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Wharton Working Paper

The Fourth Wave of Corporate Venture Capital?

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ABSTRACT

This working paper investigates whether the most recent 5 years of the US Corporate Venture Capital industry (2000-2005) show distinctive characteristics of an emerging Fourth Wave---related to accelerated industry and structural adjustment as well as convergence with global private equity and innovation markets. Our approach is historical and archival: we provide a detailed roadmap and longitudinal overview of the evolving themes, research questions and findings that have characterized the main body of empirical, quantitative and qualitative academic research in the CVC field over a period spanning the early 1980s to the present.

We find that Corporate Venture Capital, with its focus on-- (1) corporate-funded, often strategically-motivated equity investments and (2) typically entrepreneur-founded, small, new private company ventures or start-ups in high-potential/high-growth sectors---is a relatively small and easily distinguishable subset of the much larger body of published academic research on the topic of Corporate Venturing.

We conclude that previous industry/trade databases have been limited and that new "dynamic capability" multi-theoretic explanatory models are urgently needed to analyze this period of time and to gather and test Fourth Wave hypotheses with (1) fine-grained industry-level data and (2) strategic constructs and portfolio performance metrics.

We recommend that future research focusing on the Fourth Wave of Corporate Venture Capital be motivated to look beyond the "dyad" (one-to-one connection) and start to systematically measure the strategic performance impact of CVC-enhanced networks and eco-systems as well as platforms and standards, on multinational competitive strategy and advantage.

The main body of the working paper covers a historical or longitudinal overview of the published academic journal articles in the Corporate Venture Capital (CVC) field. We put a heavy emphasis on delineating historical time-periods because we believe that it is essential to investigate whether the most recent 5 years of the national Corporate Venture Capital industry (2000-2005) show distinctive characteristics of an emerging Fourth Wave---related to accelerated industry and structural adjustment as well as convergence with global private equity and innovation markets. This would raise the urgency of rapidly collecting an appropriate industry-level data-set to focus and analyze this recent period of time.

Without fine-grained industry-level and strategically focused quantitative data-sets available, most of the research in the field has assumed that the recent five years of corporate venture capital activity can be safely characterized as either (1) a tapering off and after-shock continuation of the "Mavericks" Wave Three corporate venture behavior of the dotcom and internet period of 1995-2000 reaching a peak of $22B or (2) a more "classic" continuation of the 10-year $5B-sized wave pattern of Wave 1 and Wave 2 of corporate investments into external ventures. Note: "Mavericks" is the name of the San Francisco surfing site that hosts a winter surfing free-style contest on 20-30 ft. waves.

Each of the falling edges of these decade-long CVC investment waves has typically stimulated an accompanying mini-wave of explanatory academic articles published in hindsight; but unfortunately, larger-scale empirical studies linking performance outcomes to specific determining factors have been infrequent and often lag the underlying phenomena studied by as much as 4-5 years. For example, the well-known NBER article on CVC performance published by Gompers and Lerner in 1998[1], analyzed 32,386 independent and corporate venture capital transactions in the period of 1983-1994, arguably capturing information about pre-internet CVC investment Wave 2 that peaked in 1986. The classic 1986 article written by Sykes[2], "The Anatomy of a Corporate Venture Program ", analyzing the success factors of 32 companies in the Exxon Ventures

portfolio during Wave 1 (1970-1981) was arguably also a delayed-in-publication autopsy, since the Exxon Ventures group was shuttered in 1981.

Our primary goal in this academic literature review is to provide a detailed roadmap to the evolving themes, research questions and findings that have characterized the main body of empirical, quantitative and qualitative research in the CVC field over a period spanning the early 1980s to the present. In keeping with our tour-guiding goal, we have highlighted for the reader, (1) the most- cited "classic" CVC articles, (2) a list of references to the relatively winding, though scenic back-roads taken by earlier research travelers, (3) important forks in the road, (4) identifiable post-2000 dissertation "guideposts" and finally, (5) a brief assessment of the applicability of the past research to the current context of 2000-2005. Our detailed recommendations for future research are covered in a subsequent report.

Section II starts by covering in-depth the approach, determining factors and findings of the earlier "classic" CVC articles (Hardymon[3], Sykes[4]) of the 1980s that shaped the field. Section III continues by highlighting the fork in the road represented by the two articles--Winter& Murfin[5] and Siegel, Siegel & MacMillan[6], published in the same 1988 Journal of Business Venturing. Section IV considers the US Corporate Venture Capital industry from the perspective of the emerging UK industry and three new empirical surveys conducted by McNally[7] in 1997 and the clear research divide between external and internal corporate ventures highlighted by Shrader & Simon's 1997[8] research using matched pairs in one industry. This section also looks at the Gompers and Lerner NBER [9]empirical study of Wave 2. Section V summarizes the "best practices" studies of the 2000-2002 timeframe—the London Business School study[10], the Corporate Executive Board report[11] and the HBR article, "Making Sense of Corporate Venture Capital" authored by Chesbrough[12]. Section VI contrasts the "best practices" studies and the earlier "classic" research to the more fine-grained and industry/region-specific frameworks characterizing three post-2000 Wave 3 empirical dissertations and several not-yet-published or forthcoming [13]articles in the field. These are described in some detail as illustrative "guideposts" to the new direction of research and emerging themes in

corporate venture capital. None of the articles reviewed in this report have analyzed the Corporate Venture Capital Industry since the dotcom bust and analyzed the impact of the well-recognized shakeout in technology-related industries, venture capital, private equity and corporate venture capital along with the weakness of the IPO market.

I. A. Exclusive focus on Corporate Venture Capital academic literature

The widespread industry and practitioner interest in Corporate Venture Capital – operationally defined for academic empirical research as, "equity or equity-linked investments in relatively new, privately-held companies, where the investor or source of funding is a designated financial intermediary, subsidiary or group member of an industrial corporation"--- is surprisingly not reflected in a large number of academic journal articles and books.

Instead, we found that Corporate Venture Capital, with its focus on-- (1) corporate-funded, often strategically-motivated equity investments and (2) typically entrepreneur-founded, small, new private company ventures or start-ups in high-potential/high-growth sectors---is a relatively small and easily distinguishable subset of the much larger body of published academic research on the topic of Corporate Venturing.

Block and MacMillan in 1993 pointed out that the term corporate venturing has been used to describe a variety of somewhat different corporate activities. Major definitional and comparison problems plague researchers seeking to integrate and distinguish between the findings of corporate venturing studies. Roberts[14] in 1980: 36 developed a table that he termed the "Spectrum of Venture Strategies" in which he divided up new venture development into (1) Venture capital, (2) Venture nurturing, (3) Venture spin-off, (4) New Style joint venture, (5) Venture merging and melding and (6) Internal venture and characterized venture capital as having low corporate involvement/risk and internal ventures as having high corporate involvement/risk. Venture strategies (1) through (5) were characterized as "External" and only Venture Strategy (6) was described as Internal.

In contrast to Corporate Venture Capital, Corporate Venturing research typically includes articles on intra-preneurship, corporate entrepreneurship, technology incubators and

internal corporate ventures characterized by non-equity corporate funding relationships. Additionally, the research topic of Corporate Venturing has a primary focus on the specific challenges and benefits associated with internal ventures and technologies developed by personnel employed inside large companies and multi-business corporations. These internal corporate ventures are not incorporated separately, or privately held by the founders or entrepreneurs (until a decision is made to spin-out or to become a "spin-off").

I. B. Comprehensiveness Methodology

We took the following methodology to provide comprehensiveness in our academic literature overview and also to prioritize our search for significant directions for future research.

We searched for published academic articles with the exact term, "Corporate Venture Capital" in the title or abstract from the online library search of all academic journal articles within the Wharton ABI Inform database. This yielded only 20 articles in total.

We then checked the list of articles and authors with specific mention of Corporate Venture Capital with the extensive bibliographies of two recent PhD theses specifically written on Corporate Venture Capital and one written on Global Venture Capital with a section on Corporate Venture Capital:

1. Kann, 2000[15]
2. Maula, 2001[16]
3. Haemmig, 2002[17]

We added Corporate Venture Capital articles (some unpublished but from authors previously published in the field) from the bibliographies of the most-cited recent academic articles on CVC—Gompers and Lerner, 1998[18] and Chesbrough, 2000[19].

We added several Corporate Venture Capital items from the bibliography of the widely disseminated London Business School report on Corporate Venturing (LBS, 2002[20]) and an additional online search of trade journals to check cited academic articles.

As mentioned earlier, combining all of these references still ended up with a surprisingly small number from which we chose the most-cited empirical articles to analyze in more detail in this report. We highlight and re-emphasize three important observations. First, the general academic research area of Corporate Venturing, including intra-preneurship, internal ventures and non-equity funded investments, is historically much larger in number of published articles and books although the performance of these internally-generated ventures are shown to consistently lag external entrepreneurial CVC ventures. Second, the primarily financially-oriented research area of Venture Capital, general private equity financing and high-risk investment and portfolio management is very large and oft-cited although the transferability of these research approaches and findings to primarily strategically motivated and intangible asset investments like CVC remains controversial. Third, increasingly fine-grained trade association databases reveal that CVC activity continues to grow and evolve despite academic warnings otherwise ("When Corporate Venture Capital Doesn't Work", HBR, 1983[21]; "Making Sense of CVC", HBR, 2000[22]) with a much larger and diverse universe of small and large corporations participating in many different transactions, stages and industry/technology/geographic sectors of CVC equity investment.

Section II: Earlier "Classic" CVC articles

II.A. The First and Second Wave of Corporate Venture Capital

The first and second wave of Corporate Venture Capital were closer to ripples, than discernable waves—as few as 70 major companies participated in corporate venture management in the entire 1961-1988 time period, with the maximum number of new venture divisions being 12 in 1967-1968. In Garvin's HBS Note on the Corporate Venture Capital Industry[23], Exhibit 3 illustrates "The Rise and Fall of New Venture Divisions, 70 Major Companies, 1961-1988". Using three sources (Gee, "Finding and Commercializing new Businesses,"[24] p. 50; Fast, "Pitfalls of Corporate Venturing,"[25]p.21 and Jones and Wilemon, "Emerging Patterns in New Venture Management,"[26] p. 15), this diagram showed the first wave of rapidly increasing and then decreasing numbers of new venture divisions as occurring between 1963-1974 and then a somewhat smaller wave between 1978 and 1988. Given that the scale used was between 0 and 14 new venture divisions, the first and second wave had a net difference of 10 groups between the peak and the trough of the waves shown. The captions indicate that in the late 1960s, the typical new venture division lasted only 4-5 years and in the 1970s and that 25% of the Fortune 500 had a venture management operation. .

The wave-like or cyclical pattern of the number of venturing programs within the Fortune 100 corporations can be explained in the following way. First, in the late 1960s, corporations such as Exxon and GE, engaged in corporate venture capital to gain a "window on technology". It is estimated that more than 25% of the Fortune 500 companies had a corporate venture capital activity in the late 1960s and early 1970s. Following a collapse in the IPO market in 1973, returns on venture capital declined and many corporate venture capital programs were soon dissolved. Of course, new commitments of venture capital strongly correspond to what is happening in the public equity markets—the early 1980s and much of the 1990s were periods of rising stock market values, high levels of new investment in the capital markets, and high levels of IPO activity. The late 1980s was a period of lower economic growth and a generally less active capital market.

The roughly 10 year cycle or investment wave is also related to the investment process of the typical venture capital fund. Most venture capital funds are intended to last about 10 years. The fund begins on the date of the first closing when the first capital call is made. The next 2-3 years are spent searching for, evaluating, negotiating and investing in portfolio companies and making additional capital calls for funds to invest in promising deals. The subsequent 4-5 years are dedicated to value creation—managing and monitoring investments, recruiting management, assisting with external relationships and additional financing for expansion and later stages of development. The final 2-3 years are related to harvesting the investment with the first preference being IPO and other exit strategies including acquisition, LBO and liquidation. At this time, proceeds are distributed and gains realized. Often the long harvesting window allows the fund more options in timing given market conditions and company-specific factors.

II.B. The Second Wave of Corporate Venture Capital: the 1980s

Corporate venture capital programs started to heat up again in the early 1980s. The second wave of CVC took place in the 1980s when it was viewed as a diversification tool. Both Exxon and General Electric, closed their corporate venture capital operations in the same period. Two important and much-cited articles attempted to analyze and extract the lessons learned from Exxon and General Electric, especially as these corporations were experienced investors and industry leaders exiting at the very time that other corporations were eager to start and fund new corporate venture capital programs. The first, titled, "When Corporate Venture Capital Doesn't Work", was authored by a general partner of an independent venture capital firm, an executive from a portfolio company funded by the exiting GE venture capital group and a HBS professor (Hardymon)[27]. The second, titled, "The Anatomy of a Corporate Venture Program: Factors Influencing Success" was authored by Hollister Sykes[28], the manager primarily responsible for the initiation of the Exxon new ventures program and its management and evaluation of its 37 portfolio ventures initiated between 1970 and 1980. Unfortunately, as the HBR article was published in 1983 and the Sykes article in 1986, these insightful analyses may not have had much impact on the second wave of corporate venture capital

activity. Investment and formation of corporate venture capital groups peaked in 1986 when 12% of all total venture capital investments were managed by corporate venture capital programs.

II. B. 1. "When Corporate Venture Capital Doesn't Work"[2930], was the provocative title of the HBR article published in May/June 1983 that argued that "stand-alone" corporate venture capital groups should not be used to achieve corporate diversification. Using the examples of Exxon and General Electric, the three authors (a general partner of an independent venture capital firm, an executive from a portfolio company funded by GE venture capital group and a HBS professor) observe that many of the arguments for a successful venture capital operation---opportunity for new, high potential businesses; decreased problems of integration if a portfolio company is acquired later; innovative practices and higher risk market access----are nullified by a Catch-22 organizational mismatch. In short, "for the venture capitalist to develop a portfolio of healthy companies, a CVC requires a good deal of autonomy. But a CVC's independence will, to a large extent, reduce its value to the parent…" (p.120).

This 1983 article concludes that, contrary to the oft-cited 1981 Strategic Management Journal article (Rind, Kenneth "The Role of Venture Capital in Corporate Development", vol. 2, 1981,p.169), the challenges of (1) a restricted universe of investment opportunities; (2) problems of acquiring companies from a venture capital portfolio; (3) the difficult in obtaining technology from companies in a venture capital portfolio; (4) the irreconcilable conflicts between the organizational needs of a diversification program and those of a portfolio investment program end up undermining the best intentions and motivations of corporate venture capital groups. The authors conclude that Corporate Venture Capital as a strategic diversification tool was not particularly well suited to "reinforcing or extending competitive strengths or altering significantly a risk/return profile."(p. 116) but that corporations, such as GE, have managed to find some financial success by replicating the conditions of the "stand-alone" venture capital firm as much as possible. The authors observe that Exxon, was the only company in their study that had acquired companies from its venture capital portfolio as part of a planned diversification

effort, but that after well over a decade in business, Exxon Enterprises was still not considered a financial success and gave up venture capital in favor of internal venturing.

II. B. 2. In 1986, Hollister Sykes[31], the manager primarily responsible for the initiation of the Exxon new ventures program and its management and evaluation of each venture's technology, markets and personnel, published the article, "The Anatomy of Corporate Venturing Program: Factors Influencing Success", in the Journal of Business Venturing (JBV 1, 275-293, 1986).

He presented a classification framework for factors that affect corporate venture success and applied this statistical analysis to a database of 37 new venture investments by Exxon that were initiated between 1970 and 1980, with 18 being venture capital and 19 internal investments. The program was considered by Exxon to be "a mixed success—a number of the ventures were technically successful, a few were financially successful, but none provided Exxon with a large, successful diversification business. The program was essentially terminated in 1981 and over the next few years most of the ventures were sold or liquidated." (p. 276).

The Corporate Parent's Perspective. Sykes' classification framework revealed the corporate parent's perspective on corporate venture capital. The framework defined the key targets of corporate venture capital research as being the individual venture startup's market success and tying that to characteristics of the corporate parent's domain expertise, core competences and technologies compared to the new venture's needs -- competences and risk-reducing previous experience in specific business, management, marketing and/or technology sectors. The two groups that he viewed as critical to corporate venture success were the corporate parent and the new venture.

Surprisingly, the intermediary organization—the stand-alone corporate venture capital group or subsidiary within Exxon (Exxon Enterprises) that Sykes likely reported to, and which typically would have had responsibility for the initial evaluation and decision to

fund 37 internal and external ventures, is never described separately or differentiated from the corporate parent, Exxon.

Sykes first categorized the factors influencing success—-- into two main areas—(A) Extrinsic and (B) Intrinsic. Venture success was rated in two categories; technical success and financial success based on the status of the overall venture program at the end of 1982. Because of the different status of each venture as of the end of 1982, some in R&D and some with sales, use of a 1982 ROI was considered less meaningful by the author and instead, market value, assessing the potential for the venture, was used in the rating of financial success.

(A) **The Extrinsic Factors** were defined as the distance (very similar or very different) between the corporate parent and the new venture's

(a) technology
(b) market
(c) organizational structure and level of autonomy
(d) personnel background

Sykes rated all of the Exxon ventures in Table 3 as having a very "unlike" or "extremely" different (a) technology; (b) market; (c) independent organization with its own development, manufacturing and sales personnel and facilities; (d) personnel background, since virtually all key managers were recruited from outside Exxon. He lists all of the Exxon ventures as being highly "unlike" Exxon in technology, market, organization and personnel. Only 2 of the ventures—in the energy area—could be observed to be in somewhat "familiar" technology areas or draw some managers from the Exxon parent. His Table 3 makes an illustrative comparison to the IBM PC venture which he describes as being very similar to IBM in Technology and Personnel and somewhat similar in Market and Organization. The author points out that the dissimilarity and high degree of independence accorded to the venture startups were initially an advantage since important new growth business areas were identified and developed at an early stage, but that this autonomy later proved to be a liability making acquisition and integration of new

opportunity areas difficult and spawning product compatibility issues and difficulty in coordinating sales efforts for overlapping products in overlapping markets.

(B) The Intrinsic Factors. Sykes hypothesized that Intrinsic Factors, defined as the "properties of each of the new ventures" were also critical and their importance in the financial and business success of Exxon's new ventures, potentially under-estimated. He quantified and analyzed both product-related factors—
(1) the degree to which the technology was developed,
(2) the level to which to market had been proven and
(3) the number of year projected from initial investment until sales;

as well as the new venture's own managerial factors—
(4) the key technical management's experience in the new venture's technology
(5) the average experience of the key sales and marketing managers in the new venture's market
(6) the general level of management experience in the new venture's management team

Intrinsic Factors Critical to Success. Sykes' article had several significant key findings for corporate venture capital parents as well as CVC and internal venture managers. Exxon's experience and data provided strong evidence that Intrinsic Factors—and specifically, the portfolio company venture managers' prior experience in the target market area and their general managerial experience, rather than their technical expertise or technical familiarity—was key to building and making successful new corporate ventures and opportunity. Secondly, that the selection and recruitment of experience personnel for the new venture area as well as the granting of a large degree of autonomy was more critical to success if an analysis of the Extrinsic Factors revealed that the new venture was highly "dissimilar" and it lay "well outside the corporation's experience" in the requisite technology, market, organizational structure and personnel background for that base business and industry.

Future Research Directions. In the conclusion of this 1983 seminal article, Sykes points out several directions for future research that turn out to be quite prescient in the next few decades of CVC research.

First, he notes that a larger cross-company comparison of Extrinsic Factors—comparing a wider range of variability between corporate parents and their venture company startups and portfolios of investments—would be important to further test the congruence concept. He hypothesized that the independence and autonomy of the portfolio company should be correlated to the corporate parent's experience and history. Specifically, he argues that the relative experience level and organizational, technology and management "similarity" of the corporate investor parent's core business should be measured and analyzed in comparison to the investee, the venture's business and industry. This comment may have catalyzed the more recent CVC research that analyzes corporate parents' "core" technologies and their motivation and outcomes in investing in market and demand-enhancing portfolio companies with "complementary" and "systemic" rather than "competing" technologies.

Much later work finds that the success of corporate programs are linked to a "strategic overlap" between the corporate parent and the portfolio firm (Gompers and Lerner[32], "The determinants of corporate venture capital success: Organizational structure, incentives and complementarities" NBER).

Not surprisingly, the more general corporate parent-venture congruence or fit concept resurfaces in many of the organizationally focused "best practices" studies of corporate venture capital. For example, "close-coupling" and strategic fit between the corporate parent and its portfolio companies is identified as a one of the success dimensions in the case study-oriented article and 2x2 matrix central to the HBR article "Making Sense of Corporate Venture Capital" (Chesbrough, 2002[33]).

Second, the author points out that a more detailed or "graduated" scale to rate the differences between "gasoline vs. semiconductor ventures" (as in the case of comparing

Exxon's ventures with IBM ventures in the article) or "computer versus communications" (used in the article as an illustrative example of a more similar or even potentially related or converging industries) would be very useful for further research. This comment seems to emphasize the importance of focusing future CVC research on high-growth industries and newer emerging technology sectors since "the increase in likelihood of failure with increases in technical and market risk make sense…[but]… the opportunities for creating major new growth businesses are more likely to be found by entering new markets with new technologies, e.g. Xerox, Polaroid, Texas Instruments, Digital Equipment Corp…."

Third, the author reminds his audience that the "measures of success can be ambiguous". Sykes, drawing upon his extensive management and inside knowledge of Exxon's ventures, decided to:

(1) rate success individually for each of the ventures he analyzed;
(2) measure "overall program success" rather than the percentage count of failures, since in a portfolio, 20-30% of the ventures account for most of the portfolio capital gains and one big winner can justify many losers if the losers are teminated at an early enough stage;
(3) measure financial success by the market value of the venture not by long term return on investment, since this market value is more interesting to the corporation than ROI or IRR, the measures used by independent venture capitalists.

Section III: Corporate Venture Capital in the 1980s---Investment Partners or Clones of Independent VCs?

Two "classic" articles published in 1988, both in the same issue of Journal of Business Venturing mark an important fork in the road for corporate venture capital research.

III. A. CVC as Investment Partners

The 1988 article "Venture Capital Investing for Corporate Development Objectives", written by two practicing venture capital investors, Terry Winters of the Columbine Venture Fund and Donald Murfin of the Lubrizol Enterprises corporate venture investment group (Winters & Murfin [34]1988: JBV 3, 207-222), was one of the first to use the larger corporate program statistical database of the Venture Economics group (76 corporations) to focus on trends in the corporate development equity investment area (300 direct investments in 1986 worth $400M) and to include performance information on the "exit routes of venture capital-financed companies" as the yearly number of acquisitions and initial public offerings in the years 1980-1987.

In the period, 1984-1987, the number of acquisitions were significantly higher than the number of initial public offerings, and this acquisition "all-time high rate" was leading to renewed corporate involvement in the venture capital process as an information, knowledge acquisition route for better evaluation and assessment of the "competition and general business climate in technology-based fields" (p.212).

The 1988 Winters and Murfin[35] article created a framework for corporations to turn their attention to the explicit organizational structure used for corporate venture capital investments. The article provides an explanation and comparison between 5 distinct corporate venture capital strategies along with their pros and cons for corporate parents. The first option is sometimes called "indirect corporate venture capital" since the corporate parent invests as a limited partner in a venture fund. Options 2,3 and 4 are often referred to as "direct corporate venture capital" because the corporation is directly investing in external companies and startups—through their own fund, subsidiary or co-investment. Option 5 is sometimes referred to as "corporate venturing or corporate intrapreneurship" because investment is made in a startup where the personnel or entrepreneur has come from inside the corporate parent, such as from the R&D group.

The 5 distinct corporate venture capital strategies described by Winters and Murfin are:

1. investing capital in other independent venture funds (becoming one of the limited partners in a venture capital limited partnership fund)

2. investing capital and funding the corporation's own stand-alone venture capital group or subsidiary (funding a "captive" fund where the corporation is the sole limited partner and the general partnership or investment managers are compensated in profit-sharing and invest autonomously, similar to a professionally managed independent venture capital fund). These corporate funds can initiate or lead deals or simply co-invest.
3. organizing a venture development subsidiary, capitalized by the parent corporation, whose mission is to create new business opportunities through venture capital investing, technology transfers or acquisitions. This subsidiary will likely invest in venture funds as well as venture companies and will typically invest alongside other venture capitalists.
4. direct equity investment in external companies and startups, but organizationally not formed as a separate entity. Sometimes direct equity investments follow strategy 1, where co-investment opportunities in portfolio companies are generated by investment in venture funds.
5. investing in internal ventures, the corporation totally funds a corporate "intrapreneur" and leverages corporate resources for an internally based startup.

Table 6 within the article compares each of these five abovementioned strategies along the dimensions of

(a) people required (internal or external experience)
(b) $ required (from $5-20M)
(c) Deal stream (how many opportunities would typically be evaluated per year)
(d) Number of portfolio companies (from few to 120)
(e) Financial return (from low to 22.5%/year)
(f) Prospective contacts (from very narrow and limited to wide)
(g) Key objective (primarily financial, strategic or mixed)

The authors conclude that "the basic problem with a corporation pursing a strategic objective by funding its own subsidiary to act as venture capitalist is not….keeping good people or….financial return. Rather, such an operation typically does not see sufficient

deal flow. No matter how well connected to the venture capital community, a corporately funded subsidiary will have difficulty achieving the deal stream of a typical venture capital fund…about 300 per year. A corporation cannot hope to maximize the strategic benefits detailed above unless it sees a large deal stream…Similar comments apply to the number of companies in a corporation's portfolio. Investments in funds give an indirect investment in about 30 companies per fund…"

The article summarizes that, in the view of the authors, the highest probability of strategic success lies, not in a particular organizational form or decision-making process or in a particular targeted investment strategy focused on technologies, industry sectors or stage of development, but in several general cross-cutting factors. Interestingly enough, the executive summary of the article assumes that "both entrepreneurs and venture capitalists welcome…(corporate investors as a)…source of later-stage capital, providing minimum equity dilution and assisting in product development, marketing and liquidity for their investment…"The main success factors identified by the article are:

1. Maximum exposure to high-quality deals
2. Management of the corporate venture capital operation—with the emphasis on the technological and business expertise as well as the reputation and venture capital community interface skills of the corporate venture group individual investment managers.
3. Active involvement with the venture community—a high level of proactive involvement to create more investment opportunities that lead to strategic success.
4. Long term commitment. Venture capital is a long term discipline (7-10 year terms for a LLC partnership) and poor investment decisions are made when there is a short term pressure to "put the money to work".
5. Selection of investment partners—"a cardinal rule should be to seed solid investment partners and never to invest alone in early-stage situations…the breadth of knowledge, contacts and skills made available via a syndicate investment is priceless…"(p. 220)
6. Internal communication. To reduce the NIH syndrome, executive and operating management need to be continually informed and committed to the program.

Compared to Sykes' 1986 article drawing upon the Exxon portfolio experience and focusing on "intrinsic" management of the portfolio company and the "extrinsic" fit between the funding corporation and the portfolio company, Winters and Murfin highlighted the importance of the existing venture capital industry as a source of deal flow and deal quality (item 1 and 3 above) and as co-investors in a syndicate investment and in a network of relationships or community (item 2,3 and 5 above). Additionally, this article identified the corporate investor as attractive in "later stage" rather than early stage financing due to the minimum impact on equity dilution at the same time as providing corporate access to resources and quicker time-to-liquidity

Additionally, Winters and Murfin defined a set of common problem areas and pitfalls. Surprisingly, item 1—inadequate definition of strategic versus financial benefits--would continue to dominate research attention, whileas items 2-8 (ranging from investor-entrepreneur relationship to decision-making responsivessness issues) seemed virtually ignored in the subsequent academic research articles as determining factors in failure:

1. inadequate definition of strategic versus financial benefits
2. corporate arrogance towards entrepreneurs
3. unsuitable venture subsidiary management since the individuals who interface between the corporation and the venture capital community are probably the single biggest determinant of success.
4. lack of response to investment opportunities in a timely fashion.
5. large dollar deals—savvy venture capitalists assume the greatest risks with the least amount of capital and spread risk across a large number of investments.
6. fear of failure—there will be failure so investment size needs to be coordinated with risk level.
7. high-level decision making—investments should not be made too quickly especially under pressure from corporate execs who do not have firsthand knowledge of the people and the deals.

8. investing alone—it is not advisable to invest alone, in times of trouble, it is advantageous to have several independent minds working toward solving the problem.

This often-cited 1988 article seems to quite clearly and forcefully point out that the key direction for future empirical research should primarily be in the areas of how corporate venture groups interface and effectively leverage the external outside-of the-corporation technology and industry knowledge and deal access, resources and capabilities of the venture capital community. In summary:

1. how corporate venture capital groups can maximize exposure to high-quality deals and deal flow
2. improving the selection and performance of corporate venture capital group managers—adding a third dimension of relationship-building, social reputation and interface capabilities with the venture capital community as being even more critical than the venture-specific business management, marketing and technical expertise already investigated and analyzed by Sykes 1983 article.
3. improving the frequency and intensity of relationship, involvement, long term commitment and reputation especially in early-stage syndication co-investments between the corporate venture capital individuals and their independent venture capital counterparts and network.

So this 1988 article highlights the importance of the network or community relationship between the individuals in the corporate venture capital group and the key outside source of information, competitive knowledge and deal flow—the independent venture capital community—to performance success.

Almost as a "last but not least" success factor, the area of how corporate venture groups interface with their corporate parents is mentioned but not as strongly. Item number 6 in the list of key strategic factors in corporate venture success is "improving the internal communications". The accompanying explanation points out that marketing, promoting and championing of the corporate venture capital program, using periodical status

presentations can minimize the possible opposition of operating groups and executives within the parent corporation.

III. B. CVC as "Clones of Independent VCs"

The two articles published by the Journal of Business Venturing a few pages apart in 1988, Winters and Murfin's "Venture Capital Investing for Corporate Development Objectives" (p. 207-222) and R. Siegel et al's[36] "Corporate Venture Capitalists; Autonomy, Obstacles and Performance" (p. 233-247), marked an important fork in the CVC research road because practitioner-authors Winters and Murfin concluded that the main factor in CVC success was the linkage and close interaction between the CVC group and the existing venture capital community, whileas the Siegel, Siegel and MacMillan academic study concluded that the main factor in CVC success and performance was the autonomy and independence of the CVC group from the funding corporate parent.

The 1988 article called "Corporate Venture Capitalists: Autonomy, Obstacles and Performance" took a very different approach from Winters and Murfin to addressing and analyzing the success factors for corporate venture capital in the U.S. The academic research authors (Robin Siegel, Eric Siegel and Ian MacMillan of the Wharton School) hypothesized that the autonomy of the CVC in relation to its corporate parent would be a significant determinant of effectiveness of the venture activity. This hypothesis was tested by dividing the corporate venture capital community (52 U.S. corporate venture capitalists) into two broad categories—"pilots", groups that were characterized by substantial organizational independence (38% of respondents) and "co-pilots", groups that were highly dependent on corporate management with respect to venture funding and decision authority (62% of respondents).

The1988 Siegel, Siegel and MacMillan survey had two major findings—first, autonomy and firm commitment of capital (the pilot approach) are necessary conditions to provide an environment conducive to effective corporate venture capital operations and second, the pilot approach was successful in producing both financial benefits—measured as

return on investment-- as well as several strategic benefits—self-measured performance on goals such as (1) exposure to new technologies and markets and (2) opportunities to manufacture and market new products. The co-pilot approach had slightly better results in the strategic benefit of identifying (3) acquisition candidates and neither pilot or co-pilot corporate venture capital approaches were highly successful in generating the strategic benefit of (4) opportunities to improve manufacturing processes. In the body of the article, the authors point out that "the fundamental differences between CVC criteria and those of independent venture capitalists is that CVCs will sacrifice financial and entrepreneur quality criteria to achieve strategic fit for the corporation. As we shall see below, this is a sacrifice of dubious value…"

The authors point out that their results require further study to determine how a few CVC co-pilots and pilots achieve outstanding performance relative to strategic benefit as well as how CVCs successfully integrate financial and strategic considerations and which benefits are most likely to be achieved. However, the actual direction of a large body of continuing research in the CVC field seem to follow the more simplistic statement made in one of the earlier concluding paragraphs, just before the pleas made for further study:

"At this point, one might conclude that if corporate venture capital is to be successful, CVCs should simply be made clones of independent capitalists…"

Unfortunately, given the promising avenues for further research uncovered in these two classic articles in 1988, overall interest in CVC research waned as the second wave of corporate venture capital activity ended. Many of the corporate venture capital programs were quickly dissolved after the stock market crash at the end of the 1980s.

Section IV.

IV. A. The Globalization of Corporate Venture Capital: Insights from the UK

The 1997 book, "Corporate Venture Capital: Bridging the Equity Gap in the Small Business Sector" (McNally[37], London and New York: Routledge, 1997) that resulted

from Kevin McNally's PhD thesis in the Geography department of the University of Southampton provides evidence of the broadening inter-disciplinary and multi-national nature of research into corporate venture capital and entrepreneurship. This book, following the primarily European-based research streams in inter-firm collaborations, positions corporate venture capital as a particular form of collaboration between large and small firms involving minority equity stakes taken by the large company in investing in small startup and entrepreneurial firms.

Although the sample size used in the studies detailed in the book's Chapter 3, 4, 5 and 6 is not very large, being focused on the relatively nascent UK CVC industry, the comprehensiveness of the study is admirable. Chapter 3 contains an empirical study using survey methods to compare the state of CVC in the UK with the US, Chapter 4 looks at the characteristics and patterns of CVC investment in the UK, Chapter 5 uses a newly developed data set to analyze the advantages and disadvantages of indirect CVC investment from the point of view of the fund manager and Chapter 6 uses yet a third primary data set to consider the investee or portfolio company's perspective and the motives of small technology based startup firms in establishing a corporate venture capital relationship with a large corporate investor.

Like the earlier referenced Shrader and Simon article, McNally highlights the distinctions between corporate venture capital and corporate venturing, pointing out that his study is the first to use a database of 109 UK-based companies exclusively involved in corporate venture capital, defined as having a large corporate parent take an equity stake in a small external entrepreneurial startup.

71 of the companies originally contacted for the study were UK companies and 38 that were subsidiaries of foreign corporations. Seventy-three companies ended up participating in the survey—19 UK and 9 foreign corporation subsidiaries—which involved semi-structure questionnaires administered via face-to-face and telephone interviews. Face to face interviews were conducted with most of the 28 companies that had made CVC investments due to the quantity of information required. These 28

companies represented a broad range of industries—six utilities, five computer/electronic firms, four engineering companies, three gas/oil companies two transport and distribution companies and two iron and steel companies with the remaining companies active in diversified fields from toys to plastics.

IV. A. 1. UK v. US Corporate Venture Capital Industry

McNally's first set of findings in Chapter 3 provides detailed information quantifying and comparing the state of CVC in the UK with the known characteristics, objectives, level of investment and strategies of the US corporate venture capital industry. He points out that during the late 1980s and early 1990s, large US corporations had become an important source of venture capital for entrepreneurial companies so that CVC was now a "well-established and widely accepted tool of corporate strategy in the United States." (quoting Collins and Doorley 1991: 186). He also cites Rind, 1994 in highlighting how the stock market declines of 1970, 1974, led to the exit of many large corporations such as Alcoa, Dow, DuPont, Ford, General Dynamics, Mobil, Monsanto, Singer and Union Carbide, who then re-entered in the early 1980s, including new entrants such as Johnson and Johnson, 3M, AT&T, IBM and Lubrizol. The European Venture Capital Journal in 1990 refers to the 1980s as a transition period where the pioneering programs were restructured and many companies began experimenting with their own internally managed programs, having learnt about the process from indirect investments.

According the Block and MacMillan[38] (1993), approximately half of the US companies that have made CVC investment have used the direct approach, while the other half have invested indirectly. Mast[39], 1991 noted that this might also be the result of an increasingly phased approach to corporate venture capital investment where companies tend initially to invest in externally managed funds and then move towards direct investment later.

McNally concludes that the motivations of companies in the UK for making venture capital investments are largely strategic, supporting the findings of numerous researchers

in the US (Rind, 1981; Siegel et al, 1988; Sykes, 1990, Mast, 1991; Block and MacMillan, 1993; Silver[40], 1993).

However, in Chapter 3, he finds that, unlike Sykes's 1990 survey of US CVC, his survey found an important distinction between the objectives of direct and indirect CVC. Specifically, the executives running direct, internally managed investments found that this arrangement offered more contact with investee portfolio firms and more control. Direct CVC was a good fit for large companies seeking primarily strategic objectives targeting a small number of relevant technologies and/or markets. In contrast, executives managing indirect investments and externally managed investments found that this provided greater deal flow while requiring less management time and resources. These Indirect CVC investments seemed best suited to either companies with social responsibility related objectives or companies new to CVC and seeking to learn and gain expertise about venture capital. Indirect CVC investments also seem preferred by large companies motivated by particular strategic aims requiring strategic breadth, as in the opportunity to gain windows on a wide range of new technologies. Additionally, McNally concludes that CVC is an underdeveloped strategy with a lower level of CVC investment in the UK, particularly in comparison to the alternative development strategies such as acquisition, internal business development.

IV. A. 2 Performance and stage of investment of direct v. indirect CVC

McNally's second set of findings in Chapter 4 provides detailed examination of the corporate decision-making process used by UK investors in the CVC process, an identification of the performance of past investments and finally, the general characteristics and patterns of CVC investment in the UK. The survey results indicate that poor investment performance—often due to the inappropriate choice of investment method and unrealistic objectives—has resulted in disillusionment with the CVC process and early withdrawal from CVC activity. Despite the seeming potential of CVC to "bridge the equity gap" for early stage high technology small business startups, McNally's UK survey found that a majority of indirect CVC investments were made in early stage technology firms, but that direct CVC investments (the ones that tended to be

more strategic and involve closer control and contact between the corporate investor and the portfolio company), were far more likely to be made in later stage companies operating in medium or low technology sectors.

McNally's third set of findings in Chapter 5 focus on the advantages and disadvantages of indirect CVC (the corporation investing as a limited partner into an independent venture capital fund) from the point of view of the vc fund managers. Although theoretically, the role of non-financial companies as indirect providers of finance for high risk firms is evident, McNally questioned fund managers on the actual ability of corporate investors to provide fund managers with value-added strategic benefits such as industry-specific knowledge, technical skills and advice as well as an exit route. Arguably, these kinds of benefits indirectly increase the value of the investee firm. The results of the UK survey suggests that the disadvantages of indirect CVC investments seem to outweigh the potential strategic advantages. The survey found that relatively few fund managers were interested in targeting non-financial companies as limited partners for future funds and either did not see evidence of these value-added strategic benefits or had been discouraged by poor previous experiences or lack of corporate commitment.

IV. A. 3. The portfolio company's perspective on large corporate investors

Finally, McNally's fourth set of findings in Chapter 6 looked at the investee or portfolio company's perspective and the motives of small technology based startup firms in establishing a corporate venture capital relationship with a large corporate investor. Forty eight UK firms agreed to participate in this study. The majority of the sample classified themselves as technology-based enterprises, operating in high technology industrial sectors, ranging from medical, computers, acoustic, electronics, biotech, and electricity generation. The survey found that direct investees, typically had approached potential corporate investors where they had an established business relationship due to supplier or R&D collaboration agreements. Factors of importance included size of investment, industrial sector of investor, percentage of equity sought by investor, investing company's objectives, willingness of investor to provide further rounds of

finance, investing company's previous CVC experience (Table 6.12, Factors taken into account by direct investees when finally selecting corporate investors, p. 184).

Key value-added benefits perceived by portfolio companies

When negotiations were finished, the portfolio company considered credibility, help with short-term problems, access to corporate technical expertise, opportunities to establish further business relationships and access to corporate management expertise and access to corporate marketing/distribution networks as being important advantages of the direct CVC over other forms of equity financing. The portfolio company also perceived that the direct corporate investor had the following primary motivations---financial return on investment, exposure to new technologies, access to new markets, identification of new products—among many other more secondary goals.

After direct investment, the UK portfolio companies surveyed had found that they had benefited in many other ways than just financial—they placed particular emphasis on the credibility that they had gained from their linkage with a major or large multinational corporation, the help they had with short-term problems, their access to management and technical expertise as well as the markets and distribution channels of investing companies. Portfolio companies also benefited from the patience and understanding of corporate investors and the relatively high valuation of their equity.

Complementarity with other sources of financial funding

McNally concludes that these "non-financial value-added aspects of direct CVC suggest the complementarity of this form of investment with other, more conventional, forms which offer the benefits of more financially oriented advice and management expertise". Indirect CVC portfolio companies did not seem to benefit as often from the value-added offered by corporate investors, seemingly as a consequence of the lack of contact and control of indirect corporate investors and limited partners in the independent and autonomous venture fund manager's deals.

IV. B. Within a single industry, are external and internal ventures different?

In 1997, the article, "Corporate versus Independent New Ventures", authored by Rodney Shrader and Mark Simon argued that even within a single industry, ventures established by independent entrepreneurs were significantly different than corporate ventures, controlled by a larger company.

The Shrader and Simon[41] article was an empirical study comparing independent ventures (IVs) established by individual independent entrepreneurs and corporate ventures (CVs) that are controlled by larger companies and typically established by internal entrepreneurs. The study uses a matched sample of 30 CVs and 30 IVs in the computer and communications equipment manufacturing industries to analyze for significant differences in the two groups'

(1) performance (measured by growth in sales and return on sales) ,
(2) resources (capital sources, proprietary knowledge, marketing expertise and brand) and
(3) strategies (strategic breadth, specialized product, service, low cost).

The relatively surprising findings were that measured performance was very comparable, controlling for age and stage of development and both venture types could be equally successful, but that the managers of these different groups followed very different roads to success. Resources and internal vs. external funding were not directly significantly related to the performance of either type. For example, CVs placed greater emphasis on internal capital sources, proprietary knowledge and marketing expertise, while placing less emphasis on development of brand identification. IVs placed greater emphasis on external capital sources and development of brand identification. For corporate ventures, emphasis on strategic breadth and low cost had a negative impact on performance. For independent ventures, emphasis on customer service and specialty products had a positive impact on performance, possibly providing the means for them to differentiate themselves, pursue focus-type strategies and make the best use of their limited resources. The results of the study indicate that corporate ventures and independent ventures, even within the same industry, systematically differ in the resources that they emphasize and the strategies that they leverage for differentiation.

The importance of the 1997 Shrader and Simon article for corporate venture capital research is that it demonstrates that venture origin—external or internal—(and by extrapolation, corporate versus independent sources of venture capital funding) is an important source of difference in resources, strategies and performance even within the same industry.

This calls into question corporate venturing studies (even the more recent LBS 2002 study and Chesbrough's HBR article) where the researchers have treated new ventures as homogenous, and have combined both types of ventures—external startups as well as corporate ventures within single studies, potentially masking important relationships among resources, strategy and performance.

IV.C. New Empirical Evidence from VentureOne for private company transactions in 1983-1994 time-period (Wave 2)

One of the largest empirical studies of corporate venture investments was published by Paul Gompers and Josh Lerner[42] as a NBER Working Paper No. 6725 in September of 1998 and titled "The Determinants of Corporate Venture Capital Successes: Organizational Structure, Incentives and Complementarities".

This 1998 paper was one of the first research studies to analyze differences in corporate venture capital investments and independent venture capital investments using the sample of thirty thousand transactions in a database by VentureOne, a firm established in 1987 to collect and market data on firms that had obtained venture capital financing. The transactions in the original database included firms that had received early stage equity financing from independent venture capital organizations, non-financial corporations' corporate venture capital programs and other investors such as individuals, institutional investors such as pension funds, government bodies and hybrid funds affiliated with commercial and investment banks. The authors used an unpublished database of venture organizations assembled by Venture Economics' Investors Services Group to exclude a

variety of private equity investors, individuals, SICs and fund sponsored by banks and other financial institutions to arrive at a database containing only corporate venture capital groups and independent venture capital funds making investments in privately held firms between 1983 and 1994.

In their examination of historical trends in CVC, Gompers & Lerner (1998) identified a later Third Wave of corporate venture capital activity that seemed to start rising in 1993 and peaked at 25 Fortune 100 venturing programs announced in press accounts in the Corporate Venturing Report and elsewhere in 1998. However, their empirical paper and the findings described here were based on transactions made in the period of 1983-1994, the Second Wave of corporate venture capital activity.

The large-scale empirical analysis conducted in this 1998 paper compared investments by corporate venture organizations with those of independent and other venture groups to test a number of hypotheses and findings that had emerged from earlier, smaller sample corporate venture capital studies. In the database, investments by independent venture funds represented over one-half of the total transactions in the sample. Corporate venture capital investments represent a much smaller number, having a share of about 6%, Because, typically four investors participate in each financing round, the number of rounds represented, 8506, is significantly smaller.

In general, the corporate investments closely resembled those of other funds in status at time of investment, location of firm, industry of the firm and maturity of the firm and stage of investment characteristics. Corporate venture investments with a strategic focus tended to focus on a few high-technology industries. Corporate venture funds tend to invest in later and larger financing rounds and in slightly older firms than other venture funds.

There were a number of important surprises as well as findings that either ran contrary to popular perception or raised questions about the possible collinearity and interdependence of prior research explanatory factors of success and failure:

1. First and foremost, corporate venture investments in entrepreneurial firms appear to be at least as successful (using a different and quantitative non-self-measured performance measure such as the probability of the portfolio firm going public) as those backed by independent venture organizations. Firms backed by corporate venture groups are significantly more likely to have gone public than those financed by other organizations and less likely to have been liquidated.
2. Specifically, corporate venture investments characterized by strong strategic overlap (as measured by technological relatedness via the IPC industry segment patent measure) have a measurably higher probability of success (as measured by public filing or acquisition at a valuation twice the post money valuation of the financing) than non-related corporate investments. Corporate venture investments in general do not perform better than independent venture groups, only those with a strategic fit. Additionally, the corporate venture programs characterized by strong strategic overlap in the portfolio companies appear to be as stable in duration as independent venture organizations.
3. The investment premium (measured as pre-money valuation) paid by corporate venture capitalists over other investors is not higher in corporate investments with a strong strategic overlap, only in corporate investments in unrelated or non-complementary areas.
4. Corporate venture investments not characterized by strong strategic overlap are less successful and the investment programs they are associated with appear to be much less stable, frequently ceasing operations after only a few investments.
5. The existence of a subset of corporate funds with a strong strategic focus having the same levels of performance and success as independent venture organizations challenges the emphasis in the finance literature on the importance of the partnership structure and compensation scheme employed by independent venture capital funds to performance.

The authors explain the combination of Findings 2 and 3 above by suggesting that corporations are likely more savvy investors in portfolio companies that are close to their

existing lines-of-business, resulting in fewer overpriced transactions. In areas outside the corporation's expertise, overpaying for investments may be more common.

The authors also point out that Finding 4 may also explain the poor performance and limited duration of corporate venture organizations with a low degree of autonomy—called co-pilots in the previously mentioned article authored by Siegel, Siegel and MacMillan—coupled with a low level of incentive compensation. One possibility offered by the authors is that the corporate venture organizations without a clear strategic focus also tend to be the ones with a low degree of autonomy and low levels of incentive compensation—thus serving as a proxy for the organizational structure employed by the venture group.

Potential Limitation of the 1983-1994 transaction sample

As mentioned in the section detailing Winters and Murfin's study—a different data research house—the Venture Economics group (76 corporations) focused on trends in the corporate development equity investment area (300 direct investments in 1986 worth $400M) and collected performance information on the "exit routes of venture capital-financed companies" as the yearly number of acquisitions and initial public offerings in the years 1980-1987. In the period, 1984-1987, the number of acquisitions were significantly higher than the number of initial public offerings, so potentially venture capitalists were experiencing a higher number of trade sales of their portfolio companies as liquidation compared to their usual exit route of IPO. The high frequency of acquisitions would probably also reduce the IPO likelihood rate of portfolio companies for corporate investors in this period, but not as significantly.

Similar to the studies of how a simple name change to a dotcom in the 2000 period could impact the market valuation at IPO, several savvy corporate venture capitalists asked if the findings could be explained by venture capitalists bringing a few brand-name same-industry corporate investors in to invest right before IPO to raise the market valuation, credibility and guarantee the success of the public offering. This could raise the statistical likelihood of IPO for the portfolio investments of these corporate investors

since these later stage investments are less risky than investing in the early stage. Additionally, the value of the corporate investor would be one of market reputation and signaling. By signalling the public market through a minority equity investment, a strategic investor (with potentially better access to inside information and technology) could raise the perceived value of the privately held stock at IPO. A simple test of this hypothesis would be to statistically control for the stage of investment by the corporate vc versus the independent vc.

By using a sample of transactions from 1983-1994, this empirical study analyzes the second wave of corporate venture capital activity that we know heated up in the early 1980s due to the "mirage" of corporate diversification and improved acquisition performance/integration. Investment and formation of corporate venture capital groups in the second wave peaked in 1986 when 12% of all total venture capital investments were managed by corporate venture capital programs and then abruptly fell off in the late 1980s. As mentioned at the beginning of this section, the early 1980s was a period of rising stock market values, high levels of new investment in the capital markets, and high levels of IPO activity. The late 1980s was a period of lower economic growth and a generally less active capital market.

So although this study was published in 1998, it carefully avoids capturing the unusual effects of the third wave of venture capital activity that took place in the mid 1990s to 2000, spiking quite significantly in the 1998-2000 period due to internet and dotcom investment, rising stock market values, high levels of IPO activity and a surprisingly accelerated period of time between early stage investment and IPO.

Section V. Generalized Best Practice Approach in the Third Wave (1994-2002)

Chesbrough's[43] CMR article "Corporate Venture Capital in the Shadow of Venture Capital", drawing upon newly available VentureOne data, clearly showed that the Third Wave of Corporate Venturing had a much larger number of active CVC investors (519) than the 127 worldwide shown for the 1985 timeframe (includes non-Fortune 100 U.S.

companies) and that the overall size of investments worldwide ($22B) was more than 4 times the size of the previous First and Second Waves ($5B) .

The Third Wave of Corporate Venture Capital seems to have broken through a number of important thresholds, besides sheer size of investments and number of active corporate investors. In comparison to earlier waves, where corporate investment was less than 5% of the total, the % of corporate investment as a proportion of total venture capital dollars invested rose to 15.7%. The number of portfolio firms with corporate venture investors rose by an order of magnitude to 1804 in 2000 from the low level of 112 in 1995. Finally, at $22B in 2000, corporate venture capital investment levels were finally of a magnitude where they rivaled total federal funding for R&D (estimated $30B in 2000), could be an invisible but substantial component of the overall industry R&D funding (estimated $230B in 2000) and significantly dwarfed the academic and other R&D funding in the U.S. (estimated $10B in 2000). A recent NVCA study[44] investigates the contribution of VC-funded firms to the US Economy and estimates that in the year 2000, R&D expenditures by these firms totaled $157.3B and employed 12.5M people in the U.S.

Additionally, Chesbrough points out that the exceptional rates of return generated by venture capital (VC) firms over the past two decades have resulted in academic researchers using these firms as a model of financial "best practice" for private equity investments in high risk emerging technology sectors and as a benchmark to compare the performance of other equity investors, including corporate venture capital groups (CVC).

In particular, Sahlman's[45] pioneering study in 1990 modeled the relationship between the high-risk venture capitalist investor and the portfolio company's entrepreneur-founder as a two level principal-agent relationship and highlighted the value of clearly delineated (by risk and timing) stages of investment and carefully engineered term sheets/contingent contracts that tied continued staged investment to performance and information/control rights. To quickly summarize, Sahlman's two-level principal agent model--In the first level, the venture capitalist investor is the principal and has informational problems or

encounters information asymmetry/adverse selection in evaluating the entrepreneur/portfolio company. In the second level, the venture capital firm is an agent, being a financial intermediary with its funds coming from a range of "limited partners"--institutional limited partners (pension funds, etc), corporate limited partners (corporations) and angels (wealthy individuals) and undergoes the risk of not attracting further funds if it does not perform satisfactorily.

We can extrapolate that the corporate venture capital group experiences the same principal agent issues as other high-risk venture capitalist investors, with the added informational issues posed by relationships with co-investors who are independent vc funds (different motivations, stage of investment and hurdle rates) and higher probabilities of early termination for both financial and non-financial reasons (change in executive team or champions, for example).

In contrast, the independent fund typically has a contractual term of 7-10 years and will start raising follow-on funds II, III, IV, etc as soon as they can show a positive ROI or significant distributions. Wright and Robbie, 1998[46] have made a comprehensive recent review of the stream of literature focusing on venture capital and private equity financial principal-agency issues.

For the purposes of this literature review and for future empirical studies, it is important to mention the linkage between the theoretical principal-agent models, transaction cost economics and the "best practices" design of term sheets and contracts followed in the venture capital industry when investing in high-technology and in early stages. Kaplan and Stromberg[47] in 2000 considered detailed information on 200 venture capital investments in 118 US companies by 14 venture capital firms over the period of 1986-1999. About 36% of these companies are located in the IT/software industries and a further 39% in other high tech industries sectors such as biotechnology, telecommunications and healthcare. Their study validates the theory that investors can reduce agency problems by providing quasi-equity (such as convertible and/or preferred stock) rather than full equity finance. The hypothesis is that the use of quasi-equity

should be especially wide-spread in high tech industries such as software and biotechnology where the initial phases of development involve tests that only the entrepreneur can observe and accurately evaluate (high information asymmetry and possible adverse selection), while outsiders VCs or CVCs can more readily assess later stages. Kaplan and Stromberg's findings were that convertible preferred stock is by far the most commonly used financial instrument, appearing in 189 out of 200 financing rounds—and allowing higher assurance of the cash flow rights, voting right and control rights of the investors contingent on observable measures of financial and non-financial performance. If the company performs poorly, the investors take full control and replace the management team; if the company performance meets expectations, the company acquires more cash and control rights over time/ if the company performs very well, median return of 30% pa over a four year period to IPO, the vcs relinquish most of their control and liquidation rights, while retaining their cash flow rights. These contingent clauses are found to be more common in start-up and early-stage financings than in later financing rounds, a result consistent with the theory that the potential conflicts of interest between investors and entrepreneurs/portfolio companies will depend on the degree of uncertainty and financial risk which tends to be highest in high-tech sectors and in the early stages of the project/company's life.

Empirical studies show that a large proportion of venture capital investments fail, while a small proportion are exceptionally successful. CVC researchers such as Sykes have classified the factors as either intrinsic or extrinsic sources of risk (Sykes, 1986). Intrinsic or internal risk is specific to the portfolio firm such as execution, technological development, management experience and extrinsic or external risk is market-determined, including factors such as economic downturns that slow market growth or prevent initial public offerings. Entrepreneurial and corporate finance researchers would argue that the advances in performance and contractual monitoring (embodied in the extant term sheets) coupled with staged investments have played a major role in reducing exposure to intrinsic sources of risk as well as to guarding against early stage conflicts of interest, adverse selection, information asymmetry and hold-up by the entrepreneur. Sahlman[4849] in 1990 notes that "the most important mechanism for controlling the

venture is staging the infusion of capital", where successive investments are contractually tied to the achievement of performance goals. If the venture's progress starts to falter or halt, the investor may refuse to participate in the next round. From a theoretical perspective, staging has positive benefits viewed through principal-agent theory as well as real options theory. Staging financing from a principal-agent and transaction cost economics view reduces hold-up because over time, the human capital and sweat/intellectual capital of the entrepreneur becomes embodied or co-specialized to the physical capital, products and services of the start-up company. Staging financing from a real options theory perspective creates an option value. Between rounds, uncertainty is resolved, allowing for better decisions in the next round and allowing the investor a valuable option to abandon the investment at the next investment stage if it is inefficient to continue. The monitoring cost is balanced by the option value (Gompers, 1995).

Stage of Investment or Investment Project Stage

By the Third Wave of Corporate Venture Capital, the relationship of investment risk to stage of investment and the value of staged investment and contingent contracting based on portfolio company/entrepreneur achievement of explicit milestones in a timely fashion seems well established and entrenched in actual investment and portfolio management practice. In the definitional diagram provided by Haemmig, 2002[50], most industry associations would agree on the division of the stages of investment into:

1. Seed/R&D
2. Start-up
3. Other early stages
4. Expansion/Development
5. Late Stage/Pre-IPO
6. IPO
7. Buyout/restructuring

Additionally, the investment risk assumed by investors vary from high in the early stages to low in the late stages.

Haemmig points out that the U.S. tends to define Venture Capital as stages 1-5 and that traditionally, private equity firms and investment banks take over at the IPO and dominate the post-IPO stage of buyouts and restructuring. Corporate Venture Firms participate alongside independent vcs in Start-up(2) and Other early stages(3) and then are joined by investors from private equity and investment banks in the expansion/development(4) and late stage/pre-IPO(5) stages.

Often outside the US, the terms private equity and venture capital are used interchangeably and the term "Mezzanine" is used to describe the late stage pre-IPO VC round. Sometimes "Mezzanine" is also used to describe the subordinate debt financing used post-IPO by private equity firms in buyouts and restructuring.

Investment Stage and Financing Rounds

The stage of investment is a valuable indicator of the equity financing requirements of the portfolio company. In general, venture-capital backed start-up companies moving from seed/R&D stage towards IPO are in a cash negative or annual net loss position until the annual break even point that typically takes place between the early stage and expansion/development stage. The burn-rate is the rate cash is being used up by the portfolio company until the cash flow goes positive through NRE, contracts, revenues, customer sales, licenses, etc. The annual net income or cash flow tends to be positive and increasing throughout the expansion/development and late-stage/pre-IPO stage

A recent NVCA (National Venture Capital Association) funded report[51] indicates that the structure and focus of venture capital investment has changed dramatically during the Wave 3 time period of investment. Not only has the magnitude of investment, number of investors and number of venture-backed portfolio companies shot up, but also the investor composition, risk profile and investment portfolio management strategies have shifted.

By 1994, pension funds and institutional investors dominated the venture capital landscape (as limited partners and funders of the independent venture capital firms),

looking towards venture capital as a high-risk but high return private equity asset class. The sensitivity of institutional investors to short term losses has dramatically shifted the structure and focus of venture capital investment. Volatile start-up, early stage and emerging technology projects are being passed over in favor of more predictable late stage, expansion projects that are closer to the exit strategy of an IPO. This trend is apparent in two metrics monitored by the National Venture Capital Association Yearbook: share of investment dollars by investment project stage and financing round data.

In 1980, during the Second Wave of Corporate Venture Capital, early stage projects were the most popular for all venture capital investors, accounting for 41.7% of all invested dollars. Expansion and Buyout Stage projects were a distant second, accounting for 27% and 22% of disbursements that year, with Later Stage projects accounting for a mere 8.9%. Twenty years later, during the Third Wave, the emphasis has shifted towards Expansion and Later Stage projects. In 2000, Expansion Stage projects alone accounted for 54.3% of all invested dollars, while Later Stage projects accounted for 19.9%. Early and Buyout Stage projects are far less popular than before, accounting for 23% and 2.8% of disbursements respectively in 2000.

A similar trend also emerges in the financing round data. In the early 1980s, during the Second Wave, the number of companies receiving initial round financing far outweighed the number of companies receiving follow-on financing. In 1980, the ratio of initial to follow-on-financing peaked at 1.8. In comparison, by 1990, the ratio of initial to follow-on financing bottomed out at a low of .3 and then started to increase, with the ratio reaching 1.0 in 2000. This means that every early stage investment transaction is being matched by a later-stage round funding round in the Third Wave, compared to a halving of follow-on investments by the follow-on stage in the Second Wave. This evidence also supports the argument that volatile start-up and early stage projects are being passed over in favor of more predictable late stage, expansion projects.

The innovation gap: inefficient private capital markets for early-stage technology

Careful empirical tracking of the structural and longitudinal shift in investment from early stage to later stage and from higher-risk to follow-on, more predictable later stage, expansion projects in the Third Wave (1994-2000) has led to public and industry sector concern about an "innovation gap" or private capital "market failure". Because venture capital has tended increasingly to flow to projects in later stages of development and to already-proven technologies with attractive financial returns, most funding for technology development in the phase between invention and innovation comes from individual private equity angel investors, corporations and the federal government. Entrepreneurs report a dearth of sources of funding for technology projects that no longer count as basic research but are not yet far enough along to form the basis for a business plan. Efficient markets do not exist for allocating risk capital to early-stage technology ventures. And "patient capital" is often needed since up to a decade is required for the transition from invention to innovation, especially in areas such as biotechnology, molecular engineering, nanotechnology and advanced materials.

A large variety of institutional arrangements have developed for funding early-stage technology development—angel networks, university and corporate equity investments, seed investments, experimental R&D programs run by federal and state agencies. Angel investments are reminiscent of the pre-ARD days when wealthy individuals were the main source of higher-risk funding.

However, in 2000, academic and other funding was less than 5% of the total R&D funding in the US with all Federal R&D funding having dropped to 26% of the total in 2000 compared to 47% in 1980. Industry R&D is about 69% of the total 270B$ of US R&D funding in 2000, according to estimates by Haemmig, 2002[52]. Corporate equity investments in the form of corporate venture capital has increased in proportion to venture capital funding, but has not shifted as dramatically as independent venture capital and private equity away from early-stage, emerging, high risk technology ventures.

London Business School report, 2002

Given the dramatic change in the structure, focus and staging of venture capital investment, and the order of magnitude increase in corporate venture capital activity and portfolio companies during the Wave 3 time period of investment, it would not be surprising for a researcher to observe dramatic shifts in the determining factors necessary to compete and perform successfully in this increasingly sophisticated and crowded high risk/high-return industry. In particular, one might expect that factors such as internal vs. external ventures (Shrader & Simon, 1997), stage of investment (NVCA report), direct or indirect investment strategy (McNally, 1998), industry sector (emerging, disruptive, long innovation to commercialization gestation as in biotech, high-tech), performance metrics (Gompers &Lerner, 1998) and performance monitoring mechanisms (Sahlman, 1990) would have a significant impact on the performance of a corporate venture capital group during the Wave 3 time period of investment, including the internet and the dotcom boom.

However, the report published by the London Business School[53], "Corporate Venturing: The State of the Art and the Prospects for the Future" in July 2002 concluded after a twelve month detailed study, interviewing venture unit executives in more than 40 companies in eight countries and 95 corporate venture capital units, that "None of these success factors will come as a great surprise. What is surprising is the number of venture units that have failed to follow them…". The success factors tested and validated were the "classic" factors described in Siegel, Siegel and MacMillan, 1986—organizational autonomy of the venture unit from the corporate parent as well as the importance of linkages to the venture capital community for deal flow and deal quality, listed as success factors (2) and (3) in Winters and Murfin's article published in 1988.

The LBS 2002 study did a statistical correlation between venture unit structure and performance and found statistically on their sample that better financial-performing venture units tend to have greater autonomy and that there was a strong positive correlation between strategic performance and frequency of communication with the VC community.

Unfortunately, although the study announces that it surveyed a larger number of active corporate venture units than any other contemporary study, the 95 units studied had investments in both internal and external corporate venture units—according to Table 4.1, 4 different kinds of groups were sampled—(1) CVC groups that invested in external ventures for a financial return (30 units); (2) CVC groups that invested in external ventures for a strategic return (29 units); (3) CVC groups that invested in internal ventures (25 units); (4) CVC groups that invested in internal ventures with the motivation of spinning off (11 venture units). In the definition we proposed earlier for corporate venture capital, only the results of group 1 and group 2 totalling 59 units would be valid for survey or empirical study.

The London Business School report concluded with five Key Success Factors:
Key success factor 1: Develop clear goals and a structure to deliver on them.
Key success factor 2: Build specialized capabilities—including systems to sense and evaluate new ideas, networks with the VC community and a process to stop funding to unpromising ventures quickly.
Key success factor 3: separate venture units from the mainstream business
Key success factor 4: build links to the corporate parent when the venture unit is established
Key success factor 5: high level champions and critical mass in portfolio

Key research questions included: How are the corporate venture units' objectives, capabilities and level of autonomy linked to their overall financial and strategic performance? How closely tied is corporate venturing to the broader strategic agenda of the parent company?

A survey questionnaire was administered with all of the participants (venture unit executives) with multiple sections probing for details on what investments the venture unit focused on; what was the organizational structure of the venture unit and its links/ relationship to the rest of the parent corporation; what were the financial and strategic performance measurements of the venture group? The authors point out the limitations

of their survey approach--that the performance of venture units were self-reported and evaluated. In further studies they would want to focus on long-term results as viewed by the corporate parent and the portfolio company managers—the ability of the venture unit to deliver financial results to the parents, the integration of portfolio companies back into the parent company and the survival of the venture unit when corporate strategies change.

The LBS study takes the viewpoint that the CVC industry on average and particularly the corporate venture capital survivors of the recent economic downturn who participated in the study have typically benefited from learning and copying the more disciplined investing and highly specialized skills of the independent venture capital VC model in the third wave (1990s). However, the authors conclude that a surprising number surveyed still have not been able to avoid the structural failures of corporate venturing originally identified through academic research in the first wave (1970s) and second wave (1980s)—multiple or unclear goals; insufficient management commitment and inadequate compensation schemes (Lerner, 2000). Other researchers pinpointed problems in transferring technologies and business ideas from the venture unit back to the mainstream business (Alterowitz and Zonderman, 1988).

The LBS study surveyed a large number of active corporate venture units and thus were able to confirm that a number of corporate venture capital wave 1-2 themes and findings still seemed useful for contemporary active corporate venture units—the importance of independence from the parent company in the early years of the venture unit (echoing the seminal work of Siegel, Siegel and MacMillan); some key differences between internal and external venture units (validating the earlier work of the Shrader and Simon) and the need to develop VC-like capabilities to manage the process effectively. As the authors state in their executive summary before describing their five key success factors, "None of these success factors will come as a great surprise. What is surprising is the number of venture units that have failed to follow them…"

Perhaps the only surprising finding in the LBS study was the authors' conclusion that "corporate venturing should never be viewed as a permanent solution". The authors'

stated opinion was that new business creation was such an important competence of the whole organization that a separate corporate venture unit should be viewed only as a temporary catalyst, not a permanent substitute for embedding the new business creation skills, entrepreneurial mindset and market sensing/funding processes throughout the entire organization.

The Corporate Strategy Board Executive Inquiry, May 2000

The Corporate Executive Board wrote an executive brief entitled, "Corporate Venture Capital: Managing Equity investments for Strategic Returns" in May 2000 (available on the web at …..). It observed that Corporate Venture Capital activity had grown dramatically in recent years, with the corporate share of venture capital spending rising from 2 percent in 1994 to 15 % by 1999. Additionally, the authors noted that soaring stock market valuations had led a record number of corporations to invest in start-ups for financing gains. Despite the financial attractiveness, most companies cited strategic interests—and specifically access to technological developments that threatened existing business models and industry structures—as being the foremost driver of CVC activity.

The executive brief had the stated study objective to help CVC managers charged with directing strategic equity investments to address the key questions of:
What tools enable identification of strategically relevant deals? (pp. 11-20)
What activities facilitate the transfer of strategic value to the corporation? (pp. 21-26)
How can CVC managers measure strategic returns to the corporation? (pp. 27-38)

Additionally, the brief included an appendix for companies contemplating the more fundamental question of whether to initiate strategic equity investing by addressing four key launch considerations for determining CVC investing strategy (pp.39-47).

The research team was supported by several fund managers, the NVCA and Hank Chesbrough, professor at the Harvard Business School. They were advised by 21 industry advisors, representing many of the large corporations with corporate venture groups including Intel, J&J, UPS, Siemen, Nokia, IBM, HP, UPS, 3M, etc.

The Corporate Board interviews with more than 25 companies highlighted three frequently cited challenges:

1. Securing strategically relevant deals--The key obstacles seem to be misaligned investing criteria and inconsistent or not-rigorous enough screening methods.
2. Transferring Strategic value to the Corporation—the key obstacles tend to be unprepared start-ups lacking experienced leadership and capital as well as operating division indifference, complicating the value transfer process.
3. Tracking and Analyzing Strategic Gains—the key obstacles are a dearth of strategic value metrics given the qualitative nature of strategic objectives and extended time horizon for returns that hampers monitoring of progress and can delay equity exit decisions.

The Corporate Strategy Board interviews highlighted the lessons learned in these three areas and profiled some "leading practices" that CVC managers can use. In brief, successful CVC managers addressed challenge #1 by a rigorous and consistent set of screening tools judged by strategic relevance and the highest likelihood of strategic gains. In addressing challenge #2, successful CVC managers were forward-looking in laying the foundation between the start-up and the operating unit for a business relationship and pursued specific activities designed to nurture the start-up and convince business units of the potential value of a commercial relationship. In addressing challenge #3, successful CVC managers developed a set of customized metrics of each investment to trace difficult-to-quantify strategic returns and to review deal performance.

In contrast to the London Business School study/survey of 2002, the Corporate Strategy Board report published in 2000 was focused on pragmatic corporate venture capital industry "best practices" and insights aggregated from a range of successful industry practitioners. For example, Chapter One on screening for Optimal Deal Selection provided illustrative strategy-driven selection criteria and walked the reader through a staged investment proposal review. Chapter Two explained the concept behind being a Strategic Value Broker. Chapter Three gave specific examples of quarterly strategic

returns analysis and the composite of strategic returns metrics that the interviews had highlighted. Finally, the Appendix, outlined the logic from the industry practitioner's perspective underlying different investing objectives, stage of investment, method of investment and organizational structure.

Additionally, a big surprise in the Corporate Strategy Board report was the statement, in Observation #3 that "despite the strong financial draw, most companies cite strategic interests as the foremost driver of CVC activity. Those corporate investors primarily pursing strategic gains usually seek access to technological developments that threaten existing business models and industry structures."

In contrast, the London Business School survey included a section in Part D that asks the survey respondent to indicate how important each of 19 objectives were to the corporation (on a 1-3 scale of importance) and how well the venture unit delivered on this objective (on a 1-5 scale). The four objectives that might reflect a corporation's interest in technological developments that in the Corporate Strategy Board words, "threaten existing business models and industry structures" were worded in the following ways in the LBS survey:

1. create breakthrough technology for corporation
2. investment in disruptive technologies
3. create options on emerging technologies
4. search next core business for the corporation

The first 3 items received an aggregate score of 2.3 out of 3 where 2 was minor importance and 3 was major importance to the corporation. The 4th item received a 1.8 score.

On the aggregate scoring of how venture units deliver on various objectives, the first 2 items received an aggregate score of 3.1 or 3.2 out of 4 where 3 was equals/meets expectations and 4 was exceeds or above expectation. The 3rd item of "creating options on emerging technologies" received a 3.3. The 4th item of "search for next core business" received a 2.8 score.

Several possibilities might explain the disparity between the observations of the Corporate Executive Board and the London Business School study. The first is the sample and methodology—the Corporate Executive Board conducted personal interviews of 25 corporate venture capital groups known for their successful "best practices" investing in external technology-oriented start-ups and experience in the US-dominated CVC industry during the Third Wave. The LBS study looked at a broader sample, 95 units, but consequently aggregated the written questionnaire responses from many different geographic regions (48 from Europe and 44 from North America), levels of experience and external and internal venture focus. The LBS study contained 25 units established in 2000 and 19 units established in 2001, so that 44 units were less than 2 years old at the time of the survey and an additional 50 of the sample were established in the 1994 to 1999 time frame.

Section VI. Post-2000 Empiricists: New Explanatory Models for CVC Performance

In this section, we look closely at three doctoral dissertations examining Corporate Venture Capital and published after 2000. These three doctoral dissertations are used as illustrative of the new directions and frameworks for empirically-based research by extending, augmenting and re-interpreting the publicly-available databases from VentureOne, as well as creating new primary industry-level data sets to overcome the limitations of existing information sources. In all three cases, the findings are exciting and tantalizing; as to be expected in insightful and valuable empirical research, more analysis can be done, now that the guideposts have been established. In the following and final section, I propose the outline of a new research agenda by pointing out several "gaps" in the research to-date and by integrating the feedback received already from industry practitioners into the implications for further research and CVC data set development.

1. CVC Industry Sector and Strategic Motivations

In his doctoral thesis for Stanford University titled "Strategic Venture Capital Investing by Corporations", published December 2000, Antje Kann[54] collected a primary data base on approximately 300 firms that were active corporate venture capital investors worldwide, narrowed this initial set to a final data set of 120 U.S. based CVC programs with at least one strategic investment in an entrepreneurial firm and reviewed 6,000 articles, with about 35 sources per company to operationalize his constructs, aided in his development of hypotheses and explanatory model by initial field study interviews with 7 firms.

His thesis work is notable for its illuminating and empirically-validated findings on the differing strategic motivations and valuation criteria for corporate venture capital groups in 12 different industries active in the Third Wave of Corporate Venture Capital—the period of the late 1990s through 2000. In contrast to earlier empirical work and the contemporaneous LBS study that aggregated internal and external corporate venture

groups, his primary data set has a rigorous focus on corporate venture capital groups that invest for equity in external entrepreneurial startups and contains carefully coded industry and fine-grained firm-level information on each of the 120 U.S. based CVC programs and its portfolio investments, derived from 6000 archival publicly available articles and sources.

Of course, the reliance on independent published sources may have created a hidden bias—given the sensitive nature of strategic investments, established firms may attempt to closely guard their strategy to enter a new market currently dominated by entrepreneurial firms or for a number of competitive and strategic reasons be reluctant to publish information regarding their corporate venture capital activity or related mergers and acquisition activities. This is where the participation of the NVCA or corporate members of the NVCA could play an important role in confidentially validating and augmenting this type of previously unavailable industry-level corporate venture capital group database.

Kann's thesis research covered 12 different industries of the investor and portfolio companies---Biotech, Chemical, Business Services/Financial, Communications, Computing, Consumer goods, Healthcare, Internet content and commerce, Pharmaceutical, Publishing/Media, Software and Other. Categorizations were based on the SIC code of a firm's primary business activity. Internet content and commerce was categorized as an additional industry category that was separate. The author points out that he did this separation to be able to observe if the corporate venture capital investment made in entrepreneurial firms whose core competence was Internet related would override the behavior/SIC classification that would place them in one of the "traditional" industries.

Further industry-level CVC research could certainly focus more deeply on several of the industry sectors where corporate venture capital activity displayed the most significant structural changes, competitive activity and strategic patterns during Wave 3 of the Corporate Venture Capital industry. With careful augmentation of the industry-level

data base, it would also be possible to make some useful industry and strategic comparisons between US based venture capital groups and their US portfolio investments and non-US CVC groups and investments.

In summary, the primary database Kann created had 152 observed corporate venture capital programs with (a) three classifications of strategic motivation—45% external R&D , 30% accelerated market entry, 24% demand enhancement; (b) two organizational program structures--78% direct investment, pooled and dedicated funds at 11% each, 80% active and (c) portfolio investments in either early or late stage--25% early stage, 38% later stage, 38% mixed.

By creating this new corporate venture capital database, Kann was able to demonstrate how specific industry characteristics and a firm's competitive environment influence its strategic motives for corporate venture capital investing.

The most significant results were in the industries where products displayed strong standards or technology platforms—the software sector, communications and computing. Corporate investors in industries that display strong architectural standards or technology platforms are significantly more likely to invest with the strategic goal of enhancing demand for their products than the overall population of corporate investors. These specific industries invest in and sponsor derivative and complementary technologies and applications of their technologies that are developed by entrepreneurial firms—with impact on commercial de facto standards, the shaping of the direction of technological development and early adoption as well as dominant designs. Corporate investors in industries with demand enhancement strategic goals are more likely to invest directly rather than indirectly in early stages with a greater number of smaller early stage investments. Kann suggests that there's room to enhance the role of venture capital firms in the corporation's investment efforts through devising better compensation schemes for venture capital firms based on the strategic relevance of the deals they deliver.

Additionally, significant results were found in the industries that represented new and emerging markets including biotechnology and Internet content and commerce. Corporate venture investors such as chemical and pharmaceutical corporations are more likely to invest in biotech with the goal of more accelerated entry into these new markets than the overall population. Interestingly, time-to-market, timing and market windows motivations were more strongly supported than the typical logic of threat of new entrants or disruptive technology. Similarly, business services companies such as those in the publishing, financial services and retailing industry were more likely to invest in Internet content and new business processes start-ups for the purpose of entering these new markets.

Kann was surprised to find that the more traditional logic of companies in R&D intensive industries attempting to augment their in-house R&D efforts with "external R&D" via corporate venture capital was not supported by his findings, except in the pharmaceutical and chemical industries. He used one-sided t-tests where the sample of interest is compared to the overall population. In the communications, computing and software industries where firms spend a higher proportion of their budget on R&D compared to publishing, financial services or retail, external R&D is not indicated as the strongest strategic motivator. Instead, demand enhancement via complementary products and standard-driven solutions was more significant as a strategic motivation. However, it was noted that the pattern of investment varies with strategic motivation, so that programs whose strategic investment goal is external R&D tend to invest in their own industry, tend to invest directly and in later stages.

Kann points out that this result could partially explained by the intellectual property regime existing in these different industries—iP rights in biotech are well-established, while in communications, computing and software, the perceived danger of expropriation of poorly-protected intellectual property rights would reduce the entrepreneur's level of trust/interest in early stage corporate investment (especially if external R&D was publicly announced as the corporate venture group's strategic motivation and raison d'etre).

Kann's dissertation thesis (2000) is a "guidepost" to future empirical work since it convincingly demonstrates the usefulness of primary industry-level data sources combined with qualitative interviewing/directed archival research and illuminates the severe limitations of the transactional databases currently used by Venture One and VentureWire. He decided to create a primary data set since the readily available data on corporate venture capital investing exists only at the transactional level and since databases such as Venture One track capital investment by corporations in only in cases where they co-invest with independent venture capital firms. Often these databases do not track corporate investments when the corporation is the sole investor in a given round, and more importantly, they do not provide any information on investments by corporations into venture capital funds (called indirect corporate venture capital). Thus relying only venture capital databases introduces an inherent sample bias towards CVC direct investments and co-investment as well as transactional rather than qualitative information..

Additionally another inherent limitation of studying corporate venture capital at the transactional level is the difficulty of inferring information on the goals and structure of CVC programs and portfolios from individual investments or transactions. Aggregated transactions cannot illuminate the industry-specific reasons for strategic investment, program structures or be linked to strategic or competitive performance. Since Kann's theoretical model required identifying the population of firms that engaged in both corporate direct and indirect venture capital and classifying their investment program by the industry, the strategic investment goal, the investment channel, the degree of involvement with the entrepreneurial firm and the target investment stage, it was clear that this level of data was not available from publicly available databases.

Another CVC empirical researcher, Gary Dushnitsky, originally at NYU and now at Wharton, has approached the question of industry and firm-specific motivations for external R&D and external knowledge acquisitions in several innovative studies augmenting the VentureXpert database maintained by Venture Economics and used by Bygrave[55], 1989; Gompers 1995; Sorenson & Stuart[56], 2001. Both of the studies

described below strongly suggest that further industry-level empirical research into the investment patterns and strategic motivations of corporate venture capital groups in the Third Wave and post-2000 are extremely valuable and yield results quite distinctive from the findings of the First and Second Wave.

The main theme and research question of Gary Dushnitshky and Michael Lenox's paper is stated in the title, "When do Firms Undertake R&D By Investing in New Ventures" (unpublished draft June 11, 2003[57]) and addresses the corporate venture capitalist's strategic motivation towards "external R&D".

The authors point out that corporate venture capital investment, as a capital expenditure, lends itself to empirical observation and measurement, unlike the cost of internal R&D, the calculation of R&D alliance or consortium costs or the price one should place on maintaining ties with star scientist or academic researchers. The authors hypothesize that a profit-seeking firm will choose invest in CVC when the CVC's marginal innovation output is higher than that of internal R&D.

A sample of 700 US public firms during the time period 1969-1999 (a period spanning three waves of corporate venture capital investment) from the Venture Economic's VentureXpert database was used and augmented with data from Standard and Poor's, the NBER version of the US Patent database (cited in his paper as coming from Hall, Jaffe and Tratjenberg, 2001) and the Carnegie Mellon Survey of Research and Development (cited in his paper as coming from Cohen, Nelson and Walsh, 2001).

The relatively surprising finding is that internal R&D and CVC are more likely complements rather than substitutes vying for research dollars. In keeping with the general argument of "absorptive capacity" (Cohen and Levinthal, 1990), internal and external sources of innovation are interdependent. Pisano (1991) reports that firms with an expertise in a given research domain also exhibit higher levels of knowledge absorption/acquisition from external sources. This might be an alternative explanation of importance that "strategic overlap" between the technology domains of the corporate

parent and its portfolio companies seem to play in performance outcomes (Gomper and Lerner, 1998).

We would interpret these results to strongly suggest that incumbents and industry players within high innovation industries with weak IP regimes (software, telecom, electronics) have a distinct advantage to acquiring external complementary R&D assets and products via equity-based investment since they already have an absorptive capacity and ability to integrate and leverage these external assets via their own base of knowledge, core technological competences, existing portfolios and platforms. Of course, it would be interesting in the future to do a more detailed, fine-grained study within each of these high innovation plus weak IP regime industries to see if performance is independently or systemically linked to factors such as the tenure and overall deal experience of the corporate venture capital group and the size of its investment portfolio, stage of investment as well as to lagged factors of overall R&D and branding, reputation, signalling expenditures.

In the unpublished manuscript, "Limitations to Inter-Organizational Knowledge Acquisition: The Paradox of Corporate Venture Capital" (Dushnitsky[58], 2004), he uses a matched sample of 28 entrepreneurial ventures and 74 corporate venture capitalists, having an investment relationship in the high tech semiconductor, hardware, software and telecom industries during the period 1990-1995. He uses a rare events logit analysis to estimate the probability of an investment relationship between any Entrepreneur-CVC pair to see if the likelihood increases when the products of the two are complementary and decreases if the products are potential substitutes. He then tests to see if further changes in probability are linked to the highest "vulnerability/expropriability of knowledge" state—arguably when the products of the two are potential substitutes and the CVC program is organized under an internally closely coupled direct investment group of the parent corporation with strategic and external R&D goals, such as Nortel Networks rather than a loosely structured program with explicit Venture Capital goals and incentives such as Nokia Ventures. His findings support his hypothesis than the likelihood of corporate venture capital investment occurring in these four high-tech

industries is significantly influenced by both the complementarity of products as well as the risk of knowledge/technology expropriability perceived by the entrepreneur (proxied by the tight or loose coupling of the corporate venture capital group to its corporate parent).

Part of the challenge faced by Dushnitsky in this study was deriving a large enough matched sample (across four dissimilar hardware, network, communications and software industries) to use a rare events logit analysis effectively and to obtain the information necessary to evaluate complementarity of products and risk of appropriability for the entrepreneur. A NVCA-sponsored study of one industry, such as the software industry, could potentially augment and cross-validate this database with access to more relevant. Identifiable and large-scale entrepreneur/product/technology data—for example S/W or network certification/registration information typically required of ISVs or VARs using a specific software platform such as Sun, Novell, SAP or Oracle.

(2) Social Networks and Eco-systems

The dissertation thesis, "Corporate Venture Capital and the Value-Added for Technology –Based New Firms, published in December, 2001 by Markku V.J. Maula[59] of the Helsinki University of Technology, Department of Industrial Engineering and the Institute of Strategy and International Business presents quite a contrast to the previously described Stanford thesis in its empirical data set, explanatory model and its foundations in the social capital and organizational economics research literature. Maula's work fills a significant gap in the corporate venture capital research in the area of social, informational, branding and endorsement/legitimacy relationships and the influence of social networks (rather than technological or compatibility networks and economics-oriented network externalities) between entrepreneurial firms and their corporate venture capital investors.

Maula created a primary venture set consisting of 91 U.S. technology-based entrepreneurial companies, whose CEO (82%), Chairman (3%) or Founder/Director

(14%) completed a four page written questionnaire survey that was mailed to 856 CEOs. The sample companies included in the mailing were identified from the Venture Economics database using the criteria of being founded in 1995 or later, participation in a high tech industry defined by Venture Economics as the subcategories of biotech, medical/health science, internet specific, communications, computer, software and services, computer hardware or semiconductors/other electronics, funding from at least one corporate venture capital investor and at least one independent venture capital investor as well as receiving at least one round of investments within the last two years.

Maula points out in his literature review that previous research has explored the corporate parent-independent venture relationship from the principal-agent economics literature. This dominant research paradigm comes from quantitative research in entrepreneurial finance finding that the high-powered incentives of equity ownership, staged investment and future gains in an IPO can appropriately align the diverging interests of an investor and an entrepreneur.

His study tackles the task of drilling down into the actual process of interaction and frequency of communication between the individuals in the corporate venture capital group and the entrepreneur and the multiple factors within the causal path linking this process of interaction and performance. In doing so, he develops several new constructs and ways of measuring the impact of these mediating constructs.

Maula's doctoral research had important findings in three areas that had been mentioned during decades of previous corporate venture capital research but not broadly surveyed, tested or validated until this Third Wave study.

(1) He develops and tests a new construct called dynamic complementarities that is distinct from industry relatedness.

(2) He uses his primary database to test three theoretical models of corporate venture capital value-added—resource acquisition, knowledge acquisition and endorsement

benefits. social capital in the form of structural, relational and cognitive assets generating referrals, reputation and endorsements. Not only are each of these models operationalized in an innovative way--the findings support the inter-dependence and systemic linkages between the social relationship factors and overall performance rather than the independence of the factors in these models. For example, frequent communication interaction supports resource acquisition, is a mediating factor for knowledge acquisition (similar to the absorptive capacity argument) and seems to strengthen the credibility of the corporate endorsement.

3. The only hypotheses that were not strongly supported by both multiple regression analysis and structural equation modeling was the expected benefits of distribution-related resources and the relatively weak linkage between production-related resources and knowledge acquisition.

Maula highlighted some of the future directions for research.

1. Since the analyses was based on cross-sectional data, longitudinal research designs and lagged performance variables would be very valuable extensions to this work.
2. His focus was on one side of a dyadic relationship—between the entrepreneur and the corporate investors. It would be very valuable to understand the impact of multiple investors for the entrepreneur, or to match this study with a survey of the corporate investors and their entire portfolio of investments.
3. The use of perceptual measure of "success" and meeting of expectations could be usefully validated with empirical performance measures, especially ones that controlled for industry and time frame effects. The size and market success of the sample companies was difficult to assess since many of the sample companies did not have revenues and several of the companies did not want to disclose revenues. The companies that did disclose their revenues had on average 4.89M$ in revenues in 2000. Half of the firms had $2M or less with the highest revenue being $50M.

4. The sample companies had all received corporate venture capital funding during 1999-2000. The amount of venture capital and CVC investments decreased dramatically during the first half of 2001. The geographical location of the sample companies were clustered with 56% in California and with Massachusetts having 10%. 45 of the 91 companies in the sample were Internet specific.

Potentially, items 2 and 3 above could be addressed with the participation of NVCA and NVCA corporate venture capital members. For example, several NVCA members of the Corporate Venture Capital group already internally track and monitor "cash returns on capital invested", tracked over time longitudinally for the complete portfolio and over funding stages. It would be very valuable to NVCA corporate venture capital members to be able to "benchmark" within their specific industry sector exactly how different industries tracked and indirectly "monetized" commercial relationships and linkages with their portfolio companies.

For example, a CVC portfolio "intangible asset balance sheet" might include both financial and strategic assets and real options, obtainable through questions such as:
–Where did the financial returns come from?
–Exactly what else was transferred besides $ in the relationship?
–What kind of unexpected strategic benefits came out of the relationship and how much time elapsed before the financial, market benefit was realized? (Example: SAP and CommerceOne and MySAP)

Global Corporate Venture Capital

The third dissertation considered as a CVC research "guidepost" was published in May, 2002. Martin Haemmig[60] authored a doctoral dissertation on The Globalization of Venture Capital: A Management Study of International Venture Capital Firms. I served as an outside dissertation committee member. His main goal was to examine the motivations, rationale, decision criteria and best practices of venture capital firms when going international. A small section of his study was focused on corporate venture

capital since this is a major source of investment in Asia and larger than independent venture capital in this region.

The breadth, depth and detail of this global research study is impressive, especially as it was conducted by one globe-trotting author, sponsored by the Swiss Private Equity and Corporate Finance Association (SECA) and supported by Ernst & Young, VentureOne, Center for Technology and Innovation Management (CeTIM), several global venture capital firms as well as the major venture capital market research groups and associations worldwide. Haemmig's study tackles the herculean task of surveying and individually interviewing 100 venture capitalists in 13 countries across Asia, Europe, Israel and the United States in quantitative (funds raised, investments and actual performance numbers) and qualitative details (staffing, personnel background, regulatory, financial and investment challenges, cooperation and syndication preferences, portfolio and deal specifics, organization and management, best practices) about their venture firm's operation during the revealing period of the "bubble" between 1995 and 2002.

The author points out that global innovation trends and increasingly global investment patterns requires both a management as well as academically rigorous examination of the trends, motivations and activities of internationally-based venture capitalists within the comparative context of the external national, cultural and regional factors enabling or inhibiting a truly global venture capital market. His general concluding section on "Lessons Learned by International Venture Capitalists", summarizing the insights of 100 personal interviews with venture capitalists in 13 countries are well worth reading and applying.

More specifically on corporate venture capital, his survey shows that corporate venture capital investment is the largest single source for Asian venture investments at 40% for the last 3 years and with close to $5B invested in 2000. This amount is second only to the US corporate venture capital investment number, which hit a high of $16.6 billion in 2000 and then fell to the level of $5B in 2001.

Previous research has explored the role and incentives of the independent venture capitalists operating in domestic markets and their success factors. The London Business School study described later looked at more than 100 corporate venture capital firms and surveyed their investment executives for key success factors and best practices. The Global Entrepreneurship Monitor[61], a joint effort led by London Business School and Babson College, has combined the efforts of several universities in publishing an annual report on the state of entrepreneurship in a large number of different countries.

In the context of this Corporate Venture Capital literature review, Haemmig's doctoral dissertation work expands the frontiers of the existing corporate venture capital research by (1) highlighting the regional investment and economic policy differences in corporate venture capital and (2) documenting the international venture capitalist's perspective on the role they see corporate venture capital playing in their industry.

(1) Regional and national corporate venture capital differences. In Section 2.13, titled Corporate Venture Capital (CVC), the author hypothesizes that the global expansion of high-technology markets have required the establishment of a global networks where multinational corporations and their corporate venture groups have a natural strengths and strategic fit with their existing long-term international strategies and global marketing and distribution networks.

For comparative purposes, the chapter points out that the direct capital invested by US industrial corporations totaled $400M in 1995 and had increased to $16.6Bin 2000 and $5.0 in 2001. In contrast, Europe corporate direct investments in 2000 reached 1B Euros or about $900M and 5% of all venture capital investments in Europe. Most surprisingly, the corporate share of investments in Asia was 40% or $4.9B in 2000 representing the largest single source for venture investments; the corporate share of investments in Israel was 36%, representing about $1.3B in 2000.
Thus, the corporate venture capital investment in Asia--$4.9B in 2000—actually was close to matching the amount of capital $5B, invested by all US industrial firms in corporate ventures in 2001.

In section 5.4.3 Corporate Venturing (CVC), the study points out that corporate venture capital of larger industrial firms is playing an ever-increasing role for independent venture capital firms as co-investors and exit opportunities as well as for entrepreneurial ventures as strategic market partners and investors. Especially in regions outside the US, the large corporate investor knows the global market and can benchmark the market and the technology potential more effectively than even entrepreneurs and the less-experienced-than-the-US locally based independent venture capitalists.

(2) The international venture capitalist's perspective on corporate venture capital. The brief section on corporate venture capital within the larger global venture capital research study covered and discussed the following findings:

(a) Asian VCs source between 40-50% of their capital from industrial corporates, many of whom then represent trade sales exists. 76-88% of the Israeli, US and Asian vcs expressed a "big interest in CVC cooperation" compared to 32% in European vcs.

(b) In Asia, independent VCs see CVCs as a source of technology know-how, due diligence, money and funding as well as increasing exit opportunities. American and Israeli VCs value the CVC's exit opportunity and market knowledge and access the most, given that they consider themselves already quite technology savvy.

(c) Valuation, conflict of interest and exit strategy are major concerns in all regions. This arises because CVCs are perceived as having a strategic mission that makes valuation of lesser concern. Conflict of interest arises when technology is applied to corporate solutions that may limit the general market applicability. Also that the corporate sources of funding may tend to limit the potential market for the entrepreneur to non competitors of the investor. VCs prefer the IPO exit mechanism over the trade sale or acquisition.

(d) Asian and European VCs cooperate with CVCs most often in the expansion stage when the product is already proven in the market (excluding telecommunications and biotech which are global markets and technologies). Israeli-based VCs cooperate with CVCs when portfolio companies are going international and need to transplant headquarters to US or Europe, often at the product launch stage. US VCs include CVCs most often at the product launch stage and later, since cooperation at the earlier R&D stage might cause conflict of interest issues for their portfolio companies.

(e) In all regions, VCs generally preferred to co-invest with another VC firm compared to CVCs. However, about 30% liked to include CVCs as co-investors in later stages of the portfolio firm's development, often offering co-investment options but limited co-investment rights to reduce potential conflicts of interests with the portfolio company.

(f) In all regions, a majority of VCs see external R&D or "R&D outsourcing" by large technology companies and multinationals increasing gradually or rapidly because of shorter product lifecycles, focus on core business, expanding product offerings, enlarging the value chain to become systems providers when up and downstream products have to be acquired and integrated.

(g) In Asia and Israel, a large majority of the VC firms preferred that the corporate multinational manage and own their own VC fund. In US, there was a surprisingly equal three-way split in the responses; an equal number voted for a CVC direct funds; indirect CVC funds (captive funds managed by independent VC) and for no corporate venture capital funds (this option includes being one of many limited partners and investors in existing independent VC firms).

(h) The most significant changes in the international CVC scene are forecast for Asia where American and European CVCs and VCs are flocking to India and China, similar in their move to Israel. This will cause increased competition for best deals with the locally-based VCs and CVCs, but is consistent with the US VC and CVC

> strategies of going wherever the best technology and innovation is available, regardless of border.

Haemmig concludes that one of his goals in this research project was to have the newer generations of global venture capitalists and corporate venture capitalists apply their own regional strengths and comparative advantages in developing their own "value-added" approach to nurturing entrepreneurship. He expresses the hope that the data presented in his study and lessons learned can help these new global investors avoid the risks and extensive trial and error phases that the US investment community went through to become both more financially oriented and professionalized. He cites Bygrave and Timmons[62]
(1992):

> "It is not an accident, in our view, that the demise of high industry rates of return during the 1980s coincided with a brand of so-called venture capital that was long on financial engineering and deal-making and short on the value-added attributes for which classical venture capital was noted…"

Section VI. Conclusion to the CVC Academic Literature Review

Before Wave 3 and the internet boom, corporate venture capital was a relatively small industry of $5B in investments, with only about 25% of the Fortune 500 having a corporate venture capital activity with the twin motivations of "window on technology" and corporate diversification in the late 1960s and early 1970s. There was a "restricted universe of investment opportunities" in those periods and a collapse in the IPO market in 1973, resulting in the dissolving of many programs. The "classic" articles in the field, analyzing the relatively small sample in Wave 1 and Wave 2, tended to focus on general "best practices" across industries, geographies and technologies as well as comparing the performance of external ventures with internally generated ventures and corporate venturing. Several of the articles investigate through surveys how organizational structure (direct or indirect), strategic fit between the parent and the portfolio company as well as decision-making independence (autonomy or consensual) could be factors determining the overall success of the corporate venture capital group. Gompers and

Lerner's 1998 NBER paper studies Wave 2 empirically, but only by merging the transactions of private and corporate venture capital investors from all stages and testing different clustered groups for IPO results in the period of 1983-1994.

In comparison, the "guidepost" theses typically created their own data-sets for studying the 1994-2000 period of Wave 3 and clarified the limitations of previous industry/trade databases in being able to test their new explanatory models. Their research and findings highlighted the important contributions that could be made with:

1. industry-level data
2. "strategic" constructs and new performance metrics
3. looking outside the "dyad" (one-to-one connection) by considering
    a. the portfolio, network and eco-system of companies invested in
    b. the community of venture capitalist and co-investors
    c. structured syndication
    d. social and global network of corporate investors
    e. knowledge and cumulative local, regional learning/experience/absorptive capacity
    f. the dynamic capability of orchestrating all of these multi-connections
4. looking outside the US
5. carefully specifying timeframe and context
6. multi-theoretical explanatory models

This is an important challenge that needs to be addressed for the 2000-2005 timeframe. None of the empirical academic research reviewed in this report covers the recent 5 years of the national Corporate Venture Capital industry (2000-2005). We suggest that rapidly collecting and analyzing an appropriate industry-level data-set is the best way to investigate whether a distinctive Fourth Wave is emerging and to pinpoint for industry, policymakers, current investors, corporate and independent venture capitalists as well as researchers the areas of accelerated industry and structural adjustment and convergence with global private equity and innovation markets.

CVC Bibliography:

Research Streams and Keywords:

Sample and subject of study:
CV=corporate venturing (includes internal and external ventures and non-equity financing)
CVC=corporate venture capital
VC=venture capital, venture capital model, venture-backed startups, venture capital financing, venture capital investments, private company investments, private equity
ES=entrepreneurship, size, new startups, young or small companies, large partners
N=networks, syndication, links, interorganizational coordination, inter-firm collaboration, alliances, network position, social capital, technological communities

Factors determining performance:

Information reducing risk and uncertainty:
S=signaling, endorsements, information during IPO process, asymmetric information, private company information, insider information
R=reputation, quality information, quality uncertainty, credibility, legitimacy
M=monitoring, contracts

Inter-firm linkages and position:
N=networks, syndication, links, interorganizational coordination, inter-firm collaboration, alliances, network positioning,

Processes and Paths:
C=commercialization, customer validation
T=timing, staging, innovation rate, inter-temporal, longitudinal, post-investment evolution, accelerated market entry
DC=dynamic capabilities, organizational or core competences, distinctive competences, transformative capacity, resources, strategic assets, combinations of external and internal resources

Motivations and mediating factors :

Strategic corporate factors:
D=corporate diversification, corporate growth strategies
O=options thinking, real options
SC=strategic complementarities, strategic overlap
B=business models

Strategic technology factors:
P=platforms, standards, technology adoption, early adopters, lead users, compatibility, network externalities, technology bandwagons

SA=strategic value, value creation, value-added, strategic assets
IP=intellectual property, intellectual property regime, barriers to imitation, patents, licensing, hard-to-imitate resources
KT= knowledge, technology transfer, technological change, appropriability of knowledge, absorptive capacity, organizational learning
ET=early-stage, emerging technologies, innovation, technology-based ventures
ERD=external R&D, investments in multi-technology, external sources of innovation, out-sourcing, technology make v. buy
P=portfolio, investment diversification, risk management, synergy

Contingent, non-universal and exogenous factors:
TCE=transaction cost economics, specialized or co-specialized assets, opportunism
SV=Silicon Valley, eco-systems, clusters, regional and localized systems of innovation and learning
I=industry effects, industry-specificity, product market, industry studies, industrial markets
W=wave theory, rise and fall, cycles, long-run impact, evolution
INT=international, geographic, national systems of innovation
G=US government, public and industrial policy

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