ESSAYS ON GROWTH OPTIONS AND CORPORATE STRATEGY

DISSERTATION

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Real options are investments in real assets that confer firms the right, but not the obligation, to undertake some future specified action, and they provide firms the twin organizational benefits of containing downside risk as well as capturing upside opportunities. Existing research on real options theory in strategy has tended to take a decision-theoretic approach to studying these investments, and as a result has provided insufficient direct empirical evidence on the theory’s central propositions. A key objective of this dissertation therefore is to focus on the organizational implications of real options investments that have not received much research attention in the literature.

The dissertation consists of three empirical essays that aim to test real options theory in the corporate strategy domain and they all center on the growth options that firms possess. The first essay introduces growth option value—the proportion of the firm’s value that is accounted for by growth options—and provides a way to estimate it. Growth option value is then related to a number of internal and external corporate development activities commonly viewed as investments with embedded future growth opportunities. The analysis builds on a dynamic panel dataset of 293 firms from 1989-2000, and the results indicate that firms’ investments in research and development and in joint ventures (JVs) contribute significantly to growth option value, while investments in tangible capital and in acquisitions do not. In addition, among equity JVs of various
ownership levels, only minority JVs have significant effects. The essay helps identify boundaries for the application of real options theory to strategy and the variable growth option value would have more general implications for future research on growth options.

The second essay aims to contribute to the JV literature by critically examining a proposition long held in the strategy and international business literature, namely, JVs represent valuable options to expand under market and technological uncertainty. The essay first develops a contingent perspective of this proposition and then empirically tests the effects of several important contingencies that potentially affect the growth option value that firms can capture from their JVs. The findings suggest that while JVs do enhance growth option value, they do so only under certain circumstances. Specifically, international joint ventures (IJVs) contribute to growth option value in general, and minority IJVs and diversifying IJVs have significant effects in particular, irrespective of whether the venture is located in developed or emerging economies.

The third essay is a variance decomposition study that seeks to develop the empirical evidence on the relative influence of stable and transient industry effects, stable firm effects, and year effects on growth option value. The findings suggest that stable firm effects are almost twice as much important as total industry effects on growth option value, and that year effects are relatively unimportant. These results hold when single-business firms and manufacturing firms form sub-samples for additional analyses and they also apply to separate analyses focusing on Tobin’s Q that is arguably a proxy for firms’ future growth opportunities. These results have broader implications for strategic management and real options research, given the importance of the growth of the firm to corporate strategy and that of growth options to resource allocation and value creation.
Dedicated to my parents, my parents-in-law, my brother and sister, and to my family
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Academic interest in real options theory is emerging in the field of strategic management (Adner & Levinthal, 2004; McGrath, Ferrier, & Mendelow, 2004). Behind this emerging interest are the practical concern that strategic investment decisions are often made under uncertainty (Dixit & Pindyck, 1994) and the theoretical appeal that real options theory is able to capture managers’ flexibility in adapting their future actions to changing market or technological conditions (Trigeorgis, 1996). The broader objective of this dissertation is therefore to improve existing understanding of real options theory’s applications in the domain of corporate strategy.

Myers (1977) first coined the term real options to refer to a firm’s future investment, or growth opportunities. These growth opportunities can be viewed as real options because their value ultimately depends on the firm’s discretion to invest in the future, and whether or not the firm will actually choose to make these investments is contingent on the future states of the world. There is close analogy between real options and financial options (Kester, 1984; Bowman & Hurry, 1993; Kogut & Kulatilaka, 2001). Real options are real because the investments are in real (physical or human) assets, as opposed to financial assets in the case of financial options. Real options are options
because like financial options, once invested, they confer the firm the right, but not the obligation, to undertake some future specified action. The theory’s organizational implications are that real options investments confer the investing firm the twin benefits of reducing downside risk and claiming upside opportunities (Bowman & Hurry, 1993; McGrath, 1997, 1999). Indeed, in McGrath’s (1997) words, “the distinguishing characteristic of an options approach lies in firms making investments that confer the ability to select an outcome only if it is favorable” (p. 975).

While considerable advances on real options theory have been made over the years, currently there still exists a significant gap between theory and empirical evidence (Bowman & Hurry, 1993; Trigeorgis, 1996; McGrath & Nerkar, 2004). As Schwartz and Trigeorgis (2001) point out, applications of real options theory set the next stage of real options research. While more recent research on real options has started to address this gap, extant empirical applications in strategy have tended to take a decision-theoretic approach to examining corporate investments under conditions of uncertainty. Specifically, particular investment decisions are usually ascribed to the purchase or exercise of certain options and then are linked to some forms of uncertainty, which can elevate the value of these options, thus affecting the actual likelihood or the timing of these decisions (e.g., Kogut, 1991; Folta, 1998; Leiblein & Miller, 2003; McGrath & Nerkar, 2004). To be sure, this research has provided useful evidence on whether managers value real options embedded in investments under uncertainty and whether the timing of investment behaviors can be rationalized by the existence of real options (Dixit & Pindyck, 1994). But additional research is also needed to investigate the organizational implications of firms’ investments in real options, and to provide direct
evidence on whether these investments actually benefit firms in the ways that real options theory predicts.

The specific goal of this dissertation is to provide direct empirical evidence on one of real options theory’s central predictions—that real options investments confer future growth opportunities that are valuable to the firm. The dissertation thus investigates the organizational implications of real options investments, and it complements previous studies focusing on the downside risk implications of real options investments (Reuer & Leiblein, 2000). This is an important departure from the bulk of existing decision-theoretic literature on real options in strategy. Research with such a perspective is central to real options theory’s development if the theory is to provide distinguishing insights into strategic investments and corporate strategy more generally (McGrath, 1997; McGrath et al., 2004).

In order to test real options theory in the corporate strategy domain, the dissertation introduces a variable “growth option value”, which is a concept that has existed for some time but has yet to receive more research attention in strategy. Simply put, growth option value is the proportion of the firm’s value that is accounted for by its future growth opportunities, or real options using Myers’ (1977) terminology. These real options have also been termed growth options because they are basically call options on real assets (Myers, 1977, 1984; Kester, 1984). The dissertation also presents a way to estimate growth option value using a dataset that has not been commonly used in strategy research. Previous research has suggested alternative variables, such as Tobin’s Q, as a broad proxy for a firm’s magnitude of growth opportunities. But growth option value is more consistent with Myers’ (1977) original conceptualization of growth options and
thus provide a better means of testing real options theory’s central predictions that real
options investments can help the firm obtain valuable growth opportunities. Indeed,
recent research in real options challenges Tobin’s Q as a measure of the level of growth
opportunities that firms possess (e.g., Abel, Dixit, Eberly, & Pindyck, 1996; Berk, Green,
& Naik, 1999). And this challenge also reflects the way that Tobin’s Q has been used in
previous research: besides growth opportunities, Tobin’s Q has been associated with a
number of other underlying constructs, such as monopoly power (e.g., Lindenberg &
Ross, 1981), management quality (e.g., Lang, Stulz, & Walkling, 1989), shareholder
value (e.g., Lang & Stulz, 1994), and intangible assets (e.g., Villalonga, 2004).
Therefore, the variable growth option value that is introduced and measured, as well as
the set of empirical evidence that is provided, in the dissertation also represents important
additions to the real options literature.

The dissertation consists of three empirical essays that all investigate the
organizational implications of the growth options that firms possess. Although the
existing applications of real options theory in strategy have considered the role of growth
options that corporate investments may carry (e.g., Kogut, 1991), they have yet to offer
direct evidence on whether firms actually capture growth option value from such
investments. This observation motivates the first essay (Chapter 2), which purports to
provide empirical answers to the general question of whether firms’ certain strategic
investments are related to their growth option value. The investments investigated
include firms’ both internal and external corporate development activities: investments
in R&D, investments in tangible capital, investments in joint ventures (JVs), and
investments in acquisitions.
The essay proceeds by first introducing the variable growth option value and calculating it, which is then linked to the above four types of investments commonly viewed as providing valuable future growth opportunities. The analysis builds on a dynamic panel dataset of 293 firms from 1989-2000, and the results indicate that firms’ investments in research and development and in JVs contribute significantly to growth option value, while investments in tangible capital and in acquisitions do not. In addition, among equity JVs of various ownership levels, only minority JVs have significant effects. The essay helps identify boundaries for the application of real options theory to corporate strategy, and the variable growth option value as well as the way it is calculated would have implications for future research on growth options.

While the first essay attempts to study a general question at the heart of real options theory, i.e., whether real options investments indeed confer firms future growth opportunities that are valuable, the second essay (Chapter 3) is set out to fill a very specific gap that exists in the JV and the real options literatures. Although real options theory predicts that JVs confer valuable growth opportunities to firms, there has been little empirical research that provides direct evidence on whether firms actually capture growth option value from their JVs, and if so, in what ways. While models have been developed to analyze some of the conditions under which growth opportunities in JVs are valuable to firms (e.g., Chi & McGuire, 1996, Chi, 2000), extant research has not developed or tested contingency perspectives of the use of JVs to obtain valuable growth options.

The essay thus aims to extend real options theory’s application in the JV domain by directly testing the theory’s central proposition that JVs confer valuable growth
options, and by developing a contingent view of growth options in JVs and investigating how different types of international joint ventures (IJVs) contribute to firms’ growth option value. In doing the latter, the essay theoretically links real options theory to three important variables in previous research on IJVs, namely, the ownership structure of the venture, its product market focus, and its geographic location. The empirical findings suggest that while JVs do enhance growth option value, they only do so under certain circumstances. Specifically, international joint ventures (IJVs) contribute to growth option value in general, and that minority IJVs and diversifying IJVs have significant effects in particular, irrespective of whether the venture is located in developed or emerging economies. This chapter is a stand-alone essay given the very specific research question positioned in the literature, which effectively responds to recent calls for a closer look of JV structural attributes that can affect the option value of JVs (Chi, 2000).

The sectoral and temporal tabulation of growth option value (Table 2.1) in the first essay reveals an interesting finding that growth option value differs significantly across industries and across time periods. An examination of the distribution of growth option value within certain industries further shows that growth option value differs significantly across firms as well. These findings are broadly consistent with those in an earlier study by Kester (1984) and, albeit in a somewhat different way, they mirror the classical research question of whether industry effects or firm effects matter more importantly to financial performance, a question focused in an influential body of literature in strategic management and industrial economics (e.g., Schmalensee, 1985; Rumelt, 1991; McGahan & Porter, 1997). These findings, combined with the fact that
growth option value is a relatively new variable with general implications for future real options research, provide motivations for the third essay (Chapter 4).

The essay is a variance decomposition study that seeks to develop the empirical evidence on the relative influence of stable and transient industry effects, stable firm effects, and year effects on growth option value. The findings suggest that stable firm effects are almost twice as much important as total industry effects on growth option value, and that year effects are relatively unimportant. These results hold when single-business firms and manufacturing firms form additional samples for analyses and they also apply to separate analyses focusing on Tobin’s Q that is arguably a proxy for firms’ future growth opportunities. A more straightforward interpretation of these results is that valuable growth options are often firm-specific, exclusive, and proprietary, that industry factors such as industry structure and competitive interaction matter less to growth option value appropriated by the firm, and that growth option value is not greatly affected by economy-wide factors. These results have broader implications for research in strategic management as well as real options, given the importance of the growth of the firm to corporate strategy (Penrose, 1959; Chandler, 1962) and the importance of growth options to resource allocation and value creation (Myers, 1977; Kester, 1984).

The recent debate on the unique contributions of real options theory to the strategy field (Adner & Levinthal, 2004; McGrath et al., 2004) highlights the importance to the theory’s development of investigating the organizational implications of real options investments. A real options approach to corporate investments distinguishes itself from alternative approaches in the asymmetric effects that it promises to bear on the firm, namely, the twin organizational benefits of containing downside risk while
capturing upside opportunities (Bowman & Hurry, 1993; McGrath, 1997, 1999).

Through three essays, this dissertation takes up these issues by providing empirical evidence on the relative influence on growth option value of various types of corporate investments (Chapter 2, 3), as well as that of firm-, industry-, and year-specific effects (Chapter 4). The dissertation therefore helps bring the unique contributions of real options theory to corporate strategy to the fore.
CHAPTER 2

CORPORATE INVESTMENT DECISIONS
AND THE VALUE OF GROWTH OPTIONS

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 chapter, I focus on growth options in particular and I am interested in the question of whether firms are able to capture growth option value from their real investments with option-like features.

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), I 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. I then identify several types of internal and external corporate development activities that have been commonly viewed as conferring firms discretionary future investment opportunities, and I 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. My data on firms’ external corporate development activities allow me to explore further the contingent effects of firms’ ownership positions in these investments. Although I do not find significant effects for acquisitions of any type, my analyses reveal that, among equity joint ventures of different ownership levels, only minority joint ventures contribute significantly to growth option value. My results are useful for examining the boundaries for applying real options theory to research on corporate investments and to strategy research more generally.

2.1 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 ultimate 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 chapter. First, by formalizing follow-on growth opportunities latent in corporate investments as options, the idea provides the theoretical basis not only for  

\footnote{Another important implication lies in growth options being a key determinant of capital structure in finance (see Myers, 1977).}
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), a firm’s value (V) can be decomposed into the value of assets in place (VAIP) and the value of future growth opportunities (VGO), or

\[ V = VAIP + VGO. \]

The value of growth options then, is just the value of future growth opportunities (VGO), given that the ultimate value of these growth opportunities depends on firms’ discretionary investments 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:

\[
\text{GOV} = \frac{V_{GO}}{V} = \frac{[V - \text{Current Earnings} / \text{Discount Rate}]}{V}.
\]

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 my 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 terms.

### 2.2 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 occur 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. Concerning internal corporate development, I will focus on firms’ investments in R&D and in tangible capital for the purpose of this chapter, to be discussed below.

2.2.1 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.

### 2.2.2 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, \( \alpha_{c0} \) is the call holder’s initial equity, \( \alpha_{ct} \) 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 and are less reversible than joint ventures, growth options may naturally be built into some deals. Kester (1984) maintains that it is possible that certain acquisitions, like joint venture investments, can create future growth opportunities (see also Myers, 1984). Smith and Triantis (1995) suggest that valuable growth options may be embedded in strategic acquisitions that enhance the acquirer’s capabilities in certain markets with significant growth potential. As one way to address this, I explore the influence of alternative deal
structures that may differentially impact firms’ growth option value, and I 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.

2.3 Methods

2.3.1 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 I 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).

I 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 me 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, I sought to have a five-year rolling window over which to include firms’ investments in external corporate development activities. I 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 my independent variables – R&D expenditures – is more routinely reported by manufacturing firms. I 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, I 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.

2.3.2 Measures and Data

Growth Option Value. My approach to estimating growth option value, which I detail below, is generally consistent with that of Kester (1984), but my estimation
represents several improvements over his due to my 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 I 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:

\[ V = CI + MVA. \]
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) \[ \text{MVA} = \text{PV of Expected EVA}. \]

EVA is a performance metric trademarked by Stern Stewart, yet it is a version of the residual income method used to measure operating performance. Another popular name for residual income is “economic profit,” a concept tracing its roots back to at least Marshall (1890). 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) \[ \text{RI} = \text{NOPAT} - [\text{CI} \times \text{WACC}], \]

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 (i.e., EVA Growth) 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. A firm has negative future growth
opportunities when it is believed to be unable to sustain its current level of performance, or making value-destructing investments. Notationally,

\[(6) \quad \text{PV of Expected EVA} = \text{PV of Current-Level EVA} + \text{PV of EVA Growth}.\]

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

\[(7) \quad V = \text{CI} + \text{PV of Current-Level EVA} + \text{PV of EVA Growth},\]

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., \(V_{\text{AIP}}\)), and PV of EVA Growth measures the value of growth options (i.e., \(V_{\text{GO}}\), the component of firm value attributable to growth options).

To calculate my dependent variable, the firm’s growth option value (GOV), I solve equation (7) for PV of EVA Growth (i.e., \(V_{\text{GO}}\)), and then scale it by the firm’s value \(V\):

\[(8) \quad \text{GOV} = \frac{[V - \text{CI} - \text{PV of Current-Level EVA}]}{V}.\]

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. Notably, 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 \(V_{\text{GO}}\) increases more than \(V_{\text{AIP}}\).

Given the similarity of my approach to that of Kester (1984), I 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 my measure represented in equation (8) is 0.81 (\(p<0.001\)). As will be
discussed further in the results section, I also conducted regression analyses on this alternative measure to consider whether the accounting adjustments of Stern Stewart affect the interpretation of the results.

I also explored the correlation of my 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). I 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 my measure of growth option value is 0.47 (p<0.001), and the correlation between Tobin’s Q and the measure of growth option value calculated using Compustat data is 0.41 (p<0.001). 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 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 monopoly rent (Lindenberg & Ross, 1981), management quality (e.g., Lang, Stulz, & Walkling, 1989), shareholder wealth (e.g., Lang & Stulz, 1993), intangible assets (e.g., Villalonga, 2004), 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 my 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, I 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 2.1. 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.

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. My first theoretical variable is the firm’s investments in R&D, which I 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, I 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.

My 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, I 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, I constructed variables to measure firms’ investments in equity joint ventures and in acquisitions. I 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, I 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, I 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, I 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). My 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), I 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, I 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 my econometric model as it cannot estimate time-invariant effects, as discussed in more detail below. Finally, I 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.

2.3.3 Econometric Techniques

Given the pooled time-series and cross-sectional nature of my data, panel data techniques were employed to test my hypotheses. For my 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 my 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; Greene, 2003).

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} = \alpha_i + \delta_t R\&D Investment_{it} + \beta_2\text{Capital Intensity}_{it} + \\
\beta_3\text{Joint Ventures}_{it} + \beta_4\text{Acquisitions}_{it} + \beta_5\text{Firm Size}_{it} + \\
\beta_6\text{Financial Leverage}_{it} + \beta_7\text{Organizational Slack}_{it} + \\
\beta_8\text{Industry Growth Option Value}_{it} + \epsilon_{it},

where subscripts i and t denote firm i and year t, respectively, \( \alpha_i \) represents firm fixed effects, and \( \delta_t \) 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 (Hsiao, 1986). Given the concern for autocorrelation in the dependent variable across time periods, a lagged term was added to the right hand side of the equation (Griliches, 1981), which also helped control for potential autocorrelation, if any, in the residuals. The incorporation of the lagged dependent variable makes the equation a dynamic panel data model, so it was estimated using dynamic panel data econometric techniques suggested by Hsiao (1986). Finally, heteroscedasticity-consistent robust standard errors proposed by White (1980) were used to determine the significance levels of the results.

2.4 Results

Table 2.2 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).
Table 2.3 presents regression results for my 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 2.3 shows, Models II, III, and IV all provide significant improvements in explanatory power over the baseline model.

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 my 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, I 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 previous 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 2.3 continued to hold. In another analysis, I set missing values of R&D expenditures to zero, and again obtained the same interpretations.

Second, I 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 I used these new measures in the regression, I again obtained results that were qualitatively similar to those presented in Table 2.3. 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, I tested whether the parameter estimates are sensitive to the inclusion or exclusion of these observations. I 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 2.3; 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, I 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 2.3, 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, I 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 $c_0$ 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.2 To test for this, I separate the

2 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.
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. I 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 2.4 presents regression results that test my argument above. Model I is the baseline model, and it is identical to Model IV in Table 2.3. 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 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.³

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. My control for industry growth 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 the analyses (Hsiao, 1986).

2.5 Discussion

This chapter 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. My focus on the organizational consequences of

³ In order to explore this issue further, I 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.
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). My 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 I 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, my 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 I have provided for firms’ external corporate development activities. I 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, I 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), my 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 my 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, I 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 chapter, I 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 I
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, I believe continued efforts in these directions would prove valuable to the theory’s development.
<table>
<thead>
<tr>
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<td>--</td>
<td>.22</td>
<td>.22</td>
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<td>.38</td>
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<td>.25</td>
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<td>.32</td>
<td>.26</td>
<td>.34</td>
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<td>.47</td>
<td>.36</td>
<td>.48</td>
<td>.44</td>
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<tr>
<td>Electronic and Electrical Equipment (36)</td>
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<td>.51</td>
<td>.63</td>
<td>.54</td>
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<td>Transportation Equipment (37)</td>
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<td>.38</td>
<td>.30</td>
<td>.13</td>
<td>.28</td>
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<td>.51</td>
<td>.46</td>
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<td>.50</td>
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<tr>
<td>Miscellaneous Manufacturing (39)</td>
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<td>.49</td>
<td>.43</td>
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<td>.38</td>
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<tr>
<td>Total</td>
<td>.42</td>
<td>.47</td>
<td>.41</td>
<td>.43</td>
<td>.43</td>
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</tbody>
</table>

Cell value represents mean growth option value, and the number of observations appears in parentheses.

Table 2.1: Sectoral and Temporal Distribution of Growth Option Value
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S.D.</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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<td></td>
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<td>2. Firm Size</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Financial Leverage</td>
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<td>.150</td>
<td>-221</td>
<td>.065</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Organizational Slack</td>
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<td>.137</td>
<td>.379</td>
<td>.289</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Industry GOV</td>
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<td>.356</td>
<td>.135</td>
<td>-.088</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
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<td>6. R&amp;D Investment</td>
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<td>.212</td>
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<td>.248</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>7. Capital Intensity</td>
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<td>.055</td>
<td>.159</td>
<td>-.083</td>
<td>.073</td>
<td>.120</td>
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<td>8. Joint Ventures</td>
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<td>9.276</td>
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<td>.532</td>
<td>.024</td>
<td>-.190</td>
<td>-.051</td>
<td>-.047</td>
<td>.074</td>
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<tr>
<td>9. Acquisitions</td>
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<td>8.139</td>
<td></td>
<td>.480</td>
<td>.039</td>
<td>-.094</td>
<td>-.053</td>
<td>-.088</td>
<td>-.017</td>
<td>.369</td>
</tr>
</tbody>
</table>

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

Table 2.2: Descriptive Statistics and Correlation Matrix
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<td>Lagged Dependent Variable</td>
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<td>.261***</td>
<td>.265***</td>
<td>.258***</td>
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<td></td>
<td>(.024)</td>
<td>(.024)</td>
<td>(.024)</td>
<td>(.024)</td>
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<tr>
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<td>-.008</td>
<td>-.001</td>
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<tr>
<td></td>
<td>(.018)</td>
<td>(.018)</td>
<td>(.019)</td>
<td>(.019)</td>
</tr>
<tr>
<td>Financial Leverage</td>
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<td>-.122</td>
<td>-.110</td>
<td>-.119</td>
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<tr>
<td></td>
<td>(.055)</td>
<td>(.053)</td>
<td>(.055)</td>
<td>(.053)</td>
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<tr>
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<td>.662***</td>
<td>.380**</td>
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<td></td>
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<td>(.184)</td>
<td>(.172)</td>
<td>(.183)</td>
</tr>
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<td>Industry Growth Option Value</td>
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<td>.331***</td>
<td>.345***</td>
<td>.328**</td>
</tr>
<tr>
<td></td>
<td>(.053)</td>
<td>(.054)</td>
<td>(.053)</td>
<td>(.054)</td>
</tr>
<tr>
<td>Year Fixed Effects(^{a})</td>
<td>5.21***</td>
<td>5.18***</td>
<td>5.41***</td>
<td>5.51***</td>
</tr>
<tr>
<td>Firm Fixed Effects(^{a})</td>
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<td>2.74***</td>
<td>2.77***</td>
<td>2.78***</td>
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<td>R&amp;D Investment</td>
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<td>.380**</td>
<td>---</td>
<td>.381**</td>
</tr>
<tr>
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<td></td>
<td>(.092)</td>
<td></td>
<td>(.091)</td>
</tr>
<tr>
<td>Capital Intensity</td>
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<td>-.136</td>
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<td>-.120</td>
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<tr>
<td></td>
<td></td>
<td>(.160)</td>
<td></td>
<td>(.160)</td>
</tr>
<tr>
<td>Joint Ventures (10^{-2})</td>
<td>---</td>
<td>---</td>
<td>.457**</td>
<td>.459**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.155)</td>
<td>(.157)</td>
</tr>
<tr>
<td>Acquisitions (10^{-2})</td>
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<td>---</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(.120)</td>
<td>(.119)</td>
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<tr>
<td>Adjusted (R^2)</td>
<td>.544</td>
<td>.550</td>
<td>.547</td>
<td>.553</td>
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<tr>
<td>Model (F)</td>
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<td>22.38***</td>
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<td>Hierarchical (F)</td>
<td>---</td>
<td>16.88***</td>
<td>8.27***</td>
<td>12.57***</td>
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</table>

N=2670. \(\dagger p<0.10; \star p<0.05; \star\star p<0.01; \star\star\star p<0.001\). Robust standard errors in parentheses.

\(^{a}\) \(F\)-statistics for the null hypothesis of equal year or firm effects.

Table 2.3: Fixed-Effects Multiple Regression Estimates
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<th>III</th>
<th>IV</th>
</tr>
</thead>
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<td>.257***</td>
<td>.258***</td>
<td>.257***</td>
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<td>(.024)</td>
<td>(.024)</td>
<td>(.024)</td>
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<tr>
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<td></td>
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<td>(.019)</td>
<td>(.019)</td>
<td>(.019)</td>
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<td>Financial Leverage</td>
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<td>-.120</td>
<td>-.119</td>
<td>-.119</td>
</tr>
<tr>
<td></td>
<td>(.053)</td>
<td>(.053)</td>
<td>(.053)</td>
<td>(.053)</td>
</tr>
<tr>
<td>Organizational Slack</td>
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<td>.379</td>
<td>.381</td>
</tr>
<tr>
<td></td>
<td>(.183)</td>
<td>(.183)</td>
<td>(.184)</td>
<td>(.184)</td>
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<tr>
<td>Industry Growth Option Value</td>
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<td>.326***</td>
<td>.326***</td>
<td>.325***</td>
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<tr>
<td></td>
<td>(.054)</td>
<td>(.053)</td>
<td>(.054)</td>
<td>(.054)</td>
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<tr>
<td>Year Fixed Effects(^b)</td>
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<td>5.50***</td>
<td>5.52***</td>
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<td>.379***</td>
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<td>(.157)</td>
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<td>(.165)</td>
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<td>Minority Joint Ventures (x10(^{-2}))</td>
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<td>Adjusted (R^2)</td>
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<td>.553</td>
<td>.553</td>
<td>.553</td>
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<tr>
<td>Model (F)</td>
<td>22.38***</td>
<td>21.34***</td>
<td>21.62***</td>
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N=2670.  \(^{†}\) p<0.10; \(^{∗}\) p<0.05; \(^{∗∗}\) p<0.01; \(^{∗∗∗}\) p<0.001. Robust standard errors in parentheses. \(^b\) F-statistics for the null hypothesis of equal year or firm effects.

Table 2.4: Effects of Ownership Position on Growth Option Value
A central proposition of real options theory is that joint ventures (JVs) confer options to expand, or growth options, under certain conditions of uncertainty (Kogut, 1991). Real options theory therefore portrays JVs as transitional governance structures created deliberately by firms to obtain future growth opportunities through sequential investment, rather than as long-lived, equilibrium arrangements aimed at static efficiencies, as typically emphasized by traditional economic theories of inter-firm collaboration.

Although there has been significant strategy research on real options since the last decade, the theory is still at relatively early stages of development both in general (Trigeorgis, 1996), as well as in the particular context of JVs. Recent empirical advances have considered firms’ investment decisions such as forming or terminating JVs using predictions from real options theory, yet direct evidence on the question of whether firms are actually capturing growth option value from their JVs is lacking. In addition, while formal models have been used to examine some of the conditions under which real options in JVs are valuable to firms (e.g., Chi & McGuire, 1996; Chi, 2000), extant research has not developed or tested contingency perspectives of the use of JVs to obtain valuable growth options.
This chapter aims to extend the real options theory of JVs by accomplishing two objectives. First, I directly test the theory’s central proposition that JVs confer valuable growth options. I do this by integrating some of the foundational research in finance on corporate valuation with more recent research on value-based management. Given that growth options embedded in JVs are likely to be valuable under conditions of uncertainty, I focus on different types of international joint ventures (IJVs) since they tend to involve high levels of uncertainty (Lyles & Salk, 1996; Inkpen & Beamish, 1997), and I also compare the effects of domestic and international JVs. Given the theory’s current stage of development, I believe that rigorous empirical tests can serve as an important step towards establishing its boundaries.

In a similar fashion, my second objective is to develop a contingent view of growth options in JVs and to investigate how different types of IJVs contribute to firms’ growth option value. In doing so, I theoretically link real options theory to three important variables in previous research on IJVs, namely, the ownership structure of the venture, its product market focus, and its geographic location. My tests seek to determine whether these variables individually and jointly influence firms’ growth option value. Such a contingency perspective is important in light of the fact that prior research often invokes option arguments for JVs in universalistic terms and neglects different types of alliances and collaborative motives (Osborn & Hagedoorn, 1997). It also responds to recent calls for differentiating the real options theory of corporate investments from alternative theories (Adner & Levinthal, 2004).
3.1 Background Literature

3.1.1 Real Options Theory and the Value of Growth Options

Real options theory traces its intellectual roots to Myers’ (1977) initial insight of viewing a firm’s discretionary future investment opportunities as “growth options”, or call options on real assets, in that the firm has the discretion to decide in the future whether or not it wants to exercise the option to undertake these investments. Indeed, in unfavorable states of nature in which the subsequent net present value (NPV) of future investment opportunities turns out negative, the firm will simply choose not to exercise these options.

Myers’ (1977) seminal idea has provided a useful way to interpret the theory of corporate valuation. Specifically, by viewing discretionary future investment opportunities as growth options, it is possible to arrive at an estimate of the firm’s value of growth options. According to the theory of corporate valuation first formalized by Miller and Modigliani (1961), the value of the firm (V) can be decomposed into the value of assets in place (VAIP) and the value of future growth opportunities (VGO):

\[ V = VAIP + VGO. \]

The value of growth options, then, is captured by the value of future growth opportunities (VGO), given that the ultimate value of these growth opportunities depends on the firm’s discretion to invest in the future (Myers, 1977). Assets in place, by contrast, are simply assets whose value does not depend on such discretionary investments.

Extending this idea, Kester (1984) provides the first estimates of the firm’s value of growth options (VGO), which he measures as the firm’s total market value (V) less the capitalized value of its current earnings stream. The latter represents the value of the firm
under a no-growth policy and thus is a proxy for its value of assets in place \( V_{\text{AIP}} \). He then calculates a firm’s growth option value (GOV) as follows:

\[
(10) \quad \text{GOV} = \frac{V_{\text{GO}}}{V} = \frac{[V - \text{Current Earnings} / \text{Discount Rate}]}{V}.
\]

Kester (1984) finds that, for many firms in his sample, valuable growth options constitute over half their market value. A similar approach can also be found in other related research (e.g., Strebel, 1983; Brealey & Myers, 2000; Alessandri, Lander, & Bettis, 2002).

3.1.2 Real Options Theory and Joint Ventures

Myers’ (1977) idea also provides a guide for managers to make decisions under uncertainty (Bowman & Hurry, 1993; McGrath, 1997; Kogut & Kulatilaka, 2001), such as decisions regarding investments in research and development (R&D) projects (Mitchell & Hamilton 1988), joint ventures (Kogut, 1991), emerging markets (Kogut & Kulatilaka, 1994), as well as entrepreneurial initiatives (McGrath, 1999). Of direct relevance to me is the application of real options theory to the context of JVs. Kogut (1991) provides the first set of theoretical argument and empirical evidence that firms invest in JVs to obtain growth options and sequentially enter into new and uncertain markets. JVs provide valuable growth options, because by entering into JVs, a firm is simultaneously able to limit its downside losses to an initial, limited commitment as well as to position itself to expand, but only if circumstances turn out to be favorable. In Kogut’s (1991) model, the firm undertakes expansion by exercising the option by acquiring equity from a partner when a positive demand shock materializes. Recently, Folta and Miller (2002) demonstrate how the resolution of uncertainty in high-technology alliances leads firms to acquire equity from their partners.
Using formal models, Chi and colleagues analyze the gains from obtaining real options through JVs (Chi & McGuire, 1996; Chi, 2000). Their work has examined the circumstances under which the option to acquire or sell out a JV provides positive economic value for partners, under various assumptions such as divergence in firms’ *ex post* valuations of the JV, *ex ante* asymmetry in their anticipation of the possibility of such *ex post* divergence, and the presence or absence of agreements to purchase equity from a partner at a pre-specified price.

While this body of research has significantly improved existing understanding of a real options view of JVs, the central proposition that JVs can provide firms valuable growth options has yet to be directly tested. In addition, to make further contributions, a need also exists to develop a contingent view of growth options in JVs, and to investigate the growth option value implications of important structural attributes and characteristics of JVs (Chi, 2000). This is the focus of the hypotheses developed below.

### 3.2 Theory and Hypotheses

**International Joint Ventures.** It is useful to start with the general observation that firms investing in JVs, whether domestic or international, face a variety of sources of uncertainty, which can positively affect the growth option value embedded in JVs. These sources of uncertainty include potentially opportunistic behaviors of partners, factor and product market conditions, as well as evolution of technology trajectories. These uncertainties are likely to magnify in an international setting whereby partners come from different cultural backgrounds and bring together different social and business norms (Kedia & Bhagat, 1988). For example, trust may be lower between partners that are
socially dissimilar (Zucker, 1986) and culturally distant (Barkema, Bell, & Pennings, 1996; Barkema & Vermeulen, 1997). Foreign investors in particular need to learn new “rules of the game” in host countries to overcome the liability of foreignness (Zaheer & Mosakowski, 1997; Luo & Peng, 1999). In addition, IJVs also experience some unique sources of uncertainty due to heterogeneous external environments across national borders (Sundaram & Black, 1992). For example, input prices reflect changes in exchange rates as well as macroeconomic factors in the host and home countries. Foreign investors may also be exposed to significant political uncertainty in host countries, especially in emerging economies where a substantial number of IJVs have been established (Lyles & Salk, 1996; Delios & Henisz, 2000; Peng, 2000; Steensma & Lyles, 2000; Henisz & Delios, 2001).

International joint ventures have long been viewed as an attractive foreign market entry vehicle because of their structural attributes that help firms reduce risk. By engaging in IJVs rather than outright acquisitions, for instance, firms can spread risks over multiple capital providers, and such benefits have long been documented as an important motive for IJV formation in capital-intensive industries such as automobiles, electronics, and pharmaceuticals (e.g., Contractor & Lorange, 1988). By entering into IJVs, multinational corporations (MNCs) can also rely upon local partners’ resources to manage risk, including their local knowledge, relationships with the local government, and so forth (e.g., Inkpen & Beamish, 1997).

At the core of real options theory is the insight that IJVs are useful not only because of their ability to reduce downside risk, but also because they enable firms to access upside opportunities by expanding sequentially as new information on key sources
of uncertainty becomes available. Changes in product market demand, input prices, exchange rates, and so forth can elevate the value of the JV such that the firm expands and exercises its growth options, but if negative realizations occur instead for these sources of uncertainty, the firm is not compelled to expand. For these reasons, IJVs are often viewed as attractive stepping-stones toward more extensive investments in a host country (Kogut, 1991). Thus:

**Hypothesis 1: The greater a firm’s investments in IJVs, the greater its growth option value.**

Given that domestic JVs can also provide valuable growth options, I also test whether domestic JVs have similar effects, both for the sake of completeness as well as for comparative reasons.

As mentioned previously, although I expect IJVs in general to provide valuable growth options, I would like to isolate some of the sources of growth option value latent in IJVs. To this end, three additional hypotheses are developed below that focus on IJVs’ ownership structure, product-market focus, and geographic location, respectively.

**Ownership Structure of IJVs.** Kogut’s (1991) model suggests that the growth option value embedded in a JV will be inversely related to the firm’s ownership position, everything else constant. This relationship is manifested in the way through which the firm captures value: A firm makes an initial investment in a JV and then monitors market and other cues over time to determine if the JV’s value is such that expansion via the acquisition of additional equity from the partner is warranted. Thus, by holding less equity, the firm is able to put less capital at risk upfront, as well as to capture greater value if conditions prove to be favorable *ex post.*
Algebraically stated, if $V_c$ is the value the call holder places on the entire venture, $\alpha_{c0}$ is the call holder’s initial equity (where $0 < \alpha_{c0} < 1$), and $P$ is the price at which the subsequent equity purchase occurs, then the firm will gain $(1 - \alpha_{c0})V_c - P$ by acquiring the JV, and will hold the option open if $(1 - \alpha_{c0})V_c < P$. A lower level of initial equity $\alpha_{c0}$ therefore contributes to a higher growth option value, holding everything else constant.\(^4\) Given that $\alpha_{c0}$ is the call option’s purchase price, a lower ownership level therefore reduces the firm’s downside risk in the collaboration, while still allowing it to benefit from the JV’s upside opportunities. Minority IJVs, in which the firm holds an equity stake less than the typical threshold of 50%, therefore, may be an especially ideal vehicle to capture the firm’s growth option value. Therefore:

**Hypothesis 2:** The greater a firm’s investments in minority IJVs, the greater its growth option value.

**Product Market Focus of IJVs.** The growth option value a firm derives from an IJV may not only reflect its ownership position in the venture, but also the venture’s product market focus. In fact, prior empirical research demonstrates that MNCs most often use IJVs to diversify into new product markets involving greater uncertainty (e.g., Stopford & Wells, 1972) and that the stock market rewards diversifying JVs in particular (e.g., Balakrishnan & Koza, 1993).

I believe that IJVs outside of the firm’s core business will have a significant impact on the proportion of firm value accounted for by growth options for several

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\(^4\) Of course, if the exercise price $P$ is not fixed *ex ante* and the value of the JV is not idiosyncratic to each partner (Chi, 2000), it is possible that the seller will appropriate the gains from sequential expansion, irrespective of the JV’s initial ownership structure. While most IJVs do not have a pre-specified exercise price in their contracts, asymmetric valuations across multinational and local 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 IJV termination stage.
reasons. First, prior research on the knowledge-based view of the firm as well as real options indicates that JVs are well-suited for acquiring new competencies and building knowledge platforms (Kogut & Kulatilaka, 1994, 2001; Ireland, Hitt, & Vaidyanath, 2002). These motives for interfirm collaboration will be particularly salient for more exploratory IJVs outside of the firm’s core business domain. Second, research on information economics suggests that the flexibility provided by JVs is important in diversification moves to overcome challenges stemming from asymmetric information (Balakrishnan & Koza, 1993). Unlike acquisitions that involve a terminal sale (e.g., Bergh & Lawless, 1998), JVs are useful in promoting information revelation because of shared ownership and joint control and firms’ ability to experiment first-hand with resources in question. Finally, real options theory posits that growth options embedded in less familiar domains for firms will generate greater value (Folta, 1998). Thus:

_Hypothesis 3: The greater a firm’s investments in diversifying (non-core) IJVs, the greater its growth option value._

**Geographic Location of IJVs.** In addition to product market focus, the growth option value embedded in an IJV may also reflect the venture’s geographic focus. My investigation of the location effects of IJVs follows a recent strand of international strategy research by focusing on the differences between developed and emerging economies (e.g., Hitt, Dacin, Levitas, Arregle, & Borza, 2000; Hoskisson, Eden, Lau, & Wright, 2000; Hitt, Ahlstrom, Dacin, Levitas, & Svobodina, 2004). While emerging economies might be defined along dimensions such as growth rate or market size, it is argued that the most important criterion differentiating the two groups of countries should be how well developed the market-supporting institutions are (Khanna & Palepu, 1997;
Peng, 2000). These are formal institutions embodied in rules and regulations that facilitate the efficient functioning of markets and reduce the risk of failures in product, labor, and capital markets (Peng, 2003). In developed economies, these institutions are well developed and firms can rely on them to a good extent. In emerging economies, by contrast, although certain institutions have been established that provide momentum for economic growth, overall there still exist many institutional voids waiting to be filled. The underdevelopment of these institutions presents many sources of uncertainty to firms operating in emerging economies, including supply and demand conditions, property rights, and sudden changes in government policies, and so forth (Delios & Henisz, 2000; Hoskisson et al., 2000; Henisz & Delios, 2001; Peng, 2003). According to real options theory, high levels of uncertainty in emerging economies should elevate the growth option value of IJVs in such locations in particular.

While firms operating in emerging economies need to handle considerable uncertainty, they also stand to benefit from growth opportunities that are either untapped or will only materialize in the future with the development of market-supporting institutions (Hoskisson et al., 2000; Peng, 2000, 2003; Prahalad & Lieberthal, 2003). While firms can certainly derive valuable growth options in other international market contexts, recent research argues that growth options may be more valuable for foreign direct investment (FDI) in emerging economies. These options potentially explain why MNCs routinely undertake seemingly “negative-NPV” investments in new, uncertain, but fast-growing foreign markets (Chen, Hu, & Shieh, 1991; Butler, 2000; Pantzalis, 2002). Although alternative modes of FDI such as acquisitions or greenfields may also help
capture the upside potential, JVs’ dual benefits of limiting downside losses and facilitating staged investment seem ideal for emerging economies. Hence:

**Hypothesis 4:** The greater a firm’s investments in IJVs in emerging economies, the greater its growth option value.

### 3.3 Methods

#### 3.3.1 Sample and Data

One challenge for this research is to derive an estimate of firms’ growth option value. Data used to calculate this measure were drawn from the Stern Stewart Performance 1000 developed by Stern Stewart & Co., a financial consultancy that specializes in the measurement of shareholder wealth. While the Stern Stewart dataset has been used in prior research in finance and accounting for some time, it has begun to attract attention from management and strategy researchers only recently (e.g., Coles, McWilliams, & Sen, 2001; Hawawini, Subramanian, & Verdin, 2003).

The dataset includes Stern Stewart’s annual rankings of the 1000 largest U.S. publicly-traded companies based on their Market Value Added (MVA). Besides MVA, the dataset also provides Stern Stewart’s estimates of other value-based measures such as Economic Value Added (EVA), Capital Invested (CI), and the Weighted Average Cost of Capital (WACC), which I use to derive an estimate of firms’ growth option value, to be illustrated below. This database was then merged with data on JVs from the strategic alliances module of the Securities Data Company (SDC) database, as well as accounting data from the Compustat database. Due to its broad scope of coverage, SDC currently
remains the most comprehensive data source on strategic alliances, and has been used in recent research on alliances (e.g., Anand & Khanna, 2000; Kale, Dyer, & Singh, 2002).

Several sampling criteria were imposed on the merged dataset. First, I restricted the sampling frame to the period 1989-2000 (inclusive) because the SDC database started to record JV announcements in 1985 and I sought to have a five-year rolling window over which to calculate the firm’s investments in JVs. Second, I only focused on manufacturing firms (i.e., SICs 2000-3999), which reduced the sample size to 420 from the initial 1000. Using a manufacturing sample facilitates comparisons between my findings and previous studies and addresses differences in investment activities and accounting practices across industry sectors. Third, I excluded conglomerates that did not report a primary SIC designation as well as firms that were reported to be inactive over the sampling period in the Compustat database. After accounting for missing data, these screening procedures yielded an unbalanced panel dataset comprising 293 firms and a total of 2,698 firm-year observations across 19 industries (at the two-digit SIC level). For this dataset, I deflated all financial figures to the base year 1989 to account for inflation, using GDP deflators provided by the U.S. Bureau of Economic Analysis.

3.3.2 Variables and Measurement

Growth Option Value. My approach to calculating growth option value is generally consistent with that of Kester (1984), but my estimation represents several improvements due to my use of the Stern Stewart dataset. First, this dataset provides firm-specific discount rates and avoids applying some arbitrary 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 if R&D were not capitalized and amortized, the firm’s capital effectively utilized would be understated, potentially leading to overstated profits. Other major adjustments include adjustments to goodwill, provisions, operating leases, and so forth. Below I provide an explanation of the derivation of growth option value using Stern Stewart measures, and a more detailed discussion of these measures and common accounting adjustments can be found elsewhere (e.g., Stewart, 1991; 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 terminology, the former is called Capital Invested (CI) and the latter Market Value Added (MVA), and the firm’s market value (V) is therefore:

\[ V = CI + MVA. \]

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:

\[ MVA = PV \text{ of Expected EVA}. \]

EVA is a performance metric trademarked by Stern Stewart, yet it is a version of the residual income method used to measure operating performance. Another popular
name for residual income is “economic profit”, a concept tracing its roots back to at least Marshall (1890). Unlike traditional accounting profitability measures (e.g., earnings) that only consider the cost of debt capital, residual income measures profit net of all capital charges that include the cost of equity capital as well, and can be expressed as follows:

\[ RI = NOPAT - [CI \times WACC], \]

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 (i.e., EVA Growth) 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. A firm has negative future growth opportunities when it is believed to be unable to sustain its current level of performance, or making value-destructing investments. Notationally,

\[ \text{PV of Expected EVA} = \text{PV of Current-Level EVA} + \text{PV of EVA Growth}. \]

Combining the above equations (3, 4, and 6) and rearranging terms, the firm’s market value \( V \) can be rewritten as follows:

\[ V = CI + \text{PV of Current-Level EVA} + \text{PV of EVA Growth}, \]
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., VAIP), and PV of EVA Growth measures the value of
growth options (i.e., VGO, the component of firm value attributable to growth options).

To calculate my dependent variable, the firm’s growth option value (GOV), I
solve equation (7) for PV of EVA Growth (i.e., VGO), and scale it by the firm’s value (V):

\[ \text{GOV} = \left[ \frac{V - CI - \text{PV of Current-Level EVA}}{V} \right] \]

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. Notably, 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 VGO increases more than VAIP.

Given the similarity of my approach to that of Kester (1984), I 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 my measure represented in equation (8) is 0.82 (p<0.001). As will be
discussed further in the results section, I also conducted regression analyses on this
alternative measure to consider whether the accounting adjustments of Stern Stewart
affect the interpretation of the results.

Additionally, I also explored the correlation of my measure with Tobin’s Q,
which has been used in the literature to indicate the presence of growth opportunities
(e.g., Lang, Stulz, & Walkling, 1991). The correlation between Tobin’s Q and my
measure of growth option value is 0.45 (p<0.001), and the correlation between Tobin’s Q
and the measure of growth option value calculated using Compustat data is 0.41 (p<0.001). 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 perfect also suggests that growth option value and Tobin’s Q may be two distinctive constructs tapping into different underlying dimensions of growth opportunities. Tobin’s Q, for example, has also been associated with many things other than growth opportunities, such as monopoly rent (Lindenberg & Ross, 1981), management quality (e.g., Lang, Stulz, & Walkling, 1989), shareholder wealth (e.g., Lang & Stulz, 1993), intangible assets (e.g., Villalonga, 2004), and so forth.

The average firm in my sample had 43 percent of its value attributable to growth options. Consistent with Kester, I found large inter-industry differences. Firms in industries which have a relatively heavy technology component tend to have a large proportion of their value captured by growth options: 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; 45%). On the other hand, firms in industries with lower technology components, 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.** My key explanatory variables are measures of firms’ investments in equity JVs of various types. I used a 5-year rolling window to arrive at a count of the number of JV deals the firm has concluded during that period. The selection of the five-year window represents a compromise in that longer time windows might
count JVs 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 the length of
the window.

Besides reporting the year in which a JV deal was consummated, the SDC
database also provides additional information that can be used to categorize JVs based on
their ownership structure, product-market focus, and geographic location, allowing the
construction of more disaggregated measures of JVs. Specifically, JVs were coded based
on whether they were minority (i.e., less than 50%) or non-minority JVs (i.e., 50% and
above), whether they operated in the firm’s core business at the three-digit SIC level or
not, and whether they were located in emerging or developed economies (following the
classification scheme developed by Hoskisson et al., 2000: 250-251). As discussed
below, sensitivity analyses were also performed by further disaggregating non-minority
JVs into 50/50 versus majority JVs and by defining diversifying versus non-diversifying
JVs at the two-digit SIC level.

**Control Variables.** First, I controlled for firm size since larger firms tend to have
larger JV portfolios and have more resources available for investments in growth
opportunities. Firm size was measured as the natural logarithm of a firm’s total sales.
Second, I controlled for the firm’s capital structure because corporate debt policy can
affect the firm’s investment decisions and the value of growth options. More
specifically, Myers’ (1977) model of growth options and corporate financing decisions
suggests that equity is better suited for financing growth options relative to debt, since
debt can introduce *ex post* distortions in firms’ decisions to take on investment projects.
Financial leverage was calculated as the ratio of a firm’s long-term debt to its total capital. Third, I accounted for organizational slack given its role in releasing resources for discretionary investment and encouraging creativity and innovation (Nohria & Gulati, 1996). My measure of slack focused on a firm’s absorbed slack and, consistent with previous studies (e.g., Bromiley, 1991; Singh, 1986), I relied on accounting data and measured organizational slack as the ratio of a firm’s selling, general, and administrative expenses to its total sales. Fourth, I controlled for the firm’s investments in R&D. Previous research has suggested that R&D investment can be viewed as real options because of the sequential and strategic nature of research development projects (Mitchell & Hamilton, 1988). A control for R&D investment is also desirable because firms with more proprietary knowledge tend to engage in more FDI (Caves, 1996). Because the effects of R&D investment can persist over time, prior studies have suggested that measures of R&D investment include both current-year R&D expenditures and accumulated investments in R&D. In this study, I followed a number of prior studies (c.f., 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. Fifth, I 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 three-digit SIC level). This time-varying, firm-specific variable was incorporated to control for industry-level heterogeneity since my econometric specification does not permit the inclusion of time-invariant industry fixed effects, as discussed below. Finally, I controlled for firm fixed effects to account for unobserved heterogeneity at the firm level, as well as for year fixed effects to capture any effects due to economy-wide factors.
3.3.3 Model Specification

Econometric Model. The model used to estimate the effects of the firm’s investments in JVs on its growth option value is as follows:

\[
\text{Growth Option Value}_{it} = \alpha_i + \delta + \beta_1 \text{Joint Ventures}_{it} + \beta_2 \text{Lagged Dependent Variable} + \beta_3 \text{Firm Size}_{it} + \beta_4 \text{Financial Leverage}_{it} + \beta_5 \text{Organizational Slack}_{it} + \beta_6 \text{R&D Stock}_{it} + \beta_7 \text{Industry Growth Option Value}_{it} + \epsilon_{it},
\]

where subscripts \(i\) and \(t\) denote firm \(i\) and year \(t\), respectively; \(\alpha_i\) represents firm fixed effects; and \(\delta\) year fixed effects.

The panel data specification represents a number of advantages over purely cross-sectional data, such as controlling for individual heterogeneity, reducing multicollinearity and estimation bias, as well as providing more data variability that enhances efficiency. However, for a panel data model, there may be potential heterogeneity bias and one also needs to select between a fixed effects model and a random effects model (Hsiao, 1986), which are investigated below.

Specification Tests. First, I conducted \(F\)-tests, which rejected the null hypothesis of equal individual effects (\(\alpha_i\)), indicating that the use of panel data techniques was appropriate. Second, to investigate potential heterogeneity bias, I conducted another \(F\)-test to check whether restricting the slopes to be the same was appropriate. The test statistic, however, did not lead to a rejection of the null hypothesis of equal slopes, suggesting that heterogeneity bias was not present in my models. Third, I conducted the Hausman-Wu test, which rejected the null hypothesis of no correlation between the individual effects and regressors. Therefore, the fixed effects model was chosen. The fixed effects model offers the additional advantage that, by including firm-specific
intercepts, it helps capture any unobserved firm-level heterogeneity that may not be captured by the control variables (Griliches, 1981; Hall, 1993). However, the fixed effects model uses a within-estimator and cannot estimate time-invariant effects such as industry fixed effects (Hsiao, 1986; Greene, 2003).

Given the concern for autocorrelation in the dependent variable across time periods, a lagged term was added to the right hand side of the equation (Griliches, 1981), which also helped control for potential autocorrelation, if any, in the residuals. The interpretations presented below were invariant to the inclusion or exclusion of the lagged dependent variable, though. The incorporation of the lagged dependent variable makes the equation a dynamic panel data model, so it was estimated using dynamic panel data econometric techniques suggested by Hsiao (1986). Finally, heteroscedasticity-consistent robust standard errors proposed by White (1980) were used to determine the significance levels of the results.

3.4 Results

Table 3.1 reports means, standard deviations, and a correlation matrix. The Pearson correlation coefficients in the table are highly significant, suggesting that multivariate techniques were needed to sort out the effects of individual independent variables. The significant correlations among the independent variables also point to the need to investigate potential multicollinearity problems. However, the maximum VIF value for the variables in all of the models was 4.1, well below the rule-of-thumb threshold value of 10 that is indicative of multicollinearity problems (Neter, Wasserman, & Kutner, 1985), despite the fact that counts of different types of JVs are used can be
highly correlated. Reduction of collinearity represents one of the key advantages of utilizing panel datasets (Hsiao, 1986).

Table 3.2 reports regression results of the basic fixed effects model for the drivers of growth option value. Model I is the baseline specification with all of the control variables, including controls for firm fixed effects and year fixed effects. Model II incorporates the firm’s investments in JVs, both domestic and international. Model III presents a specification with this variable broken down into domestic versus international JVs. $F$-tests revealed the significance for all the three models ($p<0.001$). Comparisons of the three models were made using hierarchical $F$-tests; both Models II and III provide significant improvements in explanatory power over the baseline model ($F=19.80$ and $20.80$, respectively; $p<0.001$).

The first hypothesis predicted that the greater a firm’s investments in IJVs, the more of its value would be accounted for by growth options. In Model II, the coefficient estimate for JVs is positive and significant ($p<0.01$). In Model III, which reports individual effects of domestic and international JVs, it is found that while international JVs are positively associated with growth option value ($p<0.05$), the coefficient estimate for domestic JVs does not reach statistical significance. Thus there is support for H1. A statistical comparison of the coefficients for international and domestic JVs was conducted to determine if international JVs contribute more heavily than domestic JVs to growth option value. The test statistic reveals that the two types of JVs differ at a marginal level of significance ($F=2.91$, $p<0.08$).

A series of robustness checks were conducted. First, I used windows of different lengths (i.e., 3 and 4 years) to measure the number of JV deals concluded by firms. The
numbers of JVs for these different time windows were highly correlated. Specifically, the correlations were above 0.95 and, more importantly, when I used these new measures in the regression, I obtained qualitatively similar results. Second, as noted in the methods section, I also used Compustat data to calculate an alternative estimate of growth option value and regressed this measure on the same set of covariates. Again, results for the theoretical variables retained the same sign and the same level of significance as those in the table. The only differences concerned the control variables, with financial leverage being only marginally significant (p<0.10) and organizational slack becoming significant at the 0.05 level. Finally, the results are also robust to alternative approaches used to measure the firm’s investments in JVs, such as taking their natural logarithm as well as scaling them by the firm’s market value.

Given the robustness of the model, I sought to investigate IJVs in more fine-grained terms in order to test my remaining hypotheses on the contingency effects of ownership structure, product-market focus, and geographic location. First, I considered the effects of ownership structure and product-market focus of the venture, and the results are reported in Table 3.3. Model I is the baseline specification, which is identical to Model III in Table 3.2. Models II and III are specifications that focus on the effects of ownership structure and product-market focus, respectively. Both Models II and III are highly significant (p<0.001) and improve upon the baseline specification that aggregates IJVs of different ownership structures as well as core and non-core transactions (p<0.05).

Model II shows that minority IJVs have a positive and significant impact on growth option value (p<0.01), while non-minority IJVs do not. These findings thus support H2. In analyses not reported, I also separated the non-minority IJVs into 50/50
versus majority IJVs and did not find significant results for IJVs of either ownership type. Model III reveals that diversifying (non-core) IJVs have a significant positive impact on growth option value (p<0.01), while the coefficient for non-diversifying (core) IJVs fails to reach statistical significance. These results therefore provide support for H3. In addition, when I defined core vs. non-core IJVs at the two-digit SIC level and reran regressions, coefficient estimates had the same sign and retained the same level of significance.

In addition, I also examined the role of geographic location by separating out IJVs located in emerging economies from those in developed economies, and the results are reported in Table 3.4. Model I disaggregates IJVs into those in developed and emerging economies. Models II-V go a step deeper to examine the combined effects of IJV ownership structure, product-market focus, and geographic location. All of the models are significant at 0.001 level. From Model I, it is clear that IJVs in developed economies rather than in emerging economies are positively and significantly related to growth option value (p<0.01). Thus, H4 is not supported. However, finer grained results in Models II-V reveal that what matters more to growth option value is the ownership structure and product-market focus of the IJV rather than its geographic location. Minority IJVs and diversifying IJVs always contribute to the firm’s growth option value, whether they are located in developed or emerging economies.

Results for some control variables are also worth noting. The analysis finds no significant effect of firm size or organizational slack. The multivariate results for the negative effect of financial leverage are consistent with Myers’ (1977) model of growth options and corporate financing policy, confirming that corporate borrowing is inversely
related to growth option value. The effect of industry growth option value is positive and highly significant, indicating the relevance of industry effects. Finally, in all of the models, year fixed effects are jointly significant, and so are firm fixed effects, providing strong evidence in favor of using panel data techniques rather than the pooled OLS estimator (Hsiao, 1986).

3.5 Discussion

3.5.1 Contributions

Three sets of contributions emerge. First and foremost, real options theory has suggested that JVs confer valuable growth options to firms, yet empirical research to date has not offered direct evidence supporting the theory’s central proposition, absent a measure indicating the value of growth options that the firm could capture from its investments. This chapter takes up this challenge and empirically estimates the firm’s growth option value, or the proportion of firm value accounted for by growth options. By tracking this value longitudinally and relating it to the firm’s investments in JVs of different types, this chapter contributes to the literature by addressing an important gap in extant research on real options theory and joint ventures.

Beyond these empirical contributions, this chapter also makes a broader contribution to real options theory. Rather than taking a universalistic approach that assumes that all JVs are created for their growth option potential, my research adopts a finer-grained contingency perspective and examines some of the circumstances in which the growth option value of JVs is especially salient. In particular, I find that IJVs contribute more to the firm’s growth option value relative to domestic JVs, and that
among IJVs, minority and diversifying ones enhance growth option value in particular, irrespective of whether the venture is located in developed or emerging economies. Taken together, the findings respond to recent calls for a closer examination of JV structural attributes that could affect the value of real options in JVs (e.g., Chi, 2000).

Finally, my findings that firms do not generally derive growth option value from their IJVs in emerging economies challenge some prior arguments that growth options provide an important rationale for their investments there (e.g., Chen et al., 1991; Butler, 2000; Pantzalis, 2002). While these findings may reflect the high failure rate of JVs in general (e.g., Li, 1995; Park & Russo, 1996; Park & Ungson, 1997) and in emerging economies in particular (e.g., Beamish, 1985; Prahalad & Lieberthal, 2003), I provide two more specific, potential explanations. First, although JVs based in emerging economies can provide important growth options in theory, their ongoing operations may entail non-trivial transaction costs that make it difficult to capture the value of the growth options latent in these ventures in practice (Lyles & Salk, 1996; Steensma & Lyles, 2000). For example, transaction costs can be significant in emerging economies that lack market-supporting institutions (Khanna & Palepu, 1997; Peng, 2003) or are culturally distant (Root, 1987; Gatignon & Anderson, 1988). In the language of real options theory, such costs are carrying costs that reduce the benefits of holding open options. These costs and the need for additional investments in these IJVs also imply that firms’ downside losses may not be limited to their initial capital outlays in establishing JVs (Reuer & Leiblein, 2000). Further, the recent rush of many foreign investors into emerging economies (Guillen, 2002) may actually reduce the value of these growth options by bidding up the option exercise price due to increases in price for inputs such as
labor and raw materials, as well as by limiting the price firms can charge for their product due to higher levels of market competition.

Second, broadly speaking, the existence of growth opportunities associated with an investment does not guarantee that firms will realize the value of growth options latent in that investment (Reuer & Leiblein, 2000). This is because, to reap the benefits of growth options, firms also need to monitor market cues to make appropriate decisions concerning the exercise of such options (Kogut, 1991). In emerging economies, the difficulty foreign investors face in collecting information useful for competitor intelligence and decision-making may particularly reduce their chances of benefiting from the options they possess (Luo & Peng, 1999). At a more general level, my evidence calls into question the usual assumption in previous research that firms can always realize option value from their investments in emerging economies. Instead of indiscriminately advising firms to set up IJVs in emerging economies, I provide more fine-tuned advice, by suggesting that IJVs in emerging economies can capture significant growth option values, but these are better structured as minority and diversifying IJVs.

### 3.5.2 Limitations and Future Research Directions

Future research can address several limitations in the present study. First, the use of the Stern Stewart dataset not only facilitates my calculation, its value-based measures and adjustments for potential accounting distortions also help me obtain a relatively accurate estimate of growth option value. While this is a contribution of the chapter, it also raises potential concerns about the generalizability of the findings. For example, all of the firms included in this database are publicly listed and tend to be relatively large. Although these firms are among the more important ones in the U.S. economy, future
extensions could also consider whether the findings hold for other types of firms such as smaller firms and newly-listed firms. Such research would need to rely on less sophisticated residual income measures that can be derived directly from publicly available financial and accounting data.

In addition, there also exist interesting opportunities to extend the approach taken in this chapter to other empirical contexts where real options theory is applicable. For instance, rather than limiting to JVs, future studies might examine FDI activities of a larger variety (e.g., cross-border acquisitions, greenfield FDI). Moreover, my focus on JVs pertains to firms’ external corporate development activities, but there is also a wide range of internal investment activities that similarly can provide valuable growth options, such as investments in technology development projects and investments in new product lines. Besides, my research has focused particularly on corporate growth options, but there are also many other types of real options that are of strategic importance and are worth studying (Trigeorgis, 1996). Future research could join the current chapter to investigate the performance implications of corporate investments in these other options, which differentiate from previous emphasis on the decision aspect of option investments. Finally, considerable opportunities exist to examine the management and implementation aspects of real options, an area that has received scant research attention but is recognized as being very important to the future development of the theory.
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N=2698. All correlations with absolute value greater than 0.04 are significant at p<0.05.

Table 3.1: Descriptive Statistics and Correlation Matrix
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N=2698. † p<0.10; ‡ p<0.05; *** p<0.01; **** p<0.001. Robust standard errors in parentheses.

* $F$-statistics for the null hypothesis of equal year or firm effects.

Table 3.2: Results of Fixed-Effects Multiple Regression Analyses
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N=2698.  † p<0.10; * p<0.05; ** p<0.01; *** p<0.001. Robust standard errors in parentheses.

<sup>b</sup> $F$-statistics for the null hypothesis of equal year or firm effects.

Table 3.3: Effects of IJV Ownership Structure and Product-Market Focus on Growth Option Value
## Table 3.4: Effects of IJV Geographic Location on Growth Option Value

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<td>(.393)</td>
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<td>Diversifying (Non-Core) IJVs in Emerging Economies (x10⁻²)</td>
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<td>.522†</td>
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<td>Adjusted $R^2$</td>
<td>.527</td>
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<td>Model $F$</td>
<td>18.43***</td>
<td>18.58***</td>
<td>18.58***</td>
<td>17.61***</td>
<td>18.09***</td>
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N=2698. † p<0.10; * p<0.05; ‡ p<0.01; *** p<0.001. Robust standard errors in parentheses.

$F$-statistics for the null hypothesis of equal year or firm effects.
CHAPTER 4

VARIANCE DECOMPOSITION OF GROWTH OPTION VALUE

The view of the firm as a bundle of productive resources has long been at the heart of strategic management (Penrose, 1959; Chandler, 1962). Strategy dynamics centers on the firm’s discretion over the allocation of these scarce resources for gaining valuable competitive positions and pursuing valuable growth opportunities (Bower, 1970; Porter, 1991, 1996). This dynamic perspective of strategy represents an important connection to a fundamental concept in valuation that part of a firm’s value derives from its assets in place, and the other part from the investment or growth opportunities the strategy affords (Miller & Modigliani, 1961). In the parlance of real options, these growth opportunities can be viewed as growth options, or call options on real assets, because their value is ultimately contingent on the future states of the world providing them a contingent claims status (Myers, 1977). To the extent that strategy can be connected to shareholder value analysis (Hamel & Prahalad, 1994; Porter, 1996), a dynamic perspective of strategy should then pay due attention to growth option value, or the proportion of the firm’s value accounted for by growth options (Myers, 1977). Specifically, the following set of questions would need to be addressed empirically, including: What are some of the potential sources of growth options? How valuable are
growth options to the firm? Is growth option value driven by firm-specific factors, industry-specific factors, economy-wide factors, or some other factors? Are firm and industry effects on growth options permanent or transient?

These questions focus on the underlying mechanisms of value creation and appropriation, but answers to these questions in many ways resemble the stylized facts delineated in the variance decomposition studies of firm performance that have made up an influential, ongoing stream of research in the economics and strategic management literature (e.g., Schmalensee, 1985; Rumelt, 1991; Roquebert, Phillips, & Westfall, 1996; McGahan & Porter, 1997; Brush & Bromiley, 1997; Brush, Bromiley, & Hendrickx, 1999; Chang & Singh, 2000; Bowman & Helfat, 2001; Hawawini, Subramanian, & Verdin, 2003). To illustrate, research in the industrial organization economics tradition has long maintained that industry structure largely determines the magnitude of investment and growth opportunities in an industry (Scherer, 1980), implying that industry-specific factors such as industry structure and competitive interaction matter greatly to the growth option value appropriated by the firm. Research in strategic management, as well as real option theory, however, underscores the discretion (Bower, 1970; Myers, 1977) that managers have in allocating resources for investing in growth options, suggesting that firm-specific factors such as inimitable resources and exclusive rights to certain technology may be more important instead. While the relative importance of firm versus industry effects on growth option value is ultimately an empirical matter, improved knowledge about which class of effects dominates is useful because it offers additional evidence that helps inform the debate between industrial organization economists and strategic management scholars.
In this chapter, I begin to fill this gap by developing empirical evidence on the relative influence of stable and transient industry effects, stable firm effects, and year effects on the magnitude of growth options that a firm possesses. In doing so, I calculate growth option value for a sample of publicly-traded U.S. companies during 1987-1996 and then decompose the total variance of growth option value into various types of effects. Two specific contributions emerge in this regard. First, I offer growth option value as a new dependent variable for variance decomposition studies, in response to McGahan and Porter’s (2002) call to explore additional performance measures and use new datasets (e.g., Mauri & Michaels, 1998; Chang & Singh, 2000). Given that Tobin’s Q has been used as a broad proxy for firms’ growth opportunities—although this has been questioned by recent research in real options (e.g., Abel, Dixit, Eberly, & Pindyck, 1996; Berk, Green, & Naik, 1999)—I also performed the same type of analysis on this variable and compared the results with those on growth option value. This chapter thus joins recent variance decomposition studies that begin to use market-based measures focusing on strategy’s implications to the capital market (McGahan, 1999; Hawawini et al., 2003, 2004). Second, I empirically estimate growth option value for a panel of firms over an extended period of time. My sample covers firms from a wider industry scope and a longer period compared to that in previous studies (e.g., Kester, 1984; Brealey & Myers, 2000; Kester & Lowenstein, 2001; Long, Wald, & Zhang, 2003). To be illustrated in greater detail below, my estimation also represents an improvement over that in the literature due to the use of a new dataset that provides value-based measures such as economic profit that adjust for potential accounting distortions in firm performance (see also Hawawini et al., 2003, 2004).
The chapter has two broader implications for the literature. First, my use of growth option value as a dependent variable goes beyond the decision theoretic focus in most extant empirical studies applying real options theory to strategic investments analysis (e.g., Kogut, 1991; Folta, 1998), to begin to investigate the outcomes of investments with option-like features (Reuer & Leiblein, 2000). The chapter thus not only improves existing understanding of the notion of growth options, but it also contributes to the applications of real options theory in strategy more generally. Second, I provide strong evidence that firm effects are more important than industry effects on growth option value. This finding in another important way corresponds to previous variance decomposition studies that establish the basis for the search for the sources of persistent inter-firm performance differences at the firm level (Rumelt, Schendel, & Teece, 1991).

The chapter is organized as follows. I first review real options theory that advances the notions of growth options and growth option value. The review also bring together theories from different fields that have contrasting views about the potential sources of growth option value, and suggest that a variance decomposition study helps address some major disputes about the nature of growth options. The next sections provide my measure of growth option value, report the dataset and sampling procedures, and summarize the model and methodology. These are followed by the empirical results. The final section discusses research implications and suggests future research directions.
4.1 Background Theory

Real options theory traces its intellectual roots to Myers’ (1977) initial insight of viewing a firm’s discretionary future investment opportunities as growth options, or call options on real assets, in that these investments are discretionary and the firm can decide in the future whether it wants to take advantage of these opportunities or simply pass them up. Myers’ seminal idea has provided a novel perspective to understand the theory of corporate valuation and to estimate the firm’s value of growth options. According to the valuation theory formalized by Miller and Modigliani (1961), the value of the firm (V) can be decomposed into the value of assets in place (VAIP) and the value of future growth opportunities (VGO):

\[ V_{\text{AIP}} + V_{\text{GO}} = V \]  

(18)

The value of growth options is captured by the second term on the right hand side, the value of future growth opportunities, since the value of these growth opportunities ultimately depends on the firm’s discretion to invest in the future, affording them option-like features (Myers, 1977). Assets in place, by contrast, are simply assets whose value does not depend on such discretionary investments.

Kester (1984) provides the first set of empirical estimates of growth option value, defined as the proportion of the firm’s market value that is attributable to growth options. He measures the value of growth options as the firm’s market value (V) less the capitalized value of its current earnings stream, which represents the value of the firm without future growth opportunities, i.e., the value of assets in place (VAIP). A firm’s growth option value (GOV) is calculated proportion-wise as follows:

\[ \frac{V_{\text{GO}}}{V} = \frac{V - \text{Current Earnings}}{\text{Discount Rate}} / V \]

(19)
This approach is in principle consistent with Myers’ (1977) original conceptualization of growth options, and it provides the basis for the calculation of growth option value in other related research (e.g., Kester & Lowenstein, 2001; Alessandri, Lander, & Bettis, 2002; Long et al., 2003). Kester uses public market data and estimates of discount rates and calculates growth option value for a sample of fifteen firms in five industries for the year of 1983. Growth options are very valuable, which represent a significant contribution to the market value of many firms in the sample. However, there is also strong evidence that growth option value varies widely across firms as well as across industries. For instance, growth option value ranges from as low as about 10% for some firms to as high as about 90% for others. Additionally, companies in electronics, computers, and chemicals industries tend to have greater growth option value compared to those in food processing or tires manufacturing.

With these, the question of where growth options are coming from and what the major value drivers are becomes a natural one. For instance, Myers (1977: 172) first asks whether growth options arrive randomly or systematically, and whether they free or must be purchased by the firm. He speculates that growth options may not be acquired independent of real assets, and that given the discretionary nature of corporate investment decisions, many types of growth options must be firm-specific. These growth options are value enhancing because value created by them is more appropriable by the firm itself and less subject to competition. However, Myers also argues that certain growth options, such as franchises or licenses, which are separable and objectively identifiable, can be shared and tradable among market participants. Tradability of these growth options on secondary markets may suppress their value.
Some of these ideas are further developed in Kester (1984), who discusses the strategic aspects of growth options by explicitly classifying growth options into those that are proprietary and those shared. Proprietary options are firm-specific, provide exclusive rights of exercise, and usually stem from the firm’s unique bundle of knowledge assets or inimitable technologies. In contrast, shared options are collective opportunities facing all firms in an industry. The value of shared growth options is contingent on the intensity of competitive rivalry and less appropriable by an individual firm. When to exercise a growth option may also be critical to the value of the option and for a shared growth option, the timing of exercise depends on competitive rivalry. These ideas are also expressed in another study (Kester & Lowenstein, 2001).

In a cross-sectional analysis of the value of growth options, Long and colleagues (2003) find that a firm’s growth option value is positively related to its R&D intensity as well as the level of sales concentration of its focal industry. Their research brings some initial statistical evidence to bear on the idea in the real options literature that both industry and firm factors may matter to the value of growth options, but they are silent on the relative importance of industry- versus firm-level influence.

Parallel to the research on growth options in the real options literature is a significant body of research on the growth of the firm in both the industrial economics and the strategic management fields. However, in contrast to the real options literature that tends to emphasize the implications of growth options to the firm’s strategic investment behavior, the economics and strategy literatures to a greater extent focus on the sources and mechanisms of firm growth (e.g., Penrose, 1959; Chandler, 1962; Porter, 1980; Scherer, 1980; Yip, 1982), whereby growth is defined in terms of firm size and

The structure-conduct-performance paradigm in the industrial organization economics tradition, for instance, emphasizes the pivotal role that industry structure plays in determining the choice set of firm strategies such as growth strategy (Caves, 1980). Firms in an industry are assumed to be the same in all dimensions other than size (Caves & Porter, 1977). The firm in this view does not have much discretion on whether it can grow or how it wants to grow. More importantly, the structure of the industry in which the firm operates influences its ability to appropriate value embedded in the collection of growth options it possesses. In more concentrated industries, firms are more likely to extract monopoly rents, including those derived from existing assets as well as future growth opportunities (e.g., Lustgarten & Thomadakis, 1987). In perfectly competitive industries, however, any rents are transient by definition. Even if a firm is the first one among industry participants to possess a potentially valuable growth option, value created will be competed away soon by other firms that implement similar strategies to obtain that very growth option. In other words, while the growth option itself may have great value creation potential, it is the industry structure that ultimately determines the growth option owner’s ability to appropriate value from the option. To sum up, an industrial economics view of growth options would suggest that the industry in which the firm operates would have an important influence on the magnitude of growth opportunities and growth option value that the firm possesses.

The management strategy literature focuses on the discretion that the firm has in choosing its strategies (Bower, 1970), and argues that the firm’s choice set is largely
determined by the unique bundle of resources and capabilities it possesses (e.g., Penrose, 1959; Nelson & Winter, 1982; Kogut & Zander, 1992). Specifically, this literature views the firm as a bundle of resources that both motivates as well as limits the growth of the firm. On the one hand, firm growth is motivated by the managers’ aspirations to grow and is realized by managers utilizing excess resources with underutilized productive capacity (Penrose, 1959). On the other hand, brakes on unlimited growth lie in the inherent scarcity and immobility of resources, especially managerial knowledge and organizational routines (Nelson & Winter, 1982; Kogut & Zander, 1992). In the meantime, the resource-based view of the firm also argues that valuable, rare, inimitable, and non-substitutable resources create value that is appropriable by the firm (Barney, 1991). Some of these resources, such as proprietary technologies or firm-specific knowledge and experiences, underlie the firm’s future growth opportunities (Myers, 1977, Kester, 1984). In real options terms, these resources are firm-specific or proprietary growth options that are very valuable. To sum up, the strategic management literature on the growth of the firm would suggest that individual firm characteristics would have an important influence on the magnitude of growth opportunities and growth option value that the firm possesses.

The relative importance of industry versus firm effects on growth option value has not been empirically investigated however. To fill this gap and shed light on the nature of growth options, I resort to the variance components technique that has been utilized widely in previous variance decomposition studies to partition the total variance of firms’ growth option value into variances associated with firm effects, industry effects, and other classes of effects, which forms the subject of the next two sections.
4.2 Data, Measure, and Sample

4.2.1 Data

Data used to calculate a company’s growth option value (GOV) were drawn from Stern Stewart Performance 1000, a dataset developed by the New York-based financial consultancy Stern Stewart & Co. This dataset provides a ranking of the 1000 largest U.S. publicly-traded companies based on their Market Value Added (MVA) as calculated by Stern Stewart for up to 20 years. Besides MVA, the dataset also provides Stern Stewart’s other performance matrices such as Economic Value Added (EVA), Capital Invested (CI), and Weighted Average Cost of Capital (WACC). These measures combined with information on a company’s market value were used to derive an estimate of the company’s growth option value (GOV).

My use of the Stern Stewart dataset contrasts with earlier variance decomposition studies that have tended to rely on public financial and accounting datasets, such as the Federal Trade Commission database (e.g., Schmalensee 1985; Wernerfelt & Montgomery, 1988; Rumelt, 1991) the Compustat database (e.g., Roquebert et al., 1996; McGahan & Porter, 1997; Brush et al., 1999), and the Trinet database (e.g., Chang & Singh, 2000), but recent research in this stream has begun to note this dataset. Hawawini and colleagues (2003, 2004) more recently reexamine the relative importance of firm versus industry effects on economic performance using the Stern Stewart dataset, which they find retain many of the advantages of the Compustat dataset. Measures such as EVA in the Stern Stewart dataset have recently also been used in other research areas within strategy management (e.g., Coles, McWilliams, & Sen, 2001).
While in principle a firm’s growth option value can be estimated using public financial and accounting information (e.g., Kester, 1984; Kester & Lowenstein, 2001; Long et al., 2003) and indeed my approach to calculating growth option value is consistent with that in Kester (1984), the Stern Stewart dataset represents a number of advantages for my purpose. First, this dataset provides firm-specific discount rates (i.e., WACC) that help me avoid applying arbitrary discount rates across firms. Second, the dataset’s value-based measures such as EVA account for the firm’s capital costs and are better proxies for economic profit than current earnings. Third, measures such EVA also make adjustments to account for accounting policies that may distort the true level of the firm’s invested capital or operating performance. For example, in contrast to accounting conventions that expense all R&D costs, Stern Stewart capitalizes them, because were R&D not capitalized and amortized, the firm’s capital effectively utilized would be understated, potentially leading to overstated profits. Other major adjustments include adjustments to goodwill, provisions, operating leases, and so forth. Indeed, Stern Stewart has identified up to 160 different areas of such adjustments (Stewart, 1991), even though in practice most companies implementing EVA limit the number of adjustments to few than 10 (Young & O’Byrne, 2001).

Along with these advantages, the Stern Stewart dataset also presents certain challenges to a study such as this. First, the dataset involves the use of market-level data such as market value which is only available at the corporate level but not at the business-unit level. Although the market value of business units can be imputed using various approaches (e.g., Lang & Stulz, 1994), I decided not to do so due to the lack of consensus on these approaches and I avoided making potentially arbitrary assumptions on the Stern
Stewart data. Data constraints imply that I would only be able to estimate firm effects potentially reflecting both corporate- and business unit-level effects, which can not be disentangled in this study. A limitation as it might be, my firm-level focus accords to prior variance decomposition studies that have used market-level measures (e.g., Tobin’s Q) as a dependent variable (Wernerfelt & Montgomery, 1988; McGahan, 1999). Second, by assigning firms to their primary industry classification, it is likely that industry effects might be depressed due to the existence of diversified firms (McGahan & Porter, 1997); this possibility was investigated by estimating the same classes of effects for a sub-sample that only consists of single-business firms. Finally, all of the firms included in this database are publicly listed and relatively large in size, raising some concerns about generalizability. But while these firms may not be representative of the population of U.S. firms, many of them are among the most important ones in the economy and therefore, to my belief, are of importance in their own right.

4.2.2 Measure

The dependent variable for variance components analysis is firms’ growth option value. Below I illustrate the derivation of growth option value using measures in the Stern Stewart dataset and a more detailed discussion of these measures can be found in Stewart (1991). To start with, a firm’s market value comprises the book value of capital employed (the total capital 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:
(20) \[ V = CI + MVA. \]

MVA is 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 (Stern, 1991; Young & O’Byrne, 2001):

(21) \[ MVA = PV \text{ of Expected EVA}. \]

Although EVA is a performance metric trademarked by Stern Stewart, it essentially measures what is called “residual income” in accounting or “economic profit”, an economic concept usually ascribed to Marshall (1890). Unlike traditional accounting profitability measures (e.g., earnings) that only consider the cost of debt capital, residual income measures profit net of all capital charges that include the cost of equity capital as well, and can be expressed as follows:

(22) \[ RI = NOPAT - [CI \times WACC], \]

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 arrive at 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 (Stern, 1991).

Expected EVA in any given year consists of a component that is an equivalent to the current year’s EVA assuming a no-growth policy (i.e., Current-Level EVA), as well as a residual component (i.e., EVA Growth) that could be either positive or negative, depending on the firm’s investments in future growth opportunities. A firm has negative future growth opportunities when it is believed to be unable to sustain its current level of performance, or making value-destructing investments. Notationally,
PV of Expected EVA = PV of Current-Level EVA + PV of EVA Growth.

Combining the above equations (3, 4, and 6) and rearranging terms, the firm’s market value (V) can be rewritten as follows:

\[ V = CI + PV \text{ of Current-Level EVA} + PV \text{ of EVA Growth}, \]

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., \( V_{\text{AIP}} \)), and PV of EVA Growth measures the value of growth options (i.e., \( V_{\text{GO}} \), the component that derives its value from future growth opportunities).

To calculate my dependent variable, firm growth option value (GOV), I solve equation (7) for PV of EVA Growth (i.e., \( V_{\text{GO}} \)), and scale it by the firm’s value (V):

\[ \text{GOV} = \frac{[V – CI – PV \text{ of Current-Level EVA}]}{V}. \]

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 that my approach draws from that in Kester (1984), I followed Kester and 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 of GOV and my measure derived using equation (8) above is 0.82 (p<0.001), indicating good reliability of my measure.

4.2.3 Sample

The base sample consisted of all of the firms included in Stern Stewart Performance 1000. A number of screening procedures were implemented to obtain the
final sample used for analysis of growth option value. First, I restricted the sampling window to the 10-year period from 1987 to 1996 in keeping with prior variance decomposition research that use the same dataset (Hawawini et al., 2003, 2004). This generated an initial sample of 6,768 firm-year observations for which growth option value could be calculated. Second, I excluded conglomerate firms (e.g., SIC 9997) and firms that were reported to be inactive over the sampling period according to the Compustat database. 45 observations were excluded as a result. Third, because the existence of outliers may have undue effects on the results (McGahan & Porter, 1997), I followed Roquebert and colleagues (1996) and deleted 28 observations greater than four standard deviations from the mean. Fourth, industries with only one firm for which data are available were eliminated since for these industries intra-industry variances do not exist. This procedure reduced the sample size by 497 observations. This consideration was also reflected in my decision to choose to investigate industry effects at the 3-digit SIC level because in this dataset, at a finer (i.e., 4-digit) level of industry classification, a significant number of industries would only have one firm for which data become available. Narrowing the industry definition would therefore result in a substantial loss of data. The use of the 3-digit SIC level industry definition is consistent with that in Hawawini and colleagues (2003, 2004). The variance components results to be reported below are robust to the definition of industry at the 4-digit SIC level.

The screened, final sample comprised 6,198 firm-year observations for 823 firms operating in 127 industries. An average industry has about 6.5 firms and an average firm has about 7.5 observations. An average firm in the sample has a growth option value of 0.45, which is broadly consistent with that in Kester (1984) and Kester and Lowenstein.
Table 4.1 reports mean growth option value across sector and year. Over the ten-year period, mean growth option value is relatively high during 1991-1993, but overall it does not appear to exhibit a clear time trend. In terms of its distribution across sectors, mean growth option value is the highest in the agriculture, mining, and construction sector, and the lowest in the finance, insurance, and real estate sector. Mean growth option value for manufacturing firms (SICs 2000-3999) is just about the same as the mean value for the whole sample covering all sectors.

Given that some of the previous studies have focused on the manufacturing sector exclusively (e.g., Schmalensee, 1985; Rumelt, 1991; Roquebert *et al.*, 1996; Mauri & Michaels, 1998; Chang & Singh, 2000), manufacturing firms (SICs 2000-3999) were drawn from the final sample for separate analysis. Analysis of the manufacturing sample (N=3,020) allows me to investigate whether the more general results hold in this particular sector and it also enables direct comparisons with previous findings.

Prior research suggests that in a sample comprising single- and multiple-business firms, industry effects may be depressed because diversified firms are assigned to their primary industry classification (McGahan & Porter, 1997). To investigate this issue more completely, single-business firms were identified from both the full and the manufacturing samples, according to the information obtained from the Compustat Industry Segment database. These single-business firms formed sub-samples (N=3,224 and 1,238, respectively) for additional analysis, and the results were compared with those on the original samples from which the sub-samples were drawn. Mauri and Michaels (1998) report variance components results based on a sample of single-business
manufacturing firms, but the results are not compared with those on a sample that also comprises multiple-business firms as well as non-manufacturing firms.

4.3 Model and Methodology

Existing variance decomposition studies on performance have largely resorted to two statistical techniques: analysis of variance and variance components analysis (see Searle (1971) for a technical discussion, and Bowman and Helfat (2001) for a critique of the two techniques). While earlier studies (e.g., Schmalensee, 1985; Rumelt, 1991; McGahan & Porter, 1997) have used both techniques, they have also recognized that the variance components technique is preferable for the purpose of assessing the relative importance of different classes of effects and have utilized it as the flagship approach. Rumelt (1991) and McGahan and Porter (1997) further suggest that an analysis of variance test for significance is not a prerequisite to variance components analysis. More recent studies interested in the relative importance of firm versus industry effects have largely converged to the variance components technique (e.g., Roquebert et al., 1996; Mauri & Michaels, 1998; Chang & Singh, 2000; Walker, Madsen, & Carini, 2002; Hawawini et al., 2003; McNamara, Deephouse, & Luce, 2003).

In keeping with this stream of research, I used the variance components technique as my empirical approach, to evaluate the relative importance of industry, firm, and year effects. This technique takes dummy variables as predictors and decomposes the variance of the dependent variable into separate classes of effects each representing a predictor. It assumes that these classes of effects are generated by random processes that are independent of each other allowing for such decomposition. The following
descriptive model was used to estimate the percentages of the variance of the dependent variable explained by each type of the effects:

\[ g_{ijt} = \mu + \alpha_i + \beta_j + \gamma_t + (\alpha\gamma)_{it} + \varepsilon_{ijt}. \]

This model is based on that in Schmalensee (1985), Rumelt (1991), and McGahan and Porter (1997) and has been employed in more recent research in this stream with a firm-level focus (Hawawini et al., 2003, 2004). It specifies five sources of variation in the firm’s growth option value: stable and transient industry effects, stable firm effects, the effects of macroeconomic conditions, and unexplained residual effects. Specifically, the dependent variable \( g_{ijt} \) is growth option value of firm \( j \) in industry \( i \) in year \( t \); the first right-hand-side term \( \mu \) is a constant equal to the grand mean, the term \( \alpha_i \) random industry effects, \( \beta_j \) random firm effects, \( \gamma_t \) random year effects, \( (\alpha\gamma)_{it} \) random industry–year interaction effects, and \( \varepsilon_{ijt} \) unexplained residual effects.

Each of the classes of independent effects in the model is assumed to be randomly drawn from an underlying population that is normally distributed. The dependent variable \( g_{ijt} \) therefore follows a normal distribution as well, because it is a combination of normal random variables that are linearly independent. Statistical properties suggest that the total variance in the dependent variable (i.e., growth option value), \( \sigma^2_g \), can be decomposed into the sum of the variance of each independent effect (i.e., \( \sigma^2_{\alpha} \), \( \sigma^2_{\beta} \), \( \sigma^2_{\gamma} \), \( \sigma^2_{\alpha\gamma} \), and \( \sigma^2_{\varepsilon} \)) as follows:

\[ \sigma^2_g = \sigma^2_{\alpha} + \sigma^2_{\beta} + \sigma^2_{\gamma} + \sigma^2_{\alpha\gamma} + \sigma^2_{\varepsilon}. \]

I used the standard VARCOMP procedure in the SAS package to estimate each of the five variance components on the right hand side of the equation and I chose the maximum likelihood method (see also Roquebert et al., 1996; Mauri & Michaels, 1998).
I found that estimates based on the MIVQUE0 (Minimum Variance Quadratic Unbiased Estimation) method were qualitatively similar, consistent with the findings in Roquebert and colleagues (1996).

4.4 Results

4.4.1 Results on Growth Option Value

Table 4.2 presents variance estimates for each of the five classes of effects as well as the percentages of the total variance in growth option value that each of these effects can explain. Panel (A) reports results on the final sample that covers all economic sectors and Panel (B) reports results on the sample that is focused on the manufacturing sector. Column (1) of the two panels provides results on the sample that comprises both single- and multiple-business firms and Column (2) provides results on the sample that only consists of single-business firms.

Column (1) of Panel (A) indicates that, for the sample of all sectors, stable firm effects explain about 28.51% of the variance in growth option value, while total industry effects encompassing stable and transient components explain about 13.21% of the variance. Thus based on my sample, stable firm effects, which reflect both corporate parent effects and business unit-level effects, explain the variance in growth option value about twice as much as total industry effects. Year effects resulting from economy-wide factors explain about 3.45% of the variance. Finally, over half (i.e., 54.83%) of the variance in growth option value unexplained by any of the above classes of effects goes to the error term. In Column (2), there is strong evidence that stable industry effects increase to about 13.50%, which combined with transient industry effects make up about
17.34% of the variance in growth option value. Stable firm effects do not change significantly (i.e., 28.91%) and, as in Column (1), still dominate total industry effects. Year effects and residual effects drop to about 1.62% and 52.13%, respectively.

The results in Panel (B) broadly corroborate those in Panel (A) that: (1) firm effects dominate any other class of effects, and (2) industry effects become much more important when the focus changes to single-business firms. The results in the two panels differ only slightly in terms of the specific percentages explained by each class of effects. Notably, residual effects in Panel (B) are smaller, suggesting that the independent variables have a greater explanatory power in the manufacturing sample compared to the sample of all sectors. Taken together, the results in Table 4.2 reveal that, whether the full or the manufacturing sample, firm effects are always much more important than industry effects, even in a single-business setting whereby stable industry effects increase substantially.

4.4.2 Results on Tobin’s Q

I also sought to decompose the variance in Tobin’s Q. While Tobin’s Q has for some time been used to represent the magnitude of growth opportunities that a firm possesses, it is worth noting that this notion is questioned by more recent research in real options (e.g., Abel et al., 1996; Berk et al., 1999). Abel and colleagues (1996) suggest, for instance, that Tobin’s Q reflects both excess returns on existing capital as well as the value of options to invest, or growth options. Through a model and a simulation, Berk and colleagues (1999) show that it is entirely possible for two firms with different levels of growth opportunities to have identical market-to-book values. Nevertheless, I believed that a decomposition of the variance in Tobin’s Q is informative because it at least
provides me an indication of whether a similar pattern of results as above would be manifest.

I calculated Tobin’s Q for each firm in the sample period using the approach suggested by Chung and Pruitt (1994). The numerator in Tobin’s Q equals the sum of the market value of a firm’s common equity and the book value of its preferred stock as well as its debt, and the denominator is the book value of the firm’s total assets. Chung and Pruitt (1994) show that this essentially market-to-book construction produces a measure highly correlated (above 0.96) with other variants of Tobin’s Q that potentially require arbitrary assumptions about depreciation and inflation rates for assets’ replacement values.

The construction of Tobin’s Q differs from that of growth option value in two important aspects: (1) a firm’s market value serves as the numerator in Tobin’s Q, but as the denominator in growth option value, and (2) while the denominator in Tobin’s Q is the replacement value of a firm’s assets, growth option value takes as the denominator the capitalized value of a firm’s current rate of return. Sustainable excess return comes from the firm’s ability to continue to earn a rate of return beyond the current level, which is considered the source of growth options (Berk et al., 1999). This motivated me to check the correlation between Tobin’s Q and growth option value in the sample. The correlation coefficient is 0.21 (p<0.001), which while statistically significant, is far from being perfect correlation (see also Long et al., 2003). This, coupled with the different ways in which the two measures are constructed, suggests that growth option value and Tobin’s Q may be two distinctive concepts with substantively different content. This suggestion is made also in view of the fact that Tobin’s Q has been associated in previous
research with a number of other underlying constructs besides growth opportunities, such as monopoly power (e.g., Lindenberg & Ross, 1981), management quality (e.g., Lang, Stulz, & Walkling, 1989), shareholder value (e.g., Lang & Stulz, 1994), and intangible assets (e.g., Villalonga, 2004).

I went through the same screening procedures as I did on growth option value to arrive at the final sample on Tobin’s Q. For this sample, the mean value of Tobin’s Q is 1.45, which is somewhat higher than the values of 1.11 and 1.17 in Lang and Stulz (1994) and McGahan (1999), respectively. This may be because my sample was obtained from the Stern Stewart dataset that focuses on the 1000 largest companies based on their market value added, while in both Lang and Stulz (1994) and McGahan (1999), the sample was drawn from the Compustat database. In addition, my time window (1987-1996) also differs from theirs. While not reported here, mean Tobin’s Q over the ten-year period largely follows an upward trend, and it is particularly high in the lodging, entertainment, and health services sector, and relatively low in the agriculture sector as well as the transportation sector. Both of these findings are similar to those in McGahan (1999).

In terms of composition, the final sample comprised 6,598 firm-year observations, out of which 3,438 came from single-business firms, 3,060 from manufacturing firms, and 1,258 from single-business manufacturing firms. In total, these 6,598 observations included 835 firms involved in 131 industries at the 3-digit SIC level. An average industry has about 6.4 firms and an average firm has about 7.9 observations. Variance components results on Tobin’s Q are presented in Table 4.3, which has the same structure as Table 4.2.
The results in Column (1) of Panel (A) show that stable firm effects contribute to about 51.16% of the variance in Tobin’s Q and total industry effects about 25.96%. Year effects are relatively small (i.e., 1.31%), and the error variance accounts for about 21.58% of the variance in Tobin’s Q. In Column (2), a large increase in stable industry effects is also found on the sample that only consists of single-business firms. Stable firm effects drop to about 43.85% while other effects do not change materially. These results have a similar pattern as those in McGahan (1999) even though the sample, time window, and method used in the two studies differ greatly. Also, a comparison of these results with those in Table 4.2 indicates that: (1) firm effects on Tobin’s Q are much more important than industry effects, although the two classes of effects both explain a substantially larger percentage of variance than in the case of growth option value; and (2) residual effects are much smaller, indicating that the statistical model is more powerful when it is applied to the analysis of Tobin’s Q.

Panel (B) corresponds to Panel (A) that firm effects outstrip industry effects and that industry effects expand when one only samples single-business firms. One notable difference is that, compared to those in Panel (A) that covers all sectors, industry effects in the manufacturing sample are rather smaller. This finding is in accord with McGahan and Porter’s (1997, 2002) suggestions that industry effects on accounting performance appear less important in the manufacturing sector than in other sectors, even though it is based on Tobin’s Q, a different, market-based performance measure.
4.5 Discussion

This chapter examines the influence of industry, firm, and year effects on growth option value among a sample of large, public U.S. companies from 1987-1996. The use of growth option value as a new dependent variable for variance components analysis distinguishes the current chapter from most of previous research in this stream that has tended to focus on firm performance based on accounting profitability (except for Wernerfelt & Montgomery, 1988; McGahan, 1999; Hawawini et al., 2003, 2004). Growth option value is a variable worth studying in strategy research because of the importance of the growth of the firm to corporate strategy (Penrose, 1959; Chandler, 1962) and the importance of growth options to value creation and appropriation (Kester, 1984; Myers, 1984; Kester & Lowenstein, 2001). The use of a new, Stern Stewart dataset enables the calculation of growth option value to be more accurate and for a larger sample covering a longer period than allowed in prior studies (e.g., Kester, 1984; Brealey & Myers, 2000; Kester & Lowenstein, 2001; Long et al., 2003). The chapter also reports changes in the magnitude of industry effects when the focus on the full sample comprising both single- and multiple-business firms changes to a sub-sample only consisting of single-business firms. A comparison of the two sets of results shows that including diversified firms in variance components analysis dampens industry effects considerably. While such results have been speculated (McGahan & Porter, 1997), they have not been empirically investigated and reported in previous variance decomposition studies.

The following three results are generated: (1) firm effects are almost twice as much important as industry effects on growth option value, (2) year effects are relatively
unimportant, and (3) residual effects explain a quite large amount of variance. These results hold when single-business firms and manufacturing firms form additional samples for analyses. The first two results also apply to separate analyses focusing on Tobin’s Q that is arguably a proxy for growth opportunities that firms possess. I find that the error variance in the analysis of Tobin’s Q is considerably smaller than that in growth option value.

The set of results have important implications for both the real options and the variance decomposition literatures. The results are informative to option theorists that while growth options may come in many firms (Myers, 1977; Kester, 1984), their value to the firm is determined more by firm-specific factors. This implies that the ability of the firm to appropriate value from a growth option is the key to understanding the potential importance of that option to the firm. For strategy researchers, the results provide another useful piece of evidence that firm effects are more important than industry effects in driving performance even when performance is defined as a market-based measure focusing on future growth opportunities available to the firm. This indicates again that the quest for the fundamental sources of inter-firm heterogeneity would need to start at the firm level.

Future research can develop along a number of directions. First, further efforts are needed to replicate the current study by using a larger sample of firms, say, from the Compustat database. Such research would help generalize the findings of this study in an important way, but it may face such challenges as estimating firm-specific discount rates and adjusting for accounting distortions in profits, both of which are essential to having an accurate measure of growth option value. Despite these challenges, such efforts
should prove useful for an improved understanding of the ultimate sources of firms’ valuable growth opportunities and the factors that affect value appropriation. Additionally, future studies can also examine whether findings in the U.S. can be generalized to other country settings, and in those studies, the influence of country effects can also be factored in.

Second, my study shows that firm effects only dominate among the classes of explained variations in growth option value. The unexplained amount of error variance, due to some important yet unexamined factors, is relatively large, providing interesting avenues for future inquiry. Myers (1977) suggests that intangible assets can be viewed as options that allow the firm to purchase additional units of productive capacity in the future, while tangible assets are accumulated units up to a certain point. Thus, it may be that valuable growth options are attached to a key technology or a particular piece of market knowledge. Variance components technique, however, can only capture the effects of dummy variables, and therefore is not amenable to addressing effects arising from certain resources, raising the need to use other techniques and innovative methodologies. For example, analysis of variance method (e.g., Adner & Helfat, 2003) may help account for the possibility that valuable growth options may arise from firms’ intangible assets such as research and development or advertising investments. All these also imply that future research examining the sources of individual firm differences may need to be more micro-analytic employing datasets with more detailed information.

Finally, like this chapter, future research can also explore new datasets and new performance measures for variance components analysis (McGahan & Porter, 2002). Some of the examples include, and not limited to, firms’ stock price data that permit the
calculation of cumulative abnormal returns, firms’ geographic sales data that allow the investigation of geographic segment effects, as well as international datasets that enable the comparison of various classes of effects across countries and regions of different institutions.
<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Mining, &amp; Construction (0, 1)</td>
<td>0.84 (26)</td>
<td>0.68 (29)</td>
<td>0.66 (31)</td>
<td>0.62 (34)</td>
<td>0.73 (35)</td>
<td>0.84 (34)</td>
<td>0.55 (39)</td>
<td>0.65 (40)</td>
<td>0.60 (41)</td>
<td>0.51 (42)</td>
<td>0.66 (351)</td>
</tr>
<tr>
<td>Manufacturing (2, 3)</td>
<td>0.37 (261)</td>
<td>0.32 (270)</td>
<td>0.34 (271)</td>
<td>0.40 (275)</td>
<td>0.61 (293)</td>
<td>0.60 (308)</td>
<td>0.56 (319)</td>
<td>0.46 (336)</td>
<td>0.38 (349)</td>
<td>0.44 (360)</td>
<td>0.45 (3042)</td>
</tr>
<tr>
<td>Transportation (4)</td>
<td>0.46 (41)</td>
<td>0.44 (43)</td>
<td>0.52 (43)</td>
<td>0.57 (43)</td>
<td>0.58 (45)</td>
<td>0.58 (48)</td>
<td>0.56 (53)</td>
<td>0.50 (58)</td>
<td>0.47 (62)</td>
<td>0.53 (67)</td>
<td>0.52 (502)</td>
</tr>
<tr>
<td>Wholesale &amp; Retail (5)</td>
<td>0.35 (71)</td>
<td>0.34 (70)</td>
<td>0.43 (72)</td>
<td>0.35 (72)</td>
<td>0.50 (78)</td>
<td>0.50 (78)</td>
<td>0.49 (93)</td>
<td>0.43 (94)</td>
<td>0.39 (101)</td>
<td>0.41 (108)</td>
<td>0.42 (842)</td>
</tr>
<tr>
<td>Finance, Insurance, &amp; Real Estate (6)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.16 (67)</td>
<td>0.41 (77)</td>
<td>0.42 (117)</td>
<td>0.27 (128)</td>
<td>0.18 (132)</td>
<td>0.31 (140)</td>
<td>0.33 (141)</td>
<td>0.30 (808)</td>
</tr>
<tr>
<td>Lodging, Entertainment, &amp; Health Services (7)</td>
<td>0.47 (41)</td>
<td>0.41 (43)</td>
<td>0.51 (44)</td>
<td>0.35 (43)</td>
<td>0.57 (47)</td>
<td>0.51 (54)</td>
<td>0.56 (62)</td>
<td>0.54 (69)</td>
<td>0.51 (75)</td>
<td>0.60 (90)</td>
<td>0.52 (568)</td>
</tr>
<tr>
<td>Other Services (8)</td>
<td>0.39 (7)</td>
<td>0.41 (6)</td>
<td>0.50 (5)</td>
<td>0.66 (6)</td>
<td>0.65 (9)</td>
<td>0.47 (9)</td>
<td>0.54 (10)</td>
<td>0.55 (10)</td>
<td>0.45 (11)</td>
<td>0.48 (12)</td>
<td>0.51 (85)</td>
</tr>
<tr>
<td>Total</td>
<td>0.42 (448)</td>
<td>0.37 (462)</td>
<td>0.41 (466)</td>
<td>0.39 (540)</td>
<td>0.57 (584)</td>
<td>0.56 (653)</td>
<td>0.49 (704)</td>
<td>0.43 (739)</td>
<td>0.40 (779)</td>
<td>0.44 (823)</td>
<td>0.45 (6198)</td>
</tr>
</tbody>
</table>

Cell value represents mean growth option value, and the number of observations appears in parentheses.

Table 4.1: Mean Growth Option Value by Sector and Year
Panel (A). Sample of All Sectors

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) Single- and Multiple-Business Firms(^a)</th>
<th>(2) Single-Business Firms(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Percentage</td>
</tr>
<tr>
<td>Firm</td>
<td>0.04318</td>
<td>28.51%</td>
</tr>
<tr>
<td>Industry</td>
<td>0.01344</td>
<td>8.87%</td>
</tr>
<tr>
<td>Year</td>
<td>0.00523</td>
<td>3.45%</td>
</tr>
<tr>
<td>Industry * Year</td>
<td>0.00658</td>
<td>4.34%</td>
</tr>
<tr>
<td>Error</td>
<td>0.08305</td>
<td>54.83%</td>
</tr>
<tr>
<td>Total</td>
<td>0.15148</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^a\) N=6198.
\(^b\) N=3224.

Panel (B). Manufacturing Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) Single- and Multiple-Business Firms(^c)</th>
<th>(2) Single-Business Firms(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Percentage</td>
</tr>
<tr>
<td>Firm</td>
<td>0.04026</td>
<td>31.22%</td>
</tr>
<tr>
<td>Industry</td>
<td>0.00880</td>
<td>6.82%</td>
</tr>
<tr>
<td>Year</td>
<td>0.00801</td>
<td>6.21%</td>
</tr>
<tr>
<td>Industry * Year</td>
<td>0.00781</td>
<td>6.06%</td>
</tr>
<tr>
<td>Error</td>
<td>0.06409</td>
<td>49.69%</td>
</tr>
<tr>
<td>Total</td>
<td>0.12897</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^c\) N=3020.
\(^d\) N=1238.

Table 4.2: Variance Components Analysis of Growth Option Value
Panel (A). Sample of All Sectors

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) Single- and Multiple-Business Firms&lt;sup&gt;e&lt;/sup&gt;</th>
<th>(2) Single-Business Firms&lt;sup&gt;f&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Percentage</td>
</tr>
<tr>
<td>Firm</td>
<td>0.66368</td>
<td>51.16%</td>
</tr>
<tr>
<td>Industry</td>
<td>0.31650</td>
<td>24.40%</td>
</tr>
<tr>
<td>Year</td>
<td>0.01697</td>
<td>1.31%</td>
</tr>
<tr>
<td>Industry * Year</td>
<td>0.02023</td>
<td>1.56%</td>
</tr>
<tr>
<td>Error</td>
<td>0.27990</td>
<td>21.58%</td>
</tr>
<tr>
<td>Total</td>
<td>1.29728</td>
<td>100%</td>
</tr>
</tbody>
</table>

<sup>e</sup> N=6598.  
<sup>f</sup> N=3438.

Panel (B). Manufacturing Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) Single- and Multiple-Business Firms&lt;sup&gt;g&lt;/sup&gt;</th>
<th>(2) Single-Business Firms&lt;sup&gt;h&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Percentage</td>
</tr>
<tr>
<td>Firm</td>
<td>0.67389</td>
<td>53.03%</td>
</tr>
<tr>
<td>Industry</td>
<td>0.21258</td>
<td>16.73%</td>
</tr>
<tr>
<td>Year</td>
<td>0.02473</td>
<td>1.95%</td>
</tr>
<tr>
<td>Industry * Year</td>
<td>0.02134</td>
<td>1.68%</td>
</tr>
<tr>
<td>Error</td>
<td>0.33813</td>
<td>26.61%</td>
</tr>
<tr>
<td>Total</td>
<td>1.27067</td>
<td>100%</td>
</tr>
</tbody>
</table>

<sup>g</sup> N=3060.  
<sup>h</sup> N=1258.

Table 4.3: Variance Components Analysis of Tobin’s Q
CHAPTER 5

CONCLUSION

The recent debate on the unique contributions of real options theory to strategy (Adner & Levinthal, 2004; McGrath et al., 2004) stresses the importance to the theory’s development of investigating the organizational implications of real options investments. The distinguishing characteristic of a real options approach to corporate investments lies in the asymmetric effects that it promises on the firm, namely, the twin organizational benefits of reducing downside risk while unlocking upside opportunities (Bowman & Hurry, 1993; McGrath, 1997, 1999). The key objective of this dissertation is to bring empirical evidence to bear on a particular aspect of the central proposition of real options theory—that real options investments confer future growth opportunities that are valuable to the firm. The dissertation complements prior research examining the downside risk implications of real options investments (Reuer & Leiblein, 2000) and it helps flesh out one of the unique contributions of real options theory to the domain of corporate strategy.

The first essay (Chapter 2) introduces growth option value as a new dependent variable, and to provide a direct test of real options theory’s propositions, growth option value is linked to a number of internal and external corporate development activities that firms routinely undertake and have been assumed to provide future growth opportunities.
Among the investment activities investigated, investments in R&D and investments in JVs are significantly related to growth option value. The finding on R&D is consistent with the economics, technology, and strategy literature (Roberts & Weitzman, 1981; Mitchell & Hamilton, 1988; Kogut & Kulatilaka, 2001) that has long characterized R&D investments as real options investments, and the finding on JVs suggests that investments in JVs have growth option value due to the firm’s implicit expansion option therein through the purchase of additional equity (Kogut, 1991). Further exploratory analysis reveals that minority JVs have significant effects on growth option value particularly.

The second essay (Chapter 3) aims to examine the growth option value implications of various types of JVs, given the current status and theoretical appeal of real options theory’s development in the domain of JVs (Kogut, 1991; Chi, 2000). The results show that JVs enhance firms’ growth option value, but only under certain circumstances. Consistent with the hypotheses, minority IJVs and diversifying IJVs are positively associated with growth option value, but, contrary to the hypothesis, IJVs located in emerging economies are not, even though they are often seen as providing firms with significant future growth potential. The set of results provides a contingency perspective of the growth option value of JVs and it refines existing understanding of the theory’s applicability to JVs.

The third essay (Chapter 4) undertakes a variance decomposition of growth option value, motivated by growth option value being a variable with broader implications for future real options research as well as a variable unexamined in the existing variance decomposition studies. The results join previous research in this stream in that firm effects are found to be much more important than industry effects on growth option
value, and that year effects are relatively unimportant. These results are robust to the use of various samples, different measures, and alternative estimation methods. They have useful implications for future research in strategic management as well as real options, given the importance of the growth of the firm to corporate strategy (Penrose, 1959; Chandler, 1962) as well as the importance of growth options to resource allocation and value creation (Myers, 1977; Kester, 1984).

Future research can develop along some of the directions in which the dissertation is structured. First, real options theory’s proposition on the organizational implications of real options investments should be subjected to more empirical tests that help refine the theory’s boundaries. Just as one example, besides the downside risk implications of multinationality and IJVs (Reuer & Leiblein, 2000), future research can also investigate whether entrepreneurial firms indeed follow a real options approach to investment that maximizes wealth creation while curtailing downside losses (McGrath, 1999).

Second, the variable growth option value can be applied to research in other settings aimed at a broader audience. For instance, newly listed firms tend to have greater growth option value as they tend to derive a greater proportion of their value from growth options, or future growth opportunities. An intriguing research agenda in this context is whether a firm’s growth option value, assessed by the financial market, would have any substantive meanings for its growth and performance on the product market. This research may not only help link together indicators of the financial market and the product market, but it may also tease out some of the mechanisms that the firm may use to overcome the heightened levels of information asymmetry and uncertainty surrounding
valuation at the time of listing. Research such as this may also shed light on some of the normative implications of growth options.

Third, in the specific domain of JVs, additional research is needed to examine more deeply the exercise of the embedded growth options. Kogut (1991) examines the timing of the exercise decision in the context of product demand changes that affect a firm’s valuation of a JV. In addition to product market signals, however, signals in the broader institutional environment may also change a firm’s valuation of a JV. Anecdotal evidence shows that IJVs in certain emerging economies, such as China, have increasingly been acquired and subsequently converted into wholly-owned subsidiaries by foreign investors, as institutions continue to develop there. This provides a fruitful avenue for future research on real options and JVs in general. Relatedly, research in this area may examine why certain IJVs do not actually result in acquisitions by foreign partners (e.g., key resources retained by the local partner; increasing bargaining power of the local partner due to learning) despite the development of institutions. In this research, useful insights into the conditions under which a particular JV will or will not be acquired can be generated.

Finally, on variance decomposition, additional efforts are need to explore the influence of other classes of effects, such as country effects, on growth option value, by using new, cross-country datasets. Moreover, given the relatively large unexplained amount of error variance found in the third essay, future research is also needed to delve into other intriguing but unexamined sources of growth option value.
REFERENCES


