year –1 exceeds 3%, a sample of 70 observations.

Results appear in Table 3. The *p*-value for the test of model significance for this sample is less than 5%, in each of the regressions. The coefficient estimate on LEAPS volume percentage is positive and significant at 11.0110 (*p*-value < 0.0232) and the coefficient on year –1 R&D intensity is 0.10015 (*p*-value < 0.0001). Results are not substantively different if the change in LEAPS R&D/sales intensity is replaced with the LEAPS less best match or less a portfolio of match firms.

Using the full sample we examine whether there is some minimum level of LEAPS volume for which LEAPS volume is significantly related to the change in R&D intensity. We use the full sample to re-estimate Eq. (2) and find that the coefficient on the LEAPS volume percentage is not significantly different from zero (results not reported).

We conclude that for those firms that have an economically significant level of R&D intensity, the change in R&D intensity around LEAPS introduction is increasing in LEAPS volume in the preceding year. Results are consistent with the theories, and consistent with the hypothesis that the change in R&D intensity is positively related to the LEAPS volume in the prior year.

7. An additional robustness check

We examine the evidence on whether the change in R&D intensity is greater for those firms that have higher level of R&D intensity before LEAPS are introduced. The idea is that R&D may have a more central and strategic role for high R&D intensity firms. Whereas, it may play be more of a peripheral role for low R&D intensity firms. Hence, LEAPS may have a greater impact on high R&D intensity firms than on low firms. We again partition the sample into low intensity firms, defined here as those firms with R&D/sales less than 3%, and high R&D intensity firms, those firms with R&D/sales of 3% or greater. Table 4 reports the mean difference in the percentage change in R&D/sales net of control firm(s) separately for low intensity firms (19 firms) and high intensity firms (75 firms).

For (–1,1), the difference in % change for LEAPS net of the best match firm in 4-digit industry is 21.65%, but is not statistically significant (*p*-value < 0.2338) for low intensity firms. This insignificance is likely due to the very small sample size (19). For high

Table 4
Mean differences in % change in R&D/sales for low and high R&D intensity firms

Difference in % change in R&D/sales	R&D/sales < 3%		R&D/sales ≥ 3%	
	Window (–1,1)	<i>p</i> -value of <i>T</i> -test	Window (–1,1)	<i>p</i> -value of <i>T</i> -test
LEAPS–Best match in 4-digit industry	21.65	(0.2338)	25.97	(0.0145)
LEAPS–Portfolio in 4-digit industry	21.38	(0.2216)	26.63	(0.0025)
LEAPS–Best match in 3-digit industry	24.56	(0.1898)	25.33	(0.0091)
LEAPS–Portfolio in 3-digit industry	24.20	(0.1629)	27.51	(0.0021)
Difference in % change in R&D/sales	R&D/sales < 3%		R&D/sales ≥ 3%	
	Window (–1,2)	<i>p</i> -value of <i>T</i> -test	Window (–1,2)	<i>p</i> -value of <i>T</i> -test
LEAPS–Best match in 4 digit industry	16.67	(0.3522)	25.31	(0.0064)
LEAPS–Portfolio in 4 digit industry	10.62	(0.5022)	29.43	(0.0003)
LEAPS–Best match in 3 digit industry	15.62	(0.3362)	30.89	(0.0015)
LEAPS–Portfolio in 3 digit industry	16.88	(0.2910)	30.12	(0.0005)

Difference in % change in R&D/sales is the difference between the LEAPS firm's percentage change and the best match firm's percentage change. Results have been pooled across firm-years. Window (–1,1) is the sample average percentage change net of the best match firm. R&D/sales < 3% is for the sample for which R&D/sales is less than 3% in year –1. At year –1, there are 19 firms with R&D/sales less than 3% and 75 firms with R&D/sales of at least 3%. *p*-value is for the two-tailed *T*-test of the hypothesis that the percentage change net of the match firm is equal to zero.

Table 5

Proportion of quarterly earnings that beat or meet the mean analyst forecast

Sample	Year (-1, 1)				Year (-1, 2)		
	Year -1	Year 1	Year 1-Year -1	LEAPS-Control	Year 2	Year 2-Year -1	LEAPS-Control
LEAPS	73.40	69.66	-3.74 (0.5309)	-	76.58	3.18 (0.5774)	-
4-digit match	47.87	68.97	21.10 (0.0013)	-24.84 (0.0057)	60.76	12.89 (0.0482)	-9.71 (0.2709)
3-digit match	61.70	59.31	-2.39 (0.7130)	-1.35 (0.8810)	62.66	0.96 (0.8805)	2.20 (0.6967)
4-digit portfolio	13.83	23.45	9.62 (0.0570)	-13.36 (0.1120)	25.95	12.10 (0.0162)	-8.94 (0.2830)
3-digit portfolio	12.77	18.62	5.85 (0.2184)	-9.59 (0.2047)	20.89	8.10 (0.0883)	-4.94 (0.5134)
Observations	94	145			158		

The proportion of firm-quarter earnings that beat or meet analyst forecast during the pre-LEAPS and Post-LEAPS periods. To identify a set of quarterly earnings for a period corresponding to the (-1,1) interval, quarters ending from day -547 to day -183 become year -1. Quarters ending from day -182 to day +182 become year 0. Quarters ending from day +183 to day +547 become year 1, and quarters ending from day 548 to day 912 become year 2. For each LEAPS firm and for each control firm, the four quarters which end during each of the years -1, 1 and 2 are examined. A sample is identified which includes only those firm-quarters for which analyst errors are available for both the LEAP firm and at least one control firm in the same four-digit industry. "Beating or meeting analyst forecast" is defined here as when actual earnings per share in quarter t is greater than or equal to the mean of analyst forecasts made in quarter $t-1$ about earnings per share in quarter t .

intensity firms, the difference is 25.97% and statistically significant (p -value < 0.0145). Results are similar for the (-1,2) window and 3-digit match firm and net of portfolios. While the sample size for low intensity firms is small, it appears that the high intensity firms experience an increase in intensity of greater magnitude than do the low intensity firms.

8. Beating analyst's earnings forecasts

We examine an additional implication of myopia: sacrificing long-term payoffs to beat (or at least meet) analyst's quarterly earnings forecasts. Graham et al. (2005) and Bhojraj and Libby (2005) argue that managers will myopically forgo a positive NPV project to beat short-term analyst's earnings forecasts. Cheng et al. (2005) report that firms that beat analyst's forecasts more frequently also invest less in R&D. Cheng et al. conclude that these firms beat forecasts by sacrificing R&D spending. This literature contends that myopic managers sacrifice R&D spending to beat earnings forecasts. We test the logical extension of this argument: if myopia decreases after LEAPS are introduced, then the observed propensity for a firm to beat (or meet) forecasts will decrease subsequent to LEAPS introduction.

The change in the proportion of LEAPS firm-quarter earnings that beat/meet analyst forecast, net of the control firm, is examined over two different windows surrounding LEAPS introduction, the (-1,+1) and the (-1,+2) windows. Consistent with the methodology employed by Cheng et al., "beating or meeting analyst forecast" is defined here as when actual earnings per share in quarter t is greater than or equal to the mean of analyst forecasts made in quarter $t-1$ about earnings per share in quarter t . Analyst forecasts and actual quarterly earnings are from First Call.

To identify a set of quarterly earnings for a period corresponding to the (-1,+1) interval, quarters ending from day -547 to day -183 become year -1. Quarters ending from day -182 to day +182 became year 0. Quarters ending from day +183 to day +547 become year +1, and quarters ending from day 548 to day 912 become year 2. For each LEAPS firm and for each control firm, the four quarters which end during each of the years -1, 1 and +2 are examined. A sample is identified which includes only those firm-quarters for which data is available for both the LEAP firm and at least one control firm in the same four-digit industry. Meeting this criteria are a total of 94 firm-quarters in year -1, 145 firm-quarters in year 1, and 158 firm-quarters in year 2.

Table 5 reports the proportion of quarterly earnings that beat or meet analyst's forecasts for LEAPS, 4-digit match firms, 3-digit match firms, and for portfolios of match firms identified at the 4- and 3-digit SIC code levels, respectively. For the (-1,+1) window, the proportion of firm-quarters for which LEAPS beat/meet forecast *decreased* from 73.40% to 69.66%, a decrease of 3.74% (p -value < 0.5309). By contrast, the 4-digit match control firms *increased* 21.10% (p -value < 0.0013). Therefore, the difference LEAPS-Control *decreased* 24.84% (p -value < 0.0057). Looking down the column, the LEAPS-Control difference using 3-digit match firm, 4-digit portfolio, and 3-digit portfolio is qualitatively similar.

Looking at the LEAPS-Control for the (-1,+2) window, the difference between LEAPS and the 4-digit industry is -9.71% (p -value < 0.2709). Continuing down the column, three out of four of the LEAPS-Control differences are negative.

We conclude that the predominance of the evidence supports the hypothesis that the introduction of LEAPS is associated with a reduction in the firm's likelihood of beating the analyst's quarterly earnings forecasts. In other words, the introduction of LEAPS is followed by firms acting less myopically.

9. Conclusion

Shleifer and Vishny (1990) develop a model in which the combination of mis-pricing of the shares of a firm which invest in projects with long-term cash flows, combined with the firm's manager's desire to avoid under-pricing of the firm's current stock price result in under-investment in projects with long-term cash flows. By reducing the cost of trade on long-term information, the introduction of exchange-trading in a long-term stock option on the firm should result in less mis-pricing of long-term information and a corresponding increase of corporate investment in projects with long-term cash flows.

This paper tests the hypothesis that corporate investment in long-term projects increases around the introduction of trade on a long-term stock option. We find an abnormal growth in R&D intensity ranging from 23% to 28% (annual R&D spending increases by a total of \$125–\$152 million) over the two years subsequent to the introduction of LEAPS. This is consistent with the hypothesis that capital market imperfections may play a significant role in deterring firms from pursuing projects with long-term cash flows. This highlights the importance of the costs of collecting and trading on long-term information, and suggests that the level of information problems in capital markets have a deterrent effect on long-term investment.

We find that for those firms that have an economically significant level of R&D intensity, the change in R&D intensity around LEAPS introduction is increasing in LEAPS volume. Our conclusions are robust to the choice of proxy for long-term investment and to the matching technique used to identify control firms or control portfolios.

We also find that firms with high prior R&D spending have a larger subsequent increase in R&D spending. This supports the idea that LEAPS have a greater impact on firms where R&D plays a larger and more strategic role.

Graham et al. (2005), among others, has documented a myopic focus on beating short-term earnings forecasts that finds that managers are willing to sacrifice long-term payoffs to beat short-term earnings forecasts. We test the hypothesis that a firm becomes less likely to beat analyst's quarterly earnings forecasts after LEAPS are introduced and find support for the hypothesis.

The results here suggest that understanding the positive externalities associated with the introduction of option trade is crucial to identifying all of the important costs and benefits of option trade. The positive impact of the introduction of these derivatives includes reducing barriers to long-term investment at the firm level. This potentially implies a role for regulatory policy in influencing the level of economy-wide private, long-term investment.

Long-term options appear to help solve information problems that impede firm's ability to invest in long-term projects. LEAPS trade allows these pent-up R&D projects to be pursued.

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