Corporate Investment Decisions and the Value of Growth Options

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Abstract

Recent applications of real options theory in strategy research have examined investment decisions framed as the purchase or exercise of particular options, but research has yet to offer direct evidence on whether firms actually capture option value from such investments. In this paper, we estimate the proportion of firm value accounted for by growth options and link the growth option value to corporate investments that have been commonly viewed as providing valuable growth options. The empirical analysis examines internal and external corporate development activities of a panel of 293 manufacturing firms during 1989-2000. The results indicate that investments in research and development and in joint ventures contribute to growth option value, and that investments in tangible capital and in acquisitions have no effect in general. Notably among equity joint ventures of various ownership levels, only minority joint ventures have significant effects.

Key words: real options; growth option value; corporate investments

INTRODUCTION

Real options theory has generated increased research interest in the strategy field in recent years, and this interest is natural in view of the high degree of uncertainty that firms often confront in making strategic investment decisions. The appeal of real options theory also rests on its distinctive ability to capture managers' flexibility in adapting their future actions in response to evolving market or technological conditions. While such flexibility has long been recognized and appreciated by managers in an intuitive way, until the publication of Black and Scholes' (1973) seminal work on the pricing of financial options and Myers' (1977) pioneering idea of viewing firms' discretionary future investment opportunities as real options, there had been a lack of formal models of such flexibility.

Over the years, strategy research on real options has used the theory both as a model for financial valuation and as a heuristic for managerial decision-making (Bowman & Hurry, 1993). Many corporate investments have been argued to have option-like features, and a large number of studies have conceptualized or evaluated such investment projects using the real options perspective. For example, Kogut (1991) proposes that firms can form joint ventures as real options to expand under uncertain market or technological conditions. McGrath (1997) argues that technology positioning projects embody valuable real options because of the sequential nature of staging investments and the high degree of uncertainty usually surrounding these projects. Trigeorgis (1996) offers a taxonomy of real options that maps different categories of investments into the space of different types of options.

While this stream of work has contributed significantly to the development of real options theory, currently there still exists a large gap between theory and empirical evidence (Dixit & Pindyck, 1994; Schwartz & Trigeorgis, 2001). Indeed, existing empirical studies on real options have tended to examine corporate investments in a decision-theoretic manner. More specifically, particular investment decisions are attributed to the purchase or exercise of some options and then linked to various forms of uncertainty that can elevate the value of these options and the timing of these decisions. Useful as it is, this approach has provided *prima farce* evidence consistent with the theory's prediction (Dixit & Pindyck, 1994), yet research is also needed to investigate the performance implications of firms' investments in real options, and to provide direct evidence on whether these investments actually benefit firms in certain ways. In this paper, we focus on growth options in particular and we are interested in the question of whether firms are able to capture growth option value from their investments in growth options.

To answer this question empirically would require a direct measure of the growth option value that firms possess, a variable that has been introduced for some time (e.g., Myers, 1977; Kester, 1984) but has yet to receive attention in strategy research. Based on the traditional theory of corporate valuation (Williams, 1938; Miller & Modigliani, 1961) and real options theory (Myers, 1977), we estimate the components of firm value accounted for by growth options vis-à-vis assets in place, which are then used to derive a measure of firms' growth option value. We then identify several types of internal and external corporate development activities that have been commonly viewed as conferring firms discretionary future investment opportunities, and we empirically investigate whether they contribute to firms' growth option value.

Results from a panel dataset of U.S. manufacturing firms during 1989-2000 indicate that firms' investments in research and development (R&D) and in joint ventures positively contribute to growth option value, whereas investments in tangible capital and in acquisitions have no effect in general. Our data on firms' external corporate development activities allow us to explore further the contingent effects of firms' ownership positions in these investments. Although we do not find significant effects for acquisitions of any type, our analyses reveal that, among equity joint ventures of different ownership levels, only minority joint ventures contribute significantly to growth option value. Our results are useful for examining the boundaries for applying real options theory to research on corporate investments and to strategy research more generally.

BACKGROUND ON REAL OPTIONS

Many internal and external corporate development projects such as investing in new technologies, entering into joint ventures, and so forth potentially create future investment opportunities in addition to generating benefits from their current uses. As one example, investing in an emerging product market may not only bring in cash flows from the initial investment, but can also create valuable growth opportunities should the market develop in a favorable fashion. Therefore, managers must regard such initial investment as the first link in a longer chain of subsequent investment decisions or as a part of a larger cluster of projects. This type of "time series" investment (Myers, 1984) presents particular managerial and valuation difficulties because it is not amenable to traditional valuation and capital budgeting techniques. Indeed, previous research in the strategy and finance literatures has indicated that applying these traditional techniques can lead to problems such as under-investment, myopic decisions, and even the possible erosion of a firm's competitiveness (e.g., Hayes & Garvin, 1982; Kester, 1984; Myers, 1984).

Although the follow-on investment opportunities created by a firm's internal and external corporate development activities have tended to be given short shrift in traditional decision-making frameworks, they are a central concern of real options theory. In his pioneering paper, Myers (1977) first suggests that a firm's discretionary future investment opportunities are "growth options," or call options on real assets, in the sense that the firm has the discretion to decide in the future whether or not it wants to exercise the option to make these investments. In fact, in unfavorable states of nature where the net present value (NPV) of these investment opportunities is negative, the firm will simply choose not to exercise these options.

This seminal idea has several important implications, two of which are closely related to this paper.[1] First, by formalizing follow-on growth opportunities latent in corporate investments as options, the idea provides the theoretical basis not only for adapting formal option pricing models (e.g., Black & Scholes, 1973) to the valuation of these investments, but also for using option theory as a set of tools to guide strategic decision-making under uncertainty (e.g., Bowman & Hurry, 1993; McGrath, 1997). Second, by viewing discretionary future investment opportunities as growth options, the idea also provides the theoretical basis for estimating the firm's value of growth options. More specifically, according to the theory of corporate valuation first formalized by Miller and Modigliani (1961),[2] a firm's value (V) can be decomposed into the value of assets in place (V_{AIP}) and the value of future growth opportunities (V_{GO}), or

(1) $V = V_{AIP} + V_{GO}$.

The value of growth options then, is just the value of future growth opportunities (V_{GO}), given that the ultimate value of these growth opportunities depends on firms' discretionary investments

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[1] Another important implication lies in growth options being a key determinant of capital structure. See Myers (1977) for more details.

[2] In this important paper, Miller and Modigliani provide the first rigorous proof that the value of the firm can be decomposed into the value of assets in place (or current earnings stream) and the value of discretionary future investment opportunities and that this approach is in fact equivalent to other approaches to corporate valuation assuming perfect capital markets. Interested readers are referred to the original paper for additional details.

in the future (Myers, 1977). Using this perspective, assets in place, by contrast, are simply assets whose value does not depend on such investments.

Since Myers (1977), research on real options that deals with these two implications has evolved, yet these implications have largely been investigated independently as this research stream has advanced. Regarding the first implication, research in finance has developed asset pricing models using a contingent claims approach (cf. Trigeorgis, 1996) that can be applied to real investments that have option-like features, such as technology development projects (e.g., Pennings & Lint, 1997) and investments in natural resources (e.g., Brennan & Schwartz, 1985). Research in strategic management, on the other hand, has conceptualized as real options various investments such as R&D projects (Mitchell & Hamilton, 1988), equity joint ventures (Kogut, 1991), and investments in emerging markets (Kogut & Kulatilaka, 1994), and has proposed a more strategic approach to the management of such investments.

Regarding the second implication, studies have begun to estimate empirically the firm's value of growth options. For example, Kester (1984) measures the firm's value of growth options as the difference between its total market value and the capitalized value of its current earnings stream (discounted at 15%, 20%, or 25%). The latter represents the value of the firm under a no-growth policy and therefore is a proxy for its value of assets in place. The proportion of firm value attributable to growth options, or the firm's growth option value (GOV), is then calculated as follows:

(2) $GOV = V_{GO} / V = [V – \text{Current Earnings} / \text{Discount Rate}] / V.$

Kester finds that, for many firms in his sample, valuable growth options constitute half their market value. Moreover, companies involved in electronics, computers, and chemicals industries tend to have a higher percentage of their value attributable to growth options. A similar approach can also be found in other related research (e.g., Strebel, 1983; Brealey & Myers, 2000; Alessandri, Lander, & Bettis, 2002).

In the hypotheses developed below, one of our objectives is to bring together these two largely disjoint streams of research by examining the influence on the firm's growth option value of several types of corporate development activities that have been commonly framed as investments in growth options.

THEORY AND HYPOTHESES

Corporate investments come in many varieties, and they can be categorized along several dimensions. A common approach in the strategy field is to divide corporate investments broadly into those that are internal versus external, depending on whether these investments are made within the firm or across firm boundaries. This categorization reflects two means of corporate development through which firms can obtain valuable resources: resource accumulation within the firm and resource acquisition from outside the firm (e.g., Dierickx & Cool, 1989). External investments are often discrete, including investments in various forms of alliances and acquisitions. Internal corporate development activities can also include discrete investments such as building new plants or greenfield operations, but they also refer to investments as diverse as technology development, machinery replacement, or product line extensions. For the purpose of this paper, we will focus on firms' investments in R&D and in tangible capital, to be discussed below.

Internal Corporate Development Activities

Investments in R&D. It is first worth observing that the idea that R&D investment serves as an engine for economic growth and future productivity increases traces back to as early as Ricardo (e.g., Ricardo, 1817; Cohen & Levin, 1988). Economists have long observed that R&D investment facilitates innovation and generates new knowledge and technology (e.g., Mansfield, 1981). Perhaps nowhere is the impact of innovation and new technology on economic growth better articulated than in Schumpeter (1942: 83): "The fundamental impulse which sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production, the new markets, and the new forms of industrial organization that capitalist enterprise creates." The idea that technology, or knowledge more generally, contributes to the growth of the firm is also in accord with the strategy and organization literatures. Penrose (1959), for instance, discusses how intangible resources such as knowledge form the basis for the growth of the firm.

While previous research has not explicitly linked R&D investment to any specific component of the value of the firm, R&D investment is likely to contribute to the value of growth options in particular for at least two reasons. First, R&D investment is likely to confer significant options due to the sequential nature of such investment. That R&D activities are staged as they are suggests that investment at an early stage effectively amounts to the purchase of a call option to invest at a later stage (e.g., Roberts & Weitzman, 1981). Corporate R&D activities commonly proceed in the following chain: basic research, if successful, generates proprietary know-how that provides an option to undertake applied research; applied research, if successful, lands on a product idea that provides an option to undertake development; development, if successful, ends up with a prototype that provides an option to undertake design; finally, design, if successful, produces an end-product that provides an option to commercialize. While the sequential decision-making process might also reflect a component of path-dependency (Adner & Levinthal, 2004), insofar as the exercise of these additional investment opportunities is subject to the firm's discretion (Myers, 1977), valuable growth options are manifest.

Second, although some R&D programs do bring in immediate payoffs, many of them derive the bulk of their value from some future, contingent actions that can be pre-specified. For instance, basic research may have a negative NPV, yet it is nevertheless undertaken because it creates knowledge that paves the way for further applied research eventually leading to product design and commercialization (Mitchell & Hamilton, 1988). In a similar vein, R&D aimed at other, future specific objectives also can provide valuable options. This for example includes strategic positioning in a new market where the failure to invest in R&D may lock the firm out of future growth opportunities there, particularly in situations involving competitive rivalry (Kulatilaka & Perotti, 1998).

Hypothesis 1: The greater a firm's investments in R&D, the greater its growth option value.

Investments in Tangible Capital. Whereas the first hypothesis focuses on the firm's investments in intangible assets in the form of technical knowledge, growth options may also be obtained through investments in resources of a more tangible kind. Myers (1977) suggests that capital expenditure programs such as maintenance or replacement projects can also be viewed as providing the firm growth options since, like R&D outlays, these investments may also provide discretionary investment opportunities that can be passed up if unjustified by future market conditions or other contingencies (see also Kester, 1984). Investments in upgrading existing infrastructures (e.g., IT networks) or in the replenishment of new capital goods (e.g., machinery and equipment), for instance, allow the firm to undertake certain specified actions in the future, such as capacity expansion or the introduction of new products (Trigeorgis, 1996).

The notion that real options are associated with capital expenditure programs is also reflected in previous research that examines the stock market's reaction to firms' capital expenditure announcements (e.g., McConnell & Muscarella, 1985; Chung, Wring, & Charoenwong, 1998). A general argument of this research is that firms' capital expenditures signal the availability of future investment opportunities. More specifically, managers may increase (decrease) the firm's capital expenditures when they see positive (negative) prospects for future positive-NPV projects for the firm. The empirical results are generally supportive of this view, and Chung and colleagues (1998) report that increases in capital expenditures positively affect the stock price of firms, provided they possess valuable growth opportunities.

Hypothesis 2: The greater a firm's investments in tangible capital, the greater its growth option value.

Although investments in tangible capital may provide the firm growth options, as prior literature has argued, it is also plausible that the effect of these investments on the firm's value of assets in place would be more pronounced. For instance, compared to firms in high-growth industries, those in mature industries tend to make greater capital expenditures, and the sunk costs that have been made effectively constitute barriers to entry (Scherer & Ross, 1990). To the extent that these factors are also at work, the effect of investments in tangible capital on the firm's growth option value may diminish.

External Corporate Development Activities

Investments in Joint Ventures. Just as many forms of internal corporate development may confer growth options, a firm may also capture growth option value from investments in growth opportunities through external means. Such external investments have option-like features to the extent that a firm is able to limit its downside losses to an initial, limited commitment and in the meantime still position itself to expand, but only if circumstances prove unexpectedly favorable. Applications of real options theory to the setting of external corporate development argue that equity joint ventures in particular tend to have these characteristics (e.g., Kogut, 1991). For instance, unlike many acquisitions, joint ventures have the dual advantage of limited initial commitments and the opportunity to stage commitments over time. Unlike non-equity alliances that involve a purely contractual interface, equity joint ventures involve shared ownership, and changes in equity stakes provide the means by which firms can expand sequentially.

Kogut (1991) provides the conceptual foundation for viewing joint ventures as growth options, based on the following logic: A firm makes an initial investment in a joint venture, which is limited in that it is shared with a partner. The firm then monitors market conditions and other cues over time to determine if the joint venture's value is such that expansion via the acquisition of additional equity from a partner is warranted. For instance, if a positive demand shock for the joint venture's product elevates the value of the joint venture sufficiently high, the firm can gain by acquiring additional equity; in the case of a negative turn of events, however, the firm is under no obligation to expand and can still hold the option open. Algebraically, if V_c is the value the call holder places on the entire venture, α_{c0} is the call holder's initial equity, α_{ct} is the equity level the call holder has the right to attain (where $0 < \alpha_{c0} < 1$, $0 < \alpha_{ct} \leq 1$, and $\alpha_{c0} < \alpha_{ct}$), and P is the price at which the subsequent equity purchase occurs, then the firm will gain $(\alpha_{ct} - \alpha_{c0})V_c - P$ by expanding, and it will hold the option open if $(\alpha_{ct} - \alpha_{c0})V_c < P$.

Consistent with this theory, Kogut's (1991) empirical work reveals that firms tend to buy out their partners when the joint venture experiences a positive demand shock, but firms continue on with the joint venture when negative demand signals materialize. Related research has found that firms tend to make limited equity purchases in the presence of uncertainty (Folta, 1998) and has also analyzed equity purchases under different assumptions, such as asymmetries in firms' valuations, the presence or absence of agreements to purchase equity from a partner at a pre-specified price, and so forth (e.g., Chi, 2000).

Hypothesis 3: The greater a firm's investments in joint ventures, the greater its growth option value.

Investments in Acquisitions. One of the implications of the model above is that, holding everything else constant, the terminal value of the call option is inversely related to the equity stake initially purchased. In the case of a full acquisition, the firm takes in all of the equity of the acquired unit at the time of purchase, and there is no option present to expand through the acquisition of additional equity. An acquisition may even represent the exercise of options previously purchased in the joint venture context. Moreover, an acquisition is also likely to be less reversible due to the need for integration of the acquiring and target firms and the restructuring of the firms' assets (e.g., Haspeslagh & Jemison, 1991). The commitment-intensive nature of acquisitions and the challenges firms face in internalizing valuable growth opportunities through acquisitions suggest the following hypothesis:

Hypothesis 4: The greater a firm's investments in acquisitions, the lower its growth option value.

Although acquisitions in general will require more initial commitments than joint ventures, growth options may naturally be built into some deals. Kester (1984) maintains that acquisitions, like many other investments, can create future growth opportunities (see also Myers, 1984). Smith and Triantis (1995) suggest that valuable growth options may be embedded in some strategic acquisitions that enhance the acquirer's capabilities in certain markets with significant growth potential. As will be discussed below, in order to explore the influence of alternative deal structures that may differentially impact firms' growth option value, we disaggregate acquisitions (as well as joint ventures) based on firms' ownership stakes in these investments and perform separate analyses to investigate the contingency effect of firms' ownership positions.

METHODS

Sample

The data source used to calculate the firm's growth option value is the Stern Stewart Performance 1000. Stern Stewart & Co. is a financial consultancy that specializes in the measurement of shareholder wealth and is well known for its trademarked performance metrics such as Economic Value Added (EVA) and Market Value Added (MVA). The Stern Stewart Performance 1000 is Stern Stewart's annual ranking of the 1000 largest U.S. publicly-traded companies based on their MVAs. Besides MVA, the dataset also provides data on other measures such as EVA, Capital Invested (CI), and Weighted Average Cost of Capital (WACC), which we combine to derive an estimate of the value of the firm's growth options. While the dataset has been used in previous research in finance and accounting for some time, it attracted attention from strategy researchers only recently (e.g., Coles, McWilliams, & Sen, 2001; Hawawini, Subramanian, & Verdin, 2003).

We merged this dataset with data on firms' investments in R&D and in tangible capital from the Compustat database, as well as data on firms' investments in joint ventures and in acquisitions from the Securities Data Corporation (SDC) database. Beyond relying on several thousand print and wire sources for announcements, the SDC database also canvasses alternative sources of information such as firms' prospectuses and SEC filings. Due to its scope of coverage, SDC currently remains the most comprehensive database on strategic alliances and mergers and acquisitions, and has been used widely in previous research (e.g., Anand & Khanna, 2000).

Combining these datasets led us to restrict the sampling frame to 1989-2000 because the SDC database does not report joint venture announcement data prior to 1985 and, as explained below, we sought to have a five-year rolling window over which to include firms' investments in external corporate development activities. We also focused on manufacturing firms whose primary SIC designation falls within the range of 2000-3999, and this reduced the sample size to 420. The selection of a manufacturing sample reflects several considerations, including comparability with prior empirical studies of real options, differences in accounting practices that exist across sectors, and the fact that information on one of our independent variables – R&D expenditures – is more routinely reported by manufacturing firms. We also excluded conglomerates that did not report a primary SIC designation as well as firms that were reported to be inactive over the sampling period. After accounting for missing data, the final sample takes the form of an unbalanced panel consisting of 293 firms with a total of 2,670 firm-year observations across 19 industries (at the 2-digit SIC level). For this dataset, we deflated all financial figures to the base year 1989 to account for inflation, using GDP deflators provided by the Bureau of Economic Analysis, U.S. Department of Commerce.

Measures and Data

Growth Option Value. Our approach to estimating growth option value, which we detail below, is generally consistent with that of Kester (1984), but our estimation represents several improvements over his due to our use of the Stern Stewart dataset. First, this dataset provides firm-specific discount rates and avoids applying some universal discount rate across firms. Second, the database provides value-based measures such as EVAs that account for the firm's full cost of capital and thus are better proxies for economic profit than current earnings. Third, these value-based measures also make accounting adjustments to account for accounting policies that may distort the true level of the firm's investments or operating performance. For example, in contrast to standard accounting treatment that expenses all R&D costs, Stern Stewart capitalizes them, because, their logic goes, if R&D were not capitalized and amortized, the firm's capital effectively utilized would be understated, leading to overstated profits. Other important adjustments include adjustments to goodwill, provisions for operating leases, and so forth. Below we provide an explanation of the derivation of growth option value using Stern Stewart measures, and a more detailed discussion of these elemental measures and common accounting adjustments can be found elsewhere (e.g., Stewart, 1991; Martin & Petty, 2000; Young & O'Byrne, 2001).

To start with, a firm's market value comprises the book value of capital employed (the total capital that creditors and shareholders have entrusted to the firm over the years in the form of loans, paid-in capital, retained earnings, etc.) and a residual component beyond capital employed. In Stern Stewart's language, the former is called Capital Invested (CI) and the latter Market Value Added (MVA), and the firm's market value (V) is therefore:

(3) V = CI + MVA.

MVA, however, is actually the aggregate NPV of all of the firm's investment activities and opportunities, or the present value (PV) of all of the firm's expected EVA (Young & O'Byrne, 2001), namely:

(4) MVA = PV of Expected EVA.

EVA is a performance metric trademarked by Stern Stewart, yet it is a version of the residual income method used to measure operating performance.[3] Unlike traditional accounting profitability measures (e.g., earnings) that only consider the cost of debt capital, residual income measures estimate profit net of all capital charges that include the cost of equity capital as well, and can be expressed as follows:

(5) RI = NOPAT – [CI $\ast$ WACC],

where RI is residual income, NOPAT is the firm's net operating profits after tax, and WACC is its weighted average cost of capital. To calculate its estimate of residual income (otherwise known as EVA), Stern Stewart adjusts the NOPAT and CI components on the right hand side to account for accounting anomalies or distortions, as discussed previously.

Expected EVA in any given year in the future can be viewed as consisting of a component that is an equivalent to the current year's EVA assuming a no-growth policy (i.e., Current-Level EVA), and a residual component that is beyond the current year's EVA and could be either positive or negative depending on the firm's level of investments in future growth opportunities (i.e., EVA Growth): [4]

(6) PV of Expected EVA = PV of Current-Level EVA + PV of EVA Growth.

Combining the above equations and rearranging terms, the firm's market value (V) can be rewritten as follows:

(7) V = CI + PV of Current-Level EVA + PV of EVA Growth,

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[3] Another popular name for residual income is "economic profit," a concept tracing its roots back to at least Marshall (1890).

[4] Negative investments in growth opportunities arise when the firm is believed to be unable to sustain current performance or make value-destructing investments.

where the sum of the first two terms (i.e., CI and PV of Current Level EVA) makes up the value of assets in place (i.e., V_{AIP}), and PV of EVA Growth measures the value of growth options (i.e., V_{GO}, the component of firm value attributable to growth options).

To calculate our dependent variable, the firm's growth option value (GOV), we solve equation (7) for PV of EVA Growth (i.e., V_{GO}), and scale it by the firm's value (V): [5]

(8) GOV = [V – CI – PV of Current-Level EVA] / V.

The PV of Current-Level EVA is calculated by treating the firm's current EVA as a perpetuity discounted by the firm's WACC. All the other terms appearing on the right hand side, as well as the estimate of the firm's WACC, are available from the Stern Stewart dataset.

Given the similarity of our approach to that of Kester (1984), we also calculated a measure of firms' growth option value using Compustat's accounting data and Stern Stewart's estimate of firm-specific discount rates (i.e., WACC). The correlation between this measure and our measure represented in equation (8) is 0.80 ($p<0.001$). As will be discussed further in the results section, we also conducted regression analyses on this alternative measure to consider whether the accounting adjustments of Stern Stewart affect the interpretation of the results.

We also explored the correlation of our measure with Tobin's Q, which has been used in prior studies to indicate the presence of growth opportunities (e.g., Lang, Stulz, & Walkling, 1991). We calculated Tobin's Q for each firm in the sample period using the approach suggested by Chung and Pruitt (1994). The correlation between Tobin's Q and our measure of growth option value is 0.47 ($p<0.001$).[6] While the significant correlation agrees with prior research that has used Tobin's Q as a proxy for growth opportunities, that the correlation is far from being

[5] This ratio representation not only helps account for any biases arising from firm size effects, but also has the property that increases in the ratio would suggest that V_{GO} increases more than V_{AIP}.

[6] Additionally, the correlation between Tobin's Q and the measure of growth option value calculated using Compustat data is 0.41 ($p<0.001$).

perfect also suggests that growth option value and Tobin's Q may be two distinctive concepts containing substantively different content. This suggestion is consistent with the fact that Tobin's Q has also been associated with many things other than growth opportunities such as intangible assets (e.g., Villalonga, 2004), management quality (e.g., Lang, Stulz, & Walkling, 1989), shareholder wealth (e.g., Hall, 1993), and so forth.

A final measurement issue to note is that, because GOV is a residual measure, an empirical estimate can fall outside of its natural range of [0, 1]. For example, this ratio can be less than zero when a firm is believed to have significant agency problems such that its total market value is lower than the value of its assets in place (e.g., McConnell & Muscarella, 1985). By contrast, this ratio can be greater than one when a firm has a negative EVA in a particular year, but is still believed to possess significant future growth opportunities. In our sample, about 7.1% of the observations have a growth option value lower than zero, and about 1.7% of the observations greater than one. In the results section, we discuss regression results obtained for all observations versus those that are limited to the zero to one range.

Inter-temporal and cross-sectional descriptive statistics appear in Table 1. The average firm in the sample has 43% of its value attributable to growth options. While there seems to be very little overall difference in growth option value across the four periods, secular trends do exist for certain industries. For example, the stone, clay, glass, and concrete industry (SIC 32) has witnessed a steady decline in growth option value over time, and this is also the case for furniture and fixtures (SIC 25), fabricated metal products (SIC 34), and transportation equipment (SIC 37). Notably for the electronic and electrical equipment industry (SIC 36), there has been a strong growth in growth option value, reaching as high as 63% in the 1998-2000 period. Indeed, this industry has the highest average growth option value (54%) in the manufacturing sample.

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There also exists large inter-industry heterogeneity in firms' growth option value. The following industries are comprised of firms for which growth options represent a significant proportion of firm value: electrical equipment (SIC 36; 54%); measuring, analyzing, and controlling instruments (SIC 38; 50%); chemical and allied products (SIC 28; 48%); and industrial and commercial machinery and computer equipment (SIC 35; 44%). At the opposite end of the spectrum, firms in industries such as stone, clay, glass and concrete (SIC 32; 12%); furniture and fixtures (SIC 25; 20%); and textile mill products (SIC 22; 22%) tend to derive much less value from growth options.

Explanatory Variables. Our first theoretical variable is the firm's investments in R&D, which we measure by the stock of R&D it accumulates. R&D stock is a variable used widely in the economics and strategy literatures as a proxy for firms' investments in intangible assets in the form of technical knowledge (e.g., Griliches, 1981). Because the effects of R&D investment can persist over time, prior studies have suggested that measures of R&D stock should include both current-year R&D expenditures and accumulated investments in R&D. In this study, we followed a number of prior studies (e.g., Hall, 1993) and applied a 15% depreciation rate to the firm's R&D expenditures going back four years before scaling the sum by the firm's current-year total sales. Data for this variable were obtained from Compustat.

Our other measure of internal corporate development is the firm's investments in tangible capital. Given that no consistent depreciation rate has been suggested in the literature, we measured the firm's investments in tangible capital as its capital intensity – the ratio of capital expenditures to total sales – in accord with related research in the accounting field (e.g., Kerstein

& Kim, 1995). Capital expenditures include investments in physical capital such as property, plant, and equipment, and the data necessary for calculating this measure were obtained from Compustat.

In order to examine firms' investments in external corporate development activities, we constructed variables to measure firms' investments in equity joint ventures and in acquisitions. We used a 5-year moving window to calculate the number of joint ventures a firm has formed and the number of acquisitions it has made. The selection of the five-year window represents a compromise in that longer time windows might count joint ventures and acquisitions that may have either terminated or be of less relevance to the firms' future growth initiatives, whereas very short time intervals may fail to capture important investments. The results section reports sensitivity analyses conducted for time windows of different lengths. Data on joint ventures and acquisitions were assembled from SDC starting from 1985, which is also the first year when the SDC database began reporting on equity joint ventures.

Control Variables. A number of control variables were included in the analyses because of their potential relationships with the theoretical variables and the dependent variable. First, we controlled for firm size. Larger firms may have greater project diversity (e.g., Scherer & Ross, 1990), incentives to innovate due to positional advantages (e.g., Baum & Mezias, 1992), and yet more bureaucratic decision-making processes that inhibit their responsiveness to changing external conditions (e.g., Haveman, 1993). Firm size was computed by taking the natural logarithm of a firm's total sales with data from Compustat. Second, we controlled for the firm's capital structure since Myers' (1977) model indicates that equity is more conducive than debt to financing growth options because debt can introduce *ex post* distortions in firms' investment decisions. Financial leverage was calculated as the ratio of a firm's long-term debt to its total capital, using data obtained from Compustat. Third, we accounted for firms' slack resources since they can encourage creativity and innovation (e.g., Nohria & Gulati, 1996) and provide the resources for discretionary investments (e.g., Bourgeois, 1981). Our measure of slack focused on a firm's recoverable slack resources, a concept similar to Singh's (1986) notion of absorbed slack. In keeping with previous studies (e.g., Singh, 1986; Bromiley, 1991), we relied on accounting data and measured organizational slack using the ratio of a firm's selling, general, and administrative expenses to its total sales. Fourth, we controlled for the industry's growth options, defined as the mean growth option value for all other firms in the focal firm's industry (at the SIC 2-digit level). This time-varying, firm-specific variable was incorporated to control for industry level heterogeneity; industry fixed effects were not included in our econometric model as it cannot estimate time-invariant effects, as discussed in more detail below. Finally, we controlled for firm fixed effects to account for unobserved heterogeneity at the firm level as well as for year fixed effects to capture the effects of economy-wide factors or changes over time in other unobserved variables.

Econometric Techniques

Given the pooled time-series and cross-sectional nature of our data, panel data techniques were employed to test our hypotheses. For our data, the Hausman-Wu specification test always rejected the null hypothesis at the 0.001 level that there is no correlation between the individual effects and regressors, suggesting the fixed effects model as the preferred specification over a random effects model. The use of the fixed effects specification has the additional advantage that it captures unobserved firm-level differences that may not be captured by our control variables, and it has a long tradition in previous research that examines the value of intangible assets such as R&D investment (e.g., Griliches, 1981; Hall, 1993). It is worth noting, however, that the fixed effects model uses a within-estimator and therefore cannot estimate time-invariant effects such as industry fixed effects (Hsiao, 1986).

The models used to estimate the effects of firms' corporate investment activities on their growth option value take the following form:

(9) Growth Option Value$_{it}$ = $\boldsymbol{\alpha}_i + \delta_t + \beta_1$R&D Investment$_{it}$ + β_2Capital Intensity$_{it}$ + β_3Joint Ventures$_{it}$ + β_4Acquisitions$_{it}$ + β_5Firm Size$_{it}$ + β_6Financial Leverage$_{it}$ + β_7Organizational Slack$_{it}$ + β_8Industry Growth Option Value$_{it}$ + $\boldsymbol{\varepsilon}_{it}$,

where subscripts i and t denote firm i and year t, respectively, $\boldsymbol{\alpha}_i$ represents firm fixed effects, and δ_t year fixed effects.

The use of panel data provides a number of advantages over purely cross-sectional data, such as controlling for individual heterogeneity, reducing estimation bias and multicollinearity, as well as providing more data variability that enhances efficiency. However, pooling data across time can potentially result in autocorrelation (Hsiao, 1986). Several steps were taken to test and control for this problem. First, we conducted Durbin-Watson tests, which produced statistics falling into the inconclusive region suggesting that the error terms might be serially correlated for our data. We therefore added a lagged dependent variable to the right hand side of the model and re-ran regressions (Griliches, 1981). To test for the effectiveness of this approach in helping address autocorrelation, we then conducted the Breusch-Godfrey Lagrange multiplier test instead of the Durbin-Watson test, since the latter test may not be valid in the presence of a lagged dependent variable (Greene, 2003: 270). The Lagrange multiplier tests failed to reject the null hypothesis of no autocorrelation.[7]

[7] Statistics obtained from the Durbin-Watson test were also within the acceptable range (between 1.95 and 2.00 in all models).

Finally, to address potential heteroscadasticity, in what follows we report all results with significance levels based on robust standard errors proposed by White (1980).

RESULTS

Table 2 presents descriptive statistics and a correlation matrix of the variables used in the regression analyses. The table shows that there are significant correlations among the independent variables, suggesting the need to investigate the potential of multicollinearity problems. However, the maximum VIF value for the variables in all of the models was 2.8, well below the rule-of-thumb threshold value of 10 that is indicative of multicollinearity problems (Neter, Wasserman, & Kutner, 1985).

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Insert Table 2 about here
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Table 3 presents regression results for our fixed effects model for the determinants of growth option value. Model I is a baseline specification comprising the four control variables as well as a lagged dependent variable, in addition to the year fixed effects and the firm fixed effects. Models II and III augment this model with the effects of internal investments (i.e., R&D investment and capital intensity) and external investments (i.e., joint ventures and acquisitions), respectively. Model IV is the full model consisting of all of the control variables and theoretical variables. All models are significant at the 0.001 level. Comparisons of the four models were made using hierarchical F-tests and, as the last row in Table 3 shows, Models II, III, and IV all provide significant improvements in explanatory power over the baseline model.

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Insert Table 3 about here
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The first and second hypotheses concerned the effects of two types of internal corporate development activities: investments in R&D and investments in tangible capital. Results in Model II and IV support the first hypothesis on the effects of R&D investment, but not the second one concerning tangible capital investment. Consistent with our first prediction, investments in R&D are positively related to growth option value ($p<0.001$). Contrary to the second hypothesis, the parameter estimate for firms' investments in tangible capital is negative, but it does not reach statistical significance.

The third hypothesis suggested that firms' investments in equity joint ventures increase their growth option value. The results are consistent with this hypothesis ($p<0.01$) and firms that invest in joint ventures have higher growth option value. By contrast, the coefficient estimate for the acquisitions variable, although negative, is not statistically significant. Thus, the fourth hypothesis is not supported.

Several robustness tests were performed, as mentioned earlier. First, we also used R&D stock measures that included both the current-year and accumulated R&D expenditures going back two years and three years, respectively, as proxies for the firm's investments in technology development. Both measures were highly correlated with the five-year R&D stock measure, and the correlation coefficients were above 0.98. This is consistent with pervious observations that the variance of the R&D series tends to be very low (Hall, Griliches, & Hausman, 1986). Moreover, in multivariate models not reported here, the interpretations presented in Table 3 continued to hold. In another analysis, we set missing values of R&D expenditures to zero, and again obtained the same interpretations.

Second, we also used different time windows (i.e., 2 years, 3 years, and 4 years) to measure the number of joint ventures and acquisitions in which the firm invested. As would be expected, the number of joint ventures and acquisitions for these different time frames were highly correlated. Specifically, the correlations between the numbers of joint ventures (acquisitions) were above 0.91 (0.90). More importantly, when we used these new measures in the regression, we again obtained results that were qualitatively similar to those presented in Table 3. The results are also robust to alternative approaches used to measure the firm's investments in joint ventures and acquisitions, such as taking their natural logarithm as well as scaling them by the firm's market value.

Third, given that 8.8% of the observations in the sample have a growth option value lower than 0 or higher than 1, we tested whether the parameter estimates are sensitive to the inclusion or exclusion of these observations. We discarded observations whose value falls outside of the zero to one range and estimated separate regression models. Parameter estimates for the theoretical variables were qualitatively similar to those in Table 3; among the control variables, only the effect of financial leverage changed slightly: while its coefficient was again negative, its level of significance increased ($p<0.001$).

Finally, as noted in the methods section, we also used Compustat data to calculate an estimate of growth option value and regressed this measure on the same set of covariates. Again, results on theoretical variables had the same sign and retained the same level of significance as those in Table 3, while, among the control variables, the coefficient for financial leverage was negative and only marginally significant ($p<0.10$), and the coefficient for organizational slack was positive and significant at the 0.01 level.

Having established the robustness of the model, we sought to conduct a more fine-grained analysis by investigating the influence of firms' ownership position in joint ventures and acquisitions on their growth option value. There are two reasons for doing so. First, a direct implication of Kogut's (1991) original model, as presented in the hypothesis section, is that to the extent that initial equity α_{c0} is viewed as the call option's purchase price, lower equity levels should reduce the firm's downside risk in the collaboration, while still allowing it to benefit from the joint venture's upside opportunities. This suggests that the option value embedded in the firm's joint ventures will be an inverse function of its ownership position.[8] To test for this, we separate the firm's investments in joint ventures into minority joint ventures in which the firm holds an equity stake of less than 50% versus non-minority joint ventures (i.e., 50% or higher). Second, while acquisitions in general cannot be viewed as growth options due to the commitment-intensive and terminal-sale nature, it is still conceivable that some acquisitions, such as partial acquisitions (e.g., Smith & Triantis, 1995), may carry latent growth options. We therefore separated the firm's investments in acquisitions into minority acquisitions in which the firm purchases an equity stake of less than 50% versus non-minority acquisitions (i.e., 50% or higher).

Table 4 presents regression results that test our argument above. Model I is the baseline model, and it is identical to Model IV in Table 3. Models II and III are specifications in which joint ventures and acquisitions were broken down into minority and non-minority deals, while other variables were kept the same. Model IV is the full model consisting of variables capturing different ownership structures for both joint ventures and acquisitions. As before, all models are significant at the 0.001 level. Models II and IV indicate that minority joint ventures have a

[8] Of course, if the exercise price P is not fixed *ex ante* and the value of the joint venture is not idiosyncratic to each partner, it is possible that the price a buyer pays to acquire the partner's equity will fully reflect the value to the buyer, and in this case the acquiring party captures zero additional value when exercising the option, irrespective of its initial equity position (Chi, 2000). While many joint ventures do not have a pre-specified exercise price in their contracts, unique valuations across joint venture partners are likely under many circumstances, and other means of acquiring ownership are followed in practice (e.g., Russian roulette clauses, third party valuation, etc.) that prevent full appropriation of value by the seller at the joint venture termination stage.

positive and significant impact on growth option value, while joint ventures of other ownership structures do not. In Models III and IV, neither minority nor non-minority acquisitions have a significant effect on growth option value, but the parameter estimate for minority acquisitions is positive and has a p-value of 0.13 in Model III. Hierarchical *F*-tests were conducted to determine if the effects of joint ventures and acquisitions vary across different ownership structures. Hierarchical *F*-tests comparing Model I with Model II and Model III with Model IV produced *F* values of 0.70 (n.s.) and 0.48 (n.s.), respectively; hierarchical *F*-tests comparing Model I with Model III and Model II with Model IV produced *F* values of 0.62 (n.s.) and 0.40 (n.s.), respectively. Thus, the tests did not provide evidence that could reject the null hypotheses that the coefficients for minority and non-minority joint ventures, as well as for minority and non-minority acquisitions, are equivalent.[9]

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Insert Table 4 about here
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The results for the control variables are also worth noting. There is no significant effect of firm size, which might reflect the countervailing effects of factors such as positional advantages or project diversity that offer expansion options on the one hand, and of more bureaucratic decision-making processes that impede flexibility on the other. The coefficient estimate for organizational slack is positive and significant, suggesting that organizational slack contributes to growth option value. The multivariate results for financial leverage are consistent with Myers' (1977) theory, which maintains that corporate borrowing should be inversely related to the proportion of market value attributable to growth options. Our control for industry growth

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[9] In order to explore this issue further, we separated the non-minority joint ventures into 50/50 and majority joint ventures, and the non-minority acquisitions into 50/50, majority, and full acquisitions, but the same insignificant results were obtained for the hierarchical *F*-tests examining whether the effects differ across ownership structures.

options is positive and highly significant ($p<0.001$), pointing to the relevance of inter-industry heterogeneity. Finally, in all of the models, year fixed effects are jointly significant, as are firm fixed effects, which provided additional evidence that the fixed effects model is appropriate for our analyses (Hsiao, 1986).

DISCUSSION

This paper examines the growth option value implications of several types of corporate development activities that have been commonly viewed as being able to create significant future growth opportunities. Our focus on the organizational consequences of option investments is an important departure from the decision-theoretic approach taken in most previous real options research on corporate investment decisions and thus represents a major contribution of this study. In addition, the methodology used in this study also has broader implications for future empirical studies of real options. More specifically, the methodology allows researchers to obtain an empirical estimate of the proportion of firm value accounted for by growth options, without which it would have been harder to provide direct evidence on whether firms can capture growth option value from their investments in growth options.

The findings provide strong evidence that certain corporate investments can provide future growth opportunities that are of value to the firm, but they also indicate that corporate investments vary in their ability to generate valuable growth options. R&D investment was found to be positively associated with the proportion of firm value attributable to growth options. Such investment provides the opportunity to undertake further specified investment, contingent upon satisfactory outcomes associated with the initial investment. Thus, the knowledge or capabilities acquired through technology development are real options that provide firms platforms to expand into new and uncertain markets in the future (e.g., Kogut & Kulatilaka, 2001). Our findings also build upon existing research on the effects of R&D investment on the value of the firm (e.g., Chan, Martin, & Kensinger, 1990; Hall, 1993) and suggest that, of the two components of the firm's value, R&D investment contributes to the value of growth options in particular.

Investments in tangible capital, however, do not contribute to growth option value in general, contrary to the argument in some previous research on real options. One possible explanation is that these investments increase the value of assets in place more than that of growth options, such that growth option value, or the value of growth options as a percentage of the firm's total value, decreases overall. Another possibility is that the value the stock market attaches to growth options latent in capital investment is contingent upon other factors that we did not consider. For instance, McConnell and Muscarella (1985) find that, while the market responds favorably to capital expenditure programs for most firms in their sample, it responds negatively to capital expenditure programs for firms in oil and gas industries, which they suspect might be subject to considerable agency problems. In addition, our use of the firm's capital expenditures is a very broad indicator of its investments in tangible capital, and future studies relying upon primary or industry-specific data may be able to disaggregate capital expenditures into different categories such as replacement of old machinery, maintenance of existing equipment, and purchase of new facilities or production lines (e.g., Lioukas & Chambers, 1981).

One of the contributions of this study relates to the empirical evidence that we have provided for firms' external corporate development activities. We build upon prior research that has examined joint ventures using a real options lens by investigating whether firms' investments in joint ventures actually translate into valuable growth options. While confirming Kogut's

(1991) seminal idea that joint ventures can be created as real options to expand, we also find that, among equity joint ventures of various ownership levels, only minority joint ventures have a significant impact on the firm's growth option value. Coupled with analytical insights suggesting the flexibility benefits associated with smaller initial ownership (Chi, 2000), our findings imply that investments in joint ventures involving smaller initial ownership may be a particularly valuable means of staging firms' commitments. With regard to the effect of acquisitions, while the finding does not support our hypothesis, that acquisitions generally have an insignificant influence on growth option value is consistent with the traditional view that such investments tend to be more commitment-intensive and less reversible compared to joint ventures.

Future research could address several limitations of this study. For instance, future research could go beyond the Stern Stewart dataset and derive growth option value using publicly available financial and accounting data that could potentially increase the generalizability of the findings. As another example, we have only focused on two types of internal corporate development activities, and future applications could explore internal investments of a larger variety, such as investments in learning-by-doing (e.g., Myers, 1977), investments in marketing capabilities (e.g., Tannous, 1997), and investments in human capital development (e.g., Barro & Sala-i-Martin, 1995). Such work could potentially sort out investments that enhance growth option value from those that do not, and help identify boundaries for the application of real options theory to corporate investments.

In this paper, we focus on the value of growth options to the firm in particular, but additional research is also needed on the performance implications of other types of real options of strategic importance (Trigeorgis 1996). However, estimating the value of these other options would require the use of different methodologies since the measure we employ relates specifically to growth opportunities available to the firm rather than other potential consequences these options may yield. For instance, switching options for output flexibility may enable firms to satisfy the volatile demands for multiple products. Switching options for input flexibility, which for example include the dispersion of manufacturing facilities across country borders, may be geared more toward dynamic efficiency in response to changes in foreign exchange rates, factor prices, and so forth, rather than growth *per se*. Finally, the organizational consequences of real options depend not only on the firm's investments in options, but also on its ability to manage these options and exercise them appropriately. Given the paucity of research focusing on the implementation aspect of real options, future studies that shed light on issues such as organizational design and management systems would be particularly useful (e.g., Garud, Kumaraswamy, & Nayyar, 1998). As real options theory advances in the strategy field, we believe continued efforts in these directions would prove valuable to the theory's development.

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TABLE 1
Sectoral and Temporal Distribution of the Value of Growth Options[a]

I Industry (SIC)	II 1989-1991	III 1992-1994	IV 1995-1997	V 1998-2000	VI All Years
Food and Kindred Products (20)	.46 (33)	.40 (32)	.46 (31)	.42 (27)	.44 (123)
Tobacco Products (21)	--	.30 (3)	.34 (3)	-.17 (3)	.16 (9)
Textile Mill Products (22)	--	--	--	.22 (2)	.22 (2)
Apparel (23)	--	--	--	.22 (2)	.22 (2)
Lumber and Wood Products (24)	.56 (3)	.50 (3)	.30 (6)	.38 (6)	.40 (18)
Furniture and Fixtures (25)	.30 (15)	.45 (18)	.18 (20)	-.05 (22)	.20 (75)
Paper and Allied Products (26)	.38 (27)	.49 (27)	.41 (28)	.38 (27)	.41 (109)
Printing and Publishing (27)	--	--	--	.43 (3)	.43 (3)
Chemicals and Allied Products (28)	.48 (124)	.48 (135)	.48 (154)	.47 (169)	.48 (582)
Petroleum Refining (29)	.26 (14)	.46 (17)	.35 (13)	.25 (12)	.34 (56)
Rubber and Plastics (30)	.38 (12)	.38 (12)	.35 (14)	.16 (18)	.30 (56)
Stone, Clay, Glass, and Concrete (32)	.40 (9)	.35 (12)	.01 (12)	-.20 (12)	.12 (45)
Primary Metals (33)	.39 (23)	.56 (29)	.25 (34)	.41 (29)	.40 (115)
Fabricated Metal products (34)	.40 (24)	.36 (24)	.32 (24)	.26 (24)	.34 (96)
Industrial and Commercial Machinery and Computer Equipment (35)	.37 (76)	.47 (98)	.36 (110)	.48 (127)	.44 (411)
Electronic and Electrical Equipment (36)	.43 (82)	.53 (106)	.51 (134)	.63 (151)	.54 (473)
Transportation Equipment (37)	.35 (32)	.38 (35)	.30 (42)	.13 (46)	.28 (155)
Measuring, Analyzing, and Controlling Instruments (38)	.50 (64)	.51 (67)	.46 (75)	.53 (82)	.50 (288)
Miscellaneous Manufacturing (39)	.31 (12)	.49 (12)	.43 (15)	.30 (13)	.38 (52)
Total	.42 (550)	.47 (630)	.41 (715)	.43 (775)	.43 (2670)

[a] Cell values represent average growth option values, and the number of observations appears in parentheses.

TABLE 2
Descriptive Statistics and Correlation Matrix[b]

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Growth Option Value	.434	.299								
2. Firm Size	7.789	1.447	-.263							
3. Financial Leverage	.178	.150	-.221	.065						
4. Organizational Slack	.249	.137	.379	-.289	-.205					
5. Industry Growth Option Value	.472	.186	.356	-.135	-.088	.297				
6. R&D Investment	.169	.212	.386	-.275	-.248	.644	.244			
7. Capital Intensity	.069	.055	.159	-.083	-.073	.120	.091	.303		
8. Joint Ventures	3.928	9.276	-.082	.532	-.024	-.190	-.051	-.047	.074	
9. Acquisitions	5.958	8.139	-.074	.480	.039	-.094	-.053	-.088	-.017	.369

[b] N=2670. All correlations with absolute value greater than 0.04 are significant at $p<0.05$.

TABLE 3
Fixed-Effects Multiple Regression Estimates[c]

Independent Variables	I	II	III	IV
Lagged Dependent Variable	.267*** (.024)	.261*** (.024)	.265*** (.024)	.258*** (.024)
Firm Size	-.011 (.018)	-.004 (.018)	-.008 (.019)	-.001 (.019)
Financial Leverage	-.113* (.055)	-.122* (.053)	-.110* (.055)	-.119* (.053)
Organizational Slack	.651*** (.172)	.373* (.184)	.662*** (.172)	.380* (.183)
Industry Growth Option Value	.348*** (.053)	.331*** (.054)	.345*** (.053)	.328*** (.054)
Year Fixed Effects[d]	5.21***	5.18***	5.41***	5.51***
Firm Fixed Effects[d]	2.74***	2.74***	2.77***	2.78***
R&D Investment	---	.380*** (.092)	---	.381*** (.091)
Capital Intensity	---	-.136 (.160)	---	-.120 (.160)
Joint Ventures ($x10^{-2}$)	---	---	.457** (.155)	.459** (.157)
Acquisitions ($x10^{-2}$)	---	---	-.026 (.120)	-.031 (.119)
Adjusted R^2	.544	.550	.547	.553
Model F	23.66***	23.85***	22.05***	22.38***
Hierarchical F	---	16.88***	8.27***	12.57***

[c] N=2670. † $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$. Robust standard errors appear in parentheses.
[d] F-statistics for the null hypothesis of equal year or firm effects.

TABLE 4
Effects of Ownership Position on Growth Option Value[e]

Independent Variables	I	II	III	IV
Lagged Dependent Variable	.258*** (.024)	.257*** (.024)	.258*** (.024)	.257*** (.024)
Firm Size	-.001 (.019)	-.002 (.019)	-.002 (.019)	-.002 (.019)
Financial Leverage	-.119* (.053)	-.120* (.053)	-.119* (.053)	-.119* (.053)
Organizational Slack	.380* (.183)	.382* (.183)	.379* (.184)	.381* (.184)
Industry Growth Option Value	.328*** (.054)	.326*** (.053)	.326*** (.054)	.325*** (.054)
Year Fixed Effects[f]	5.51***	5.50***	5.52***	5.50***
Firm Fixed Effects[f]	2.78***	2.73***	2.78***	2.73***
R&D Investment	.381*** (.091)	.380*** (.090)	.379*** (.091)	.379*** (.090)
Capital Intensity	-.120 (.160)	-.124 (.160)	-.117 (.160)	-.121 (.160)
Joint Ventures ($x10^{-2}$)	.459** (.157)	---	.436** (.165)	---
Minority Joint Ventures ($x10^{-2}$)	---	.778* (.389)	---	.718† (.428)
Non-minority Joint Ventures ($x10^{-2}$)	---	.300 (.248)	---	.301 (.249)
Acquisitions ($x10^{-2}$)	-.031 (.119)	-.028 (.122)	---	---
Minority Acquisitions ($x10^{-2}$)	---	---	.384 (.283)	.313 (.304)
Non-minority Acquisitions ($x10^{-2}$)	---	---	-.058 (.127)	-.050 (.129)
Adjusted R^2	.553	.553	.553	.553
Model F	22.38***	21.34***	21.62***	20.65***

[e] N=2670. † p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Robust standard errors appear in parentheses.
[f] F-statistics for the null hypothesis of equal year or firm effects.