VENTURE CAPITAL RETURNS AND PUBLIC MARKET PERFORMANCE

By

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To my family and friends, who have nurtured my intellectual curiosity throughout my lifetime

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A-Mean	Average Mean
AATI	Advanced Analogic Technologies Incorporated
AMAT	Applied Materials, Inc.
CAGR	Compound Annual Growth Rate
CAPM	Capital Asset Pricing Model
CTIUS	The Cleantech Index
DARPA	The US Defense Research Agency
DOE	Department of Energy
ECO	The Wilderhill Index
EDA	Electronic Design Automation
ENOC	EnerNOC, Inc.
EV	Electric Vehicles
FSLR	First Solar, Inc.
INTC	Intel Corporation
IPO	Initial Public Offering
IRR	Internal Rate of Return
IXIC	Nasdaq Composite
Kleiner Perkins	Kleiner Perkins Caufield & Byers
LP	Limited Partner
LSI	LSI Corporation
M&A	Merger and Acquisition
MOX	Morgan Stanley Internet Index
MW	Megawatts

NASDAQ	National Association of Securities Dealers Automated Quotations
NVCA	National Venture Capital Association
NYMEX	New York Mercantile Exchange
PC	Personal Computer
PLXT	PLX Technology
PV	Photovoltaic
R&D	Research & Development
R&D	Research and Development
SD	Standard Deviation
Sequoia	Sequoia Capital
SOX	Philadelphia Semiconductor Index
SPGTCLNT	S&P Global Clean Energy Index
STP	Suntech Power Holdings
SUZ	Suzlon Energy
T-Mean	Geometric Mean
TAM	Total Available Market
TE	Thomson VentureXpert Energy/Industrial Returns
TI	Thomson VentureXpert Internet Returns
TS	Thomson VentureXpert Semiconductor Venture Returns
TSMC	Taiwan Semiconductor Manufacturing Corporation
TXN	Texas Instruments Incorporated
UMC	United Microelectronics Corporation
VantagePoint	VantagePoint Venture Partners
VC	Venture Capital
VC	XLNX Xilinx, Inc.

YGE	Yingli Green Energy Holding Company Limited
ZOLT	Zoltek Companies, Inc.

Abstract of Thesis Presented to the Graduate School
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Since 1970, the Venture Capital (VC) industry has been a catalyst for innovation and job creation in the U.S. Over the past 40 years, venture capitalists have invested approximately $456 billion in 27,000 companies that have created innovative companies including FedEx, Starbucks, Google, Microsoft, Yahoo, Cisco, eBay, Genentech, Intel, Apple, Twitter and Facebook.

This thesis analyzes the returns to VC funds relative to the returns to publicly traded firms in similar industries over the period of 1990 until 2008. I report striking differences from the 1990 to 1999 time period and from 2000 until 2008 in venture capital returns relative to the public markets. The venture capital industry experienced a very robust and persistent growth period during the 1990s with a virtual explosion of capital inflows between 1998 and 2000. During this period VC returns and public technology stock returns were very high. In addition, VC returns were higher than the returns to the publicly traded firms and benchmark indices.

Since 2000, VC returns have been low. This is not surprising since the dramatic decline in technology stock valuations has resulted in overall lower exit multiples for VC funded exits. The striking result that I document is that VC returns have actually been

lower than the returns to publicly traded technology firms. I argue that this under-performance occurred simply because VC funded entities were not particularly successful. They were not innovators and creators of new industries during this time period.

The industry dynamics and correlations between VC returns, technology stocks and the broad market returns, for three historically important VC funded sectors, is provided in this analysis and support my thesis. Since the inception of the venture capital industry in the late 1960s through the 2000s, the areas of investment have changed over time in response to industry maturation cycles. VCs found opportunities with accelerated innovation or rapid growth that were at an inflection point of change in various industries: personal computers, disk drives, semiconductors, telecommunication equipment, as well as some Internet categories. These all were once “Hot Sectors” and attracted substantial capital. As the 40-year technology innovation for transformation in the U.S. has slowed, the ability for U.S. VCs to generate returns in excess of public markets has dwindled to an elite few.

CHAPTER 1
VENTURE CAPITAL

Over the past 30 years, technology innovation, supported by venture capital investment, was a growth catalyst in the U.S. The Venture Capital Industry, at times, produced spectacular financial returns from a variety of industries including semiconductors, biotechnology, the Internet and optical communications, among others. During the late 1990s, after several years of high returns on venture capital prior investments, investor interest increased in the asset class. This interest in venture capital soared after 1995, with new commitments from limited partners (LP) rising 24.2 percent in 1996 to nearly $10.5 billion and then rising an additional 45.0% the following year. By 2000, new LP commitments reached $93.4 billion, more than 10 times the amount available in 1995[1]. VCs were searching for the next "Big Idea," and LPs were chasing returns above the public markets. However, the technology bust of 2000 began a decade of challenging times for the VC community, the number of IPOs declined, thresholds increased, investment holding periods increased, companies became more capital intensive and merger and acquisition (M&A) values declined.

The analysis was designed to study venture capital returns during the time periods of 1990-1999 and 2000-2009 and then compare the VC returns to U.S. public market benchmarks and individual stocks in 3 industries – Semiconductors, CleanTech and the Internet. These sectors have historically accounted for at least 20% of the annual investment by VCs at one time or another. For each sector, the venture return data was collected from the Thomson VentureXpert database and Cambridge Research LLC and then compared to the broader market performance of the Nasdaq Composite and

[1] NVCA

the Russell 2000 Index. Additionally in each sector, the specific industry venture returns were also compared to the public market performance of an industry specific index and at least 5 public companies. Other assets considered as industry growth catalysts were included to determine any impact of market conditions that could influence returns. Each sector analysis includes a returns correlation matrix, R^2 matrix, a covariance matrix and a beta matrix to determine the relationships among assets. Additionally, the data from the analysis was used to identify if there was a window of time for an optimal VC exit when recent initial public offerings (IPO) returns converge to either the industry benchmarks, the Nasdaq Composite or the Russell 2000 Index.

The Venture Capital industry historically was at the forefront of development of many new markets and companies creating clusters of entrepreneurs, utilizing industry contacts, adding management expertise and providing capital. By focusing on emerging sectors where new companies could become industry giants, the VC industry generated extraordinary returns for their investors. In March 2000, the NASDAQ market peaked at 5,132, which was 500% above its level in August 1995, the same time as the Netscape IPO. By 2002, the NASDAQ market had fallen to 1,185, and Silicon Valley was left stunned with estimated losses of $1 trillion in Silicon Valley's 150 largest companies. Venture capital returns have been struggling to recover ever since.

Venture Capital Returns

Silicon Valley's venture capitalists and their Limited Partners are feeling the effects of the technology crash a decade ago, as well as the confluence of events that occurred in late 2008. VCs have nearly been choked by a near stoppage of IPOs and declining M&A valuations. For the first time since the National Venture Capital Association (NVCA) has been tracking this data, in Q4 2008 and Q1 2009, there were not any IPOs

of VC-backed companies. For the calendar years of 2008 and 2009, there were only 7 and 9 venture- backed IPOs, totaling $600 million and $1.2 billion in proceeds respectively. There were 392 IPOs of venture-backed companies between 2001-2008, significantly lower than the 1,776 between 1992 and 2000. VCs are now far more dependent upon M&A for liquidity. During the period of 2002-2008, the median M&A exit ratio for the U.S was just 1.7x and by 2009, the ratio had dropped to .9x, which means that these investments are returning less than invested capital.[2] However, the M&A exit ratio for Chinese companies during the same period was 8.8x of invested capital, significantly higher than the U.S., Europe or Israel.

According to press releases by Cambridge Associates LLC, venture returns have declined significantly over the last decade. The rolling ten-year return, reported quarterly, was 8.4% as of September 30, 2009, down from 14.3% as of June 30, 2009 and down from 40.2% one year earlier. The decline in the 10-year rolling return data was not unexpected, as the lucrative 1999 dot.com exits are no longer included in the 10-year computation.

According to The National Venture Capital Association (NVCA) and Cambridge Associates LLC,[3] which is comprised of 1,287 venture capital funds, including fully liquidated partnerships formed between 1981 and 2009, the one-year return for venture capital was -12.44%, compared to the Russell 2000 index, which was -9.55%, and the Nasdaq Composite, which posted a gain of 1.46%. Cambridge Associates reports

[2] E&Y Venture Insights Q3 2009

[3] Cambridge Associates LLC notes in the report that since venture-backed companies usually require 5-8 years to mature that these funds are really too young to have produced meaningful returns, so returns to the benchmark statistic may be irrelevant but could be indicative of a trend.

quarterly results based upon the vintage year of a fund. For the analysis, reported quarterly net IRR returns were used from the Thomson VentureXpert database. Table 1-1 summarizes the returns for the Nasdaq Composite, the Russell 2000 Index and venture capital top quartile performing funds and overall venture returns for the periods between 1990-2000 and 2000-2008.

Table 1-1: Market Return and Standard Deviation[4]

	Nasdaq Composite Geometric mean return	Nasdaq Composite Std. Deviation	Russell 2000 Geometric mean return	Russell 2000 Std. Deviation	Top Quartile Venture Geometric mean return	Top Quartile Venture Std. Deviation	Overall Venture Geometric mean return	Overall Venture Std. Deviation
1990-2000	14.36%	.306	7.74%	.207	53.86%	.501	33.74%	.316
2001-2008	1.52%	.370	5.47%	.300	6.16%	.232	-1.55%	.168

During the period of 1990-2000, overall VC returns regardless of whether a firm was in the top quartile generated very high returns and with a standard deviation similar to the Nasdaq Composite. Since 2001, the top quartile of VC firms continued to outperform the Nasdaq Composite as well as the Russell 2000 Index, although by a much narrower margin. The overall venture returns during this period underperformed the Russell 2000 Index as well as the Nasdaq Composite, prior to any adjustment for liquidity. The volatility of VC returns dropped significantly during this period. Between 1990 and 2000, venture capital funds generated stellar returns on average of 33.74%, compared to 14.36% for the Nasdaq Composite and 7.74% for the Russell 2000, net

[4] The Nasdaq Composite and the Russell 2000 Index return calculations are the time-weighted average over the specified time periods calculated by using the annualized point to point quarterly returns. The venture capital returns were derived from the Thomson VentureXpert database and represent the Time Weighted annualized pooled average of over the specified time period. The Thomson database uses periodic IRRs based upon a defined sample set. According to Cambridge Associates LLC, the equal weighted pooled mean for venture returns for a 2000 vintage fund was -2.76%. The results may vary due to due to disparity of sample size.

returns in excess of the benchmark indices were 19.38% % and 26.00% respectively. Table 1-2 summarizes the return spread during the analyzed time periods.

Table 1-2: Venture Returns Compared to the Nasdaq Composite and the Russell 2000[5]

	Venture Top 20 Spread over the Nasdaq Composite	Venture Top 20 Spread over the Russell 2000	Venture Spread over the Nasdaq Composite Russell 2000 Std. Dev	Venture Top 20 Spread over the Russell 2000
1990-2000	39.50%	46.12%	19.38%	26.00%
2001-2008	4.63%	.69%	-3.07%	-7.02%

The overall venture returns are not only underperforming the broader market indices, but in some cases they are failing to return the invested capital. Vintage year venture funds raised in 1999 have paid just 0.63 times the amount of capital paid in by Limited Partners, while the 2000 vintage funds have returned just 0.38 times. Another measure of actual performance is cash and stock distributions compared to capital drawn down by VCs, as summarized in Table 1-3.

Table 1-3: Venture Capital Cash flow Summary[6]

	Capital Drawn Down by VC	Cash Distributions	Stock Distributions	Total Distributions	Percentage of Capital Returned
1990-2000	$52,865.83	$35,013.13	$37,974.99	$79,988.12	38.063%
2001-2008	$85,022.55	$58,428.07	$17,440.51	$75,868.58	-10.767%

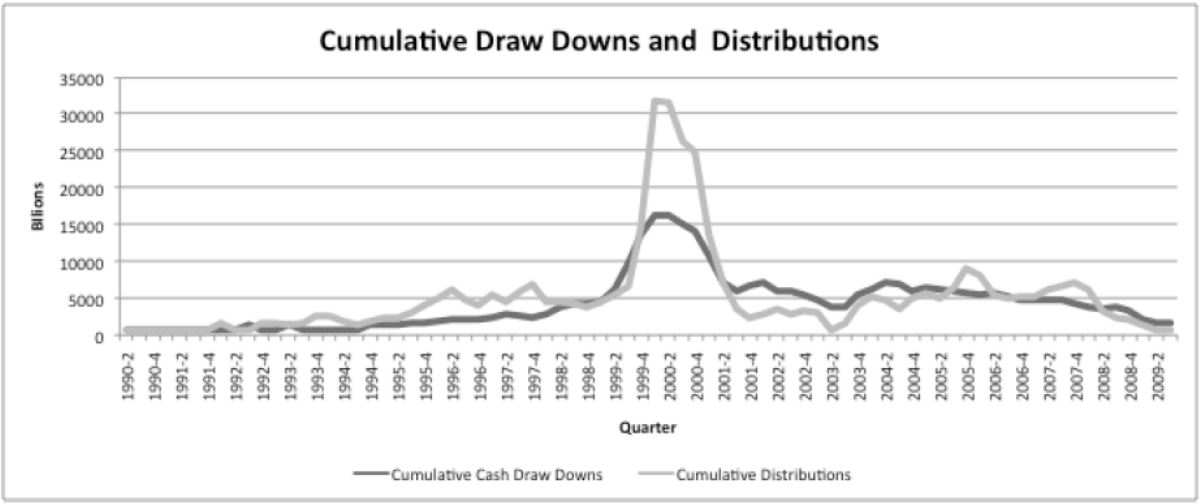
It is evident that there has been a performance shift in VC returns post 2000, which has persisted for the last 8 years. The market conditions that existed during the positive return period need to be examined further. The optimal time for a VC to invest is during the period of rapid and transformational industry innovation in emerging

[5] See footnote 4.

[6] Data was derived from Thomson VentureXpert. The sample size was $ 225,381.30 million. Average sample size was 897.

geographical markets or in emerging market segments. It is also extremely important that the environment is receptive to start-up companies; customers must be willing to purchase goods and services from a new market entrant. Historically, VCs that identified nascent market segments, ignored or dismissed by the large companies, that then underwent rapid innovation, generated substantial financial returns. It is evident that during the period from the mid-1990s to mid-2000, Venture Capital cumulative distributions to the LPs far exceeded draw downs by VC Firms

Figure 1-1. Rolling Cash Draw Downs v. Distributions



Source: Thomson Reuters @2009

The rapid innovation characteristic typical of successful VC industries was evident in semiconductors and the Internet markets and is apparent in the emerging CleanTech industry. In order for start -ups to succeed in the CleanTech sector, government policy and economic support, including financial subsidies to make the economics attractive for the ultimate customer must continue. Venture-backed companies face difficulties in competing in industries that favor the large incumbent, characterized by expensive and

long testing cycles, limited distribution channels and capital intensive. Additionally, industries that only require sustaining innovation are also unattractive. Incumbents can easily implement the next generation product, and they have significantly more knowledge regarding the industry development and the needs of customers. In transformational markets, the existing market leaders may not feel it is necessary to allocate resources since the perception is that market risk is high, timing is uncertain and the future return is unknown. Once an industry segment begins to mature by growth and profitability, the more established companies will enter the market and displace the start- ups, unless a strong company exists with the resources to ward off competition. Managing the exit strategy and timing is an important element of VC returns. The behavior of the "exit window" is important to understand; holding on too long as competition increases may compromise realized returns.

This thesis summarizes the observed correlation coefficients, geometric mean and average mean returns, as well as the Abnormal Return observations for three venture-backed industries: semiconductors, CleanTech and the Internet, which were then compared to benchmark indices and particular public stocks in each market segment. Additionally, the rolling beta of the overall venture industry, the Nasdaq Composite, the Emerging Market Index was compared to the S&P 500. The thesis includes the findings from the observed results and the potential implications for venture capital returns. Additionally, the final chapter analyzes the "convergence window" defined as the period of time for the correlations of the public companies to converge to the broader benchmark indices evident by an observed correlation coefficient in excess of >.50 for three consecutive quarters.

Over the past 30 years, VCs have pursued industries that have the potential to generate above market returns and from time to time adjusting their allocations to the "Hot Sectors" as return expectations adjust to changing market conditions. Identifying which future market will provide an accelerated growth opportunity for VCs has not been easily replicated, especially over the last 10 years.

Since the peak in 2000, when VCs invested $100.5 billion in 7,913 deals, VC investment totals have dropped in 2009 to $17.7 billion in 2,795 deals, marking the lowest level of dollar investment since 1997.[7] Later stage and expansion capital represented 64.50% of the capital invested in 2009, compared to 60.11% in 2000. The challenge for VCs is to identify market opportunities, find qualified management teams that can commercialize potentially disruptive technology or create an emerging market segment; a necessary condition for start-ups to succeed and for VC to generate above public market returns.

Literature Review

Many academic papers have been written regarding the VC industry, but few have examined the correlation and relationship, by sector, between the VC industry, specific industry indices and public market comparables. Very few research papers have been written that address the market and technology environment that existed pre-2000 that enabled VCs under favorable market conditions to generate attractive returns.

In examining Venture Capital behavior, several papers have been written to address the timing of influx of capital. In the paper "Venture Capital Investment Cycles: The Impact of Public Markets," (2005 Gompers, Lerner and Sharfstein) they find that

[7] PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Data: Thomson Reuters.

venture capitalists with the most industry experience increase their investments the most when public signals become more favorable. The authors believe that venture capitalists rationally respond to attractive investment opportunities signaled by public markets shifts. This is consistent with why VCs flock to industries simultaneously and have a general belief that the "rising tide lifts all boats," referring to a market segment that is recognized as "attractive" by the public markets defined by a high P/E rating and market capitalization. The Price Waterhouse MoneyTree data that shows that VC investment peaked in 2000 supports this theory.

However, the flow of funds into venture capital investments may in fact be negatively correlated to the returns generated by venture capital firms. According to the Price Waterhouse Coopers MoneyTree Report, which is a quarterly study of venture capital investment activity in the U.S. and is a collaboration between PricewaterhouseCoopers and the National Venture Capital Association based upon data from Thomson Reuter, the flow of funds into the semiconductor, Internet and telecommunication market at the peak of Nasdaq. The behavior of venture capital returns by sector should be examined to fully understand the impact of an industry life cycle.

The volatility of venture returns, the flow of funds and the types of investments made in any given year in the venture capital industry is also well documented, however the "reason for the variation in returns is often ignored as sectors are abandoned." What happens to the returns over time that have IPOs or sectors out of favor should be examined to understand the full life cycle of an industry segment?

The flow of funds into the industry is highly correlated to an increase in IPO valuations. which leads to additional venture capital firms to raise additional funds (Gompers and Lerner 1998b; Jeng and Wells, 2000). Moreover, returns of venture capital funds tend to be highly correlated with the returns of the market as a whole (Cochrane, 2005; Kaplan and Shoar 2005; Ljundvist and Richardson, 2003). However. the correlation to the public markets varies over time and by industry segment, which reflects the maturation of particular industry segment over the life cycle. The growth of the venture capital industry in the early 1980s and the unprecedented growth in venture capital fundraising in the 1990s were matched by a rise and fall in the IPO market activity. This suggests that both venture capital firms as well as the LPs use the public market and IPO activity as a signal for the potential for returns, rather than the actual returns or cash distribution on a risk adjusted basis.

The volatility of the number of investments made in a specific industry is often the subject of academic inquiry (e.g., Sharfstein and Stein, 1990), which addresses the fluctuation in venture capital investment activity. An influx of capital into a specific sector may be a response that venture capitalists feel compelled to follow the "herd" for the reputation consequences of being an industry contrarian or left out. VCs also find that participation by a co-investor is preferred, with the expectation that the other firm will reciprocate in the future (Lerner 1994a). Second, by sharing the due diligence, VCs can correlate market signals and thereby may select better investment opportunities in situations of uncertainly and return potential Wilson (1968), Sah and Siglitz (1986). Finally, VCs tend to have expertise that is both sector-specific and location-specific, and syndication can assist with information across industry boundaries, allowing VCs to

diversify their portfolios (Stuart and Sorenson (2001). The number of firms pursuing an investment opportunity is often perceived as a quality indicator. When a VC invests alongside another reputable firm with prior experience and expertise in a particular sector, the co-investor taking the same risk often justifies the investment decision. Additionally, building a syndicate often reduces the risk of capital available for follow on financings.

Academic papers that have attempted to address the driver behind the venture capital industry have examined the number of patents, levels of R&D spending and venture capital funding (Hellman and Puri, 2000), as well as what Kortum and Lerner (2000) focused on, which is the surge of venture capital funds after 1978, when the U.S. Department of Labor freed pensions to invest in venture capital as well the ratio of patents to R&D spending, rather than patenting. Kortum and Lerner (2000) concluded that patent filing patterns across industries over a three-decade period suggest that the impact on venture capital and technological innovation is positive and significant. They suggest that venture capital accounted for 8% of industrial innovations in the decade ending in 1992. A common conclusion among academics is that venture capital spurs growth and innovation of new firms. Another view is that when new opportunities arise for new firms to innovate, these companies require funds from venture capitalists and as a consequence venture capital investments in a sector increase. Although prior research attempts to get to answer the question of the underlying drivers of venture returns and the impact of technological innovation opportunities, the understanding of the market conditions that need to exist for venture returns, in excess of market returns to justify the risk, needs additional research. The recent collapse in venture activity for

innovation was the subject of Lerner and Schiff (2002) as well as Gompers and Lerner (2001). They concluded that while venture capital has a powerful impact on innovation, it is far from uniform. Boom periods lead to overfunding of particular sectors, which then can lead to a sharp decline in venture fund effectiveness. Additionally, Hirukawa and Ueda (2008) issued a discussion paper on “Venture Capital and Innovation: Which is first”. According to the paper, over the last 30 years, public and private pension funds as well as sovereign wealth funds have increased their allocations to venture capital, with the belief that venture returns can increase their overall returns above the public market returns over a period of time suggesting that there is not an issue with “too much money” in the industry. On the other hand, Black and Gibson (1998) argue that robustness of the venture capital market depends upon a vibrant public market that allows venture- backed companies to IPO. They point out that few firms went public in 1970s and very little venture capital was raised, which was true, but other factors such as the development of the industry and the restriction on pensions to invest money in the asset class are relevant facts. The quality of venture capital firms and their impact on the success of a startup has been studied. Hochberg, Ljundgvist, Lu (2005) analyzed that VC Funds with more influential networks have significantly better performance, as measured by the proportion of portfolio company investments that are successfully exited through an IPO or a sale to another company.

Other papers discuss measuring risk for venture capital (Woodward, SandHill Econometrics 2009), which addresses the issues of how to measure risk when stale valuations are present. Since venture capital funds are organized as limited partnerships, and these investment funds are carve-outs of the 1940 Investment

Company Act and therefore, prior to 2008, they were exempt from marking to market or to report valuations in a standard format, except as required by the limited partners. As part of the larger move toward fair value accounting, venture capital firms are required under the Financial Accounting Standards Board Accounting Standards Codification (ASC) 870, formerly FAS 157, to mark their portfolios to market on a quarterly basis. Even with the revised accounting standards, the requirement to mark for a venture capital investment is a challenging exercise given the illiquid nature of the assets in the portfolio, the standard set of criteria such as which market comparables that should be used, the discount for revenue projections given the level of uncertainty in the business plan and nascent aspects of the industry development, dilution for future rounds of financing as well as IPO dilution, the impact of the liquidation preference for preferred shares and a control position in an IPO or in the event of M&A. The assessment is highly judgmental and mainly based upon market comparables and analogous events.

Since VC firms are ranked by their reported internal rate of return (IRR) to the LPs, few will take the risk of potentially under-valuing their portfolio in fear of being ranked lower than their peers. Pre-2008, most venture capital firms valued their portfolio holdings annually at either the price of the last round or a significant event such as an IPO, new round of financing, acquisition or shut down. Therefore, valuations reflected the view of the venture capital market rather than asset appreciation. Flag Venture Management (2002) stated that “Start up companies simply have too many moving parts, each and every quarter… a single contract or strategic partnership won or lost, product development delayed, a patent awarded to permit a meaningful valuation for

even the briefest period of time."[8] The late 1990s, valuations for venture-backed companies, especially in the Internet, increased substantially regardless of the company's actual growth or profits. The valuations of the venture-backed companies were based upon market perception and fierce competition among VCs for deals by other firms. The valuation of a venture portfolio reported to the Limited Partners, even under FASB 157, is unrelated to the "current value of the assets" especially of an early stage company. The only measurement of value is the market clearing price, which generally reflects the potential future value. VC follow on financing are often based upon non-quantitative measurements. Late stage or pre-IPO round valuations can often surpass the public market comparables. Venture capitalists often choose the most attractive set of comparable, winners in their respective market segments to justify valuations.

Additionally, there are times when venture capitalists have made investments in early stage companies that do not require substantial rounds of follow on investments and those may prove to be more valuable than the carrying cost. On the other hand, the companies that have created a new market segment may be undervalued, and current market comparables may not reflect the high growth rate. Because the reported returns may not reflect the actual return, determining the relationship to public market securities or industry benchmarks is challenging. However, over time, a comparison of the returns should prove valuable as an evaluation of the maturity market segment and the potential linkage to the public markets. Attempts to overcome the portfolio valuation issue were examined in a paper by Emery (2003), where returns over longer

[8] Beyond the J Curve, Managing a Portfolio of Venture Capital and Private Equity Funds written by Thomas Meyer and Pierre-Yves Mathonet (September 2008).

time periods were used to overcome stale pricing problems. A related study is Gompers et al. (2006), which indicates that a large component of success in entrepreneurship and venture capital can be attributed to skill rather than luck. They show that entrepreneurs with a track record of success are more likely to succeed than novice entrepreneurs and those who have previously failed. They also find that funding by more experienced VCs enhances the chance of success but only for entrepreneurs without a track record of success.

During the period between1970-1999, technology innovation was in full speed in the U.S. in areas such as semiconductors, telecommunications, wireless and broadband, that led to the Internet revolution. The growing demands for computers were driven by advancement in science, industry and the government and created an opportunity to commercialize technology development in semiconductors as well as personal computers. As highlighted in the book “Making Silicon Valley: Innovation and the Growth of High Tech 1930-1970,” by Christophe Lecuyer, the rise and growth of technology innovation in Silicon Valley was not an accident but made possible by 40 years of accumulated skills and competencies with expertise in manufacturing, product engineering, sales and marketing. The companies in Silicon Valley were able to capitalize on the demand for high performance electronic components in World War II and the Cold War driving technology innovation in reliability and commercial production.

CHAPTER 2
DATA DESCRIPTION

The data set composition consists of venture returns specific to each industry from the Thomson VentureXpert database, using the Cap Weighted periodic IRRs as well as the annualized point to point quarterly returns for the Nasdaq Composite and the Russell 2000 Index. Additionally, for each sector a minimum of 4 public stocks as well as an industry-specific benchmark index, again using the annualized point to point quarterly returns was included. The correlation coefficients among the public stocks are based upon daily returns. The correlation coefficient to the Thomson venture returns are based upon quarterly periodic IRRs to the quarterly point to point returns of the public stocks. The correlation to PC sales and solar module sales was based on annual growth of the assets to the annual average growth of the other assets.

The semiconductor segment included more public stocks and only one industry benchmark, the SOX Index. The public semiconductor stocks include a sampling of small as well as more established companies. The broader definition of the Energy/Industrial sector used by the Thomson VentureXpert to calculate the CleanTech industry performance is often debated as to its applicability to the revitalized CleanTech industry, which is a broad term encompassing not only energy generation and energy storage but also EV transportation. The solar segment was emphasized due to the amount of data available compared to other CleanTech sectors and its inclusion in the venture database as well as the industry index funds. For the Internet market, the appropriate mix of public stocks included companies in search as well as e-commerce and one industry index. The objectives of the analysis were as follows:

(1) Analyze industry specific venture returns compared to the Nasdaq Composite and the Russell 2000 for a variety of time periods, including: 1990-1995, 1995-2000, 1998-2000, 2000-2008, 2007-2009;

(2) Analyze the performance of the Thomson Semiconductor (TI) annualized quarterly Cap Weighted Periodic IRR returns to the Time Weighted annualized point to point quarterly returns for the public stocks and indices including; Nasdaq Composite (IXIC), the Russell 2000 Index (RUT), the Philadelphia Semiconductor Index (SOX), Intel (INTC), Applied Materials (AMAT), Texas Instruments (TXN), Xilinx (XLNX), PLX Technology (PLXT), and Advanced Analogic Technology (AATI) as well as for PC Sales (PC);

(3) Analyze the performance of the Thomson Energy/Industrial (TE) returns to the Nasdaq Composite (IXIC), the Russell 2000 Index, The Wilderhill Index (ECO), The Cleantech Index (CTIUS), the NYMEX Crude Oil Futures (CIc1), the S&P Global Clean Energy Index (SPGTCLNT). Stocks also included in the analysis were Zoltek (ZOLT), Suntech Power (STP), First Solar (FSLR) and Yingli (YGE) and EnerNOC (ENOC) using the same methodology as the semiconductor market. The time periods prior to 2000 were eliminated due to insufficient data;

(4) Analyze the Internet Sector including the performance of the quarterly returns annualized for the Thomson Internet (TI) returns to

the Nasdaq Composite (IXIC), Russell 2000 Index (RUT), The Morgan Stanley Internet Index (MOX), Yahoo (YHOO), Google (GOOG), Amazon (AMZN), Sina (SINA), Priceline (PCLN) and PC sales (PC) again using the same methodology.

(5) Summarize the convergence observations and the potential impact on liquidity timing.

One of the benchmark indices chosen included the Russell 2000 Index, which measures the performance of the small-cap segment of the U.S. equity universe and is a comprehensive barometer and it completely reconstituted to ensure that larger stocks do not distort the performance and characteristics of the small cap universe and therefore it is a relevant benchmark for venture capital returns. The Russell 2000 index includes previously venture-backed companies including AMD, Amazon, AMAT, Broadcom, Cisco, First Solar, Google as well as Intel. The other market index chosen was the Nasdaq Composite as a measure of more broad public market performance. Its composition includes approximately 3,000 companies that trade on the exchange.

For the semiconductor market, the SOX Index, which was introduced on December 1, 1993, is the most widely recognized index that investors use to track the performance of semiconductor makers and equipment manufacturers. Because it tracks the cyclical semiconductor industry, it has been a very volatile over the years. Since the SOX is comprised of 18 stocks, of which 14 of the companies manufacture semiconductors and 4 produce semiconductor equipment, it is an indicator for the overall industry rather than a barometer of the growth companies in the sector. Additionally, it is a price-weighted index, meaning that firms with higher stock prices

have greater influence on the index, reflecting the large capitalization stocks and potentially having less relevance to venture-backed companies.

Specific industry benchmarks for the CleanTech sector included the WilderHill Index (ECO), created in 1994 to track the Clean Energy sector and emphasizing companies that benefit substantially from a societal transition toward use the of cleaner energy and conservation.[9] Stocks and sector weightings in the ECO Index are based on their significance for clean energy, technological influence and relevance to preventing pollution, including companies such as First Solar, JA Solar, Advanced Battery, Suntech, Gamesa, Suzlon as well a Portland General Electric. The Cleantech Index (CTIUS) claims to be the first and only index to reflect the surging demand for clean technology products and services. The Cleantech Index is comprised of 78 companies from the alternative energy, energy efficiency, advanced materials as well as power transmission sectors and includes companies such as Zoltek, Suntech, Suzlon, and First Solar among others.

The third industry analyzed was the Internet sector, and the industry benchmark index chosen was the Morgan Stanley Internet Index SM (MOX), which is one of the oldest indices in the sector with data available pre 2000. The MOX Index includes companies from 9 Internet subsectors: infrastructure, infrastructure services, consulting/services, portals, vertical portals, commerce, Internet/B2B software, B2B commerce, and multi-sector. The MOX Index also includes companies such as Amazon, AOL, Priceline.com, Yahoo and Microsoft.

[9] Wilderhill Index website.

Each section has a brief industry overview, summary of returns for each asset and correlation coefficients between and among assets in each industry as well as the abnormal returns for each period using the CAPM. The convergence analysis examines the dates at which the returns of the public companies begin to converge with the returns on the various benchmark indices to determine the amount of time after an IPO has an asset perform independently of the market benchmark index. The convergence analysis used a correlation coefficient of >.50 for a least 3 consecutive quarters.

CHAPTER 3
SEMICONDUCTOR INDUSTRY

The rise of Silicon Valley from the 1930s to the 1990s was a confluence of events influencing the technology innovation process, which was then shaped by successive waves of innovation and entrepreneurship. The formal beginning of the venture capital era can easily be linked with the development of the semiconductor industry and the advancement of a wide-array of electronics devices from the personal computer (PC) to the mobile phone as well as other related industries, which developed contemporaneously in Silicon Valley. When consumers required applications for the PC, the software industry responded to market needs and flourished, developing new applications increasing the utility of the home computer. Other peripherals, such as the hard disc drive, developed in response to the need for data storage driven by the new applications. The development of the telecommunications industry and the link to the PC industry creating a connected environment spawned the network equipment industry and a new way for enterprises to conduct business. The wireless market developed as consumers demanded mobility. The commercial development of the Internet linked everyone together, which was all part of the new technology ecosystem.

The semiconductor industry growth accelerated in the late 1960s, when entrepreneurs left established companies (predominantly Fairchild and RCA) and started more than 30 start-ups in Silicon Valley including Intel, Intersil, National Semiconductor and Advanced Micro Devices. As a result of these and other innovations, Silicon Valley's semiconductor industry accelerated in the 1970s with funding from early venture capitalists, angel investors and corporate development funds. The innovations developed by these new companies opened up a variety of

commercial sectors including the watch industry, consumer electronics, instrumentation, telecommunications as well as the auto industry, all made possible by a significant cost reduction of electronic functions. In the early days, the semiconductor entrepreneurs had little choice but to focus on nascent and niche markets such as pocket radios, hearing aids and military applications. However, over the next few decades, the technical innovations that would improve speed, capacity and cost eventually enabled the rise of the PC market revolution and a new group of start-ups such as Apple, Inc. (1977), Tandy Computer(1977) and Atari, Inc. (1972).[10] Intel's first RAM chip was developed in 1970 and the first microprocessor was in 1971. Further PC adoption was enabled by the floppy disk for storage and software for applications.[11]

The entrepreneurs in the semiconductor market created new markets for their products by engineering new end products and promoting these reference designs. The home computer became the personal computer. With the introduction of word processing, every PC became a typewriter and with the arrival of the modem, which permitted e-mail and Internet access, new consumer uses were discovered. The scope of PC applications ranged from games, spreadsheets and graphics, but an important impetus to sales growth was educational applications. It is not surprising that the correlation of PC sales to the Thomson Semiconductor reported IRR from 1990-2000 was .9750, which supports that the rate of innovation in the PC ecosystem had a significant impact on VC returns.

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[10] Incorporation dates are from Wikipedia www.wikpedia.com.

[11] Computer History Museum website www.computerhistory.org.

The relationship between computers and semiconductors emerged in the late 1960s. In 1968, military application accounted for 50% of semiconductor output, 30% of computer manufacturing and 20% of industrial goods. By 1979, military use accounted for only 10%, computers 30% and industrial and consumer goods 6%.[12] The semiconductor industry grew rapidly and doubled in growth from $41 million in 1964 to $120 million in 1966;by 1970 the market had reached $420 million.[13] In 1970, the Total Available Market (TAM) was $2.4 billion and the cost to build a foundry was estimated at $6 million. By 2005, the worldwide TAM for semiconductor had grown to $245 billion and the cost to build a new foundry had risen to approximately $3 billion. By the early 1970s, Silicon Valley was occupied by semiconductor companies, computer firms using their devices and programming and service companies serving both. Between 1968 and 1975, 30 venture capital firms were formed, including Mayfield fund (1968), Arthur Rock and Associates (1969), and Kleiner Perkins (1972).[14] The lure of new technologies and markets as well as the availability of venture financing led to the proliferation and growth of start- ups in the semiconductor industry. By 1980, there were 89 firms with $4 billion under management, and by 2004 there were 1,068 venture firms with $261 billion of capital under management.[15] Many believe that the availability of venture capital exploded after the successful IPO of Apple Computer that debuted with a $1.3 billion market capitalization in 1980.

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[12] *U.S. Department of Commerce, a report on the U.S. Semiconductor industry, page 8 Article Semiconductor productivity gains linked to multiple innovations – 1988. Mark Scott Sieling.*

[13] Making of Silicon Valley, Innovation and the Growth of High Tech, 1930-1970, page 255.

[14] Making of Silicon Valley, Innovation and the Growth of High Tech, 1930-1970, page 258.

[15] NVCA Yearbook 2004.

The venture capital industry continued to back new companies addressing new market sub segments in the semiconductor ecosystem. The availability of 3rd party design software gave way to Electronic Design Automation (EDA) market. Before the EDA market was established, semiconductors were designed by hand and manually laid out. ECAD (1982) was one of the early vendors of EDA software and was the foundation for Cadence,[16] which became a dominant market player. The original expert knowledge that was once required and limited to a few highly talented engineers had now been simplified.

The formation of the semiconductor equipment industry was a transitional point in the market development. Applied Materials (AMAT) was founded in 1967 and went public in 1972. AMAT's equipment and process technology innovation helped reduce the cost per transistor by 20 million times over the last 40 years[17]. Applied Materials' business model initiated a change in industry dynamics by encouraging semiconductor vendors to shift responsibility for development of manufacturing technology to equipment suppliers, third party sources of technology, which allowed semiconductor companies to focus on product development and applications rather than process and manufacturing expertise. This evolution led to the rise of a water foundry industry and the development of companies such as TSMC in 1987, UMC in 1980 and LSI Logic in 1981 all supporting a new breed of "Fabless" semiconductor companies that developed in the 1980s and 1990s.

[16] Wikipedia – overview of Cadence.

[17] Applied Materials website – www.appliedmaterials.com.

Venture Capital Returns in the Semiconductor Industry

In 2002-2003, VantagePoint Venture Partners developed a proprietary database of private venture backed semiconductor companies, which included 1,467 private semiconductor companies of which the investment team met with 30% (approx. 390) over a 1- year period. From the VantagePoint research, it was concluded that the cost of development of a single product had risen from $3 million in the late 1980s to $15 million to $20 million in 2003, depending upon the technology utilized. The data collected showed that approximately 3% of the companies surveyed had achieved sustainable revenue in excess of $10 million annually. Approximately 30% of those companies experienced flat revenue growth and had stalled at the $10 million level. It was concluded that meeting the "sustainable revenue" hurdle did not guarantee success or an eventual IPO.

A sampling of semiconductor venture-backed companies that went public revealed that the VCs whom invested in those companies realized an average of 5.65x cash on cash return. The median return was 2.85x. The companies included in the analysis followed by their incorporation date includes: AnalogicTech (1997), Atheros (1998), Hittite Microwave (1985), Ikanos (1999), PowerDsine (1999), Saifun (1996), Silicon Image (1995), SIRF (1995), Marvell (1995) and Volterra (1996). The time of investment dates back from 1997 to 2003. The average capital invested by the VCs in each company exceeded $90 million, which had become the benchmark of required capital for a Fabless semiconductor company using leading edge technology. The returns varied significantly depending upon investment timing, pre-IPO valuation, company gross margins and the amount of capital raised. Only three of the above-mentioned companies had generated returns in excess of 10x: Leadis, Marvell and PowerDsine.

Excluding these three companies, the average cash on cash return of the remaining companies was 4.21x and the median return was 2.70x. The cash on cash return numbers are based upon the IPO valuation, not the exit date which is unknown.

In 2004 and 2005, there were several venture-backed semiconductor IPOs. The group of companies that went public included AnalogicTech AATI (1997), PowerDsine, Volterra (1993), Ikanos (1999), PortalPlayer (1999), Saifun (1998), Leadis (2000) and Netlogic (1995). The average return to investors at the time of the IPO was calculated as 5.4x based upon data collected by VantagePoint Venture Partners. Of this group of companies, PowerDsine, PortalPlayer and Saifun were acquired post-IPO; AATI and Ikanos were trading below their IPO price. As of February 2010, Netlogic was trading at 2.46x while Volterra was trading at 1.47x of their respective market capitalizations at the time of their IPO.

The analysis by VantagePoint Venture Partners showed that the semiconductor market from 1980 to 2007 had a Compound Annual Growth Rate (CAGR) of 11.2% based upon data collected from the Gartner Group. The last six cycles had ranged from 3 to 7 years, with an average time peak to trough of 2.7 years. The cycle that ended in 2007 had an extended trough of approximately 2.5 years. It was also determined that the growth from 2003 to 2007 had slowed to approximately 7.7%. In 2007, the Global Semiconductor market was 268.9 billion, a 3.3% increase over 2006, and in 2008 the size of the market declined to 258.3 billion and again fell to 226.3 billion in 2009, representing a -12.4% change[18].

[18] iSuppli Corporation annual reports 2006, 2007, 2008 and 2009 found on www.Wikipedia.com. The figures exclude foundry sales.

It was clear that by 2007, the industry had become extremely challenging for venture-backed companies as the market leaders had more resources, more capital and more experience in developing complete applications. The venture-backed companies were also challenged to negotiate favorable foundry pricing with companies such as TSMC as they were focused on serving their largest customers, especially during periods of high foundry utilization. U.S. companies were also faced with market competition from Taiwan and China, where Fabless start-ups were catching up on design knowledge and were able to develop products at a lower cost and closer to the end customer. New entrants into the market such as Taiwan based Mediatek (1997) posed a difficult competitor for many Silicon Valley based companies in the consumer semiconductor market.

As the market continued to mature, start-up companies were facing other challenges such as the need for constant innovation and keeping up with Moore's Law.[19] In order to constantly adjust to the rapid pace of change in the market and the competition, start-ups were faced with significant challenges to refresh their products every 6 months requiring constant innovation and enhancements while the cost of development had increased substantially. At the same time, the rate of constant price-

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[19] Moore's Law describes a long-term trend in the history of computing hardware, in which the number of transistors that can be placed inexpensively on an integrated circuit has doubled approximately every two years.

The capabilities of many digital electronic devices are strongly linked to Moore's law: processing speed, memory capacity, sensors and even the number and size of pixels in digital cameras. All of these are improving at (roughly) exponential rates as well. This has dramatically increased the usefulness of digital electronics in nearly every segment of the world economy. Moore's law precisely describes a driving force of technological and social change in the late 20th and early 21st centuries. The trend has continued for more than half a century and is not expected to stop until 2015 or later.

The law is named after Intel co-founder Gordon E. Moore, who introduced the concept in a 1965 paper. It has since been used in the semiconductor industry to guide long-term planning and to set targets for research and development.

performance improvement in the semiconductor industry had been staggering and as a consequence, changes in the semiconductor market occurred extremely rapidly.

Semiconductors Industry Public vs. Private

Since the 1980s, the semiconductor industry has been considered to be the biggest driver of the technology economy, which was driven by the pervasiveness of semiconductor devices across all major end-markets. Two decades ago, the preponderance of semiconductor devices was targeted towards the PC industry. Today, semiconductors are ubiquitous in applications ranging from mobile phones and routers to heart monitors, automobiles, bar code readers and even children's toys.

To understand the nature of venture returns in the semiconductor market, it is illuminating to understand the relative performance of the Nasdaq Composite (IXIC), Russell Index(RUT) and the Philadelphia Semiconductor Index (SOX) as well as specific public market stocks to venture capital returns. The analysis includes Texas Instruments (TXN), Applied Materials (AMAT), Intel Corporation (INTC), Xilinx (XLNX), AnalogicTech (AATI) and PLX Technology (PLXT). These companies were chosen for their market leadership in innovation in a specific sub segment of the semiconductor industry.

The PHLX Semiconductor Sector (SOX) Index was introduced on December 1, 1993, with an initial value of 100 reached a high of 1,266.39 in July 2000. As of 12/29/2009, the SOX index closed at 356.18, substantially below the 2000 levels. The average value since inception was 404.24.

In the summary chart below, the time-weighted mean return or the geometric mean (T-Mean) the average mean (A-Mean) returns as well as the standard deviation (SD) was calculated for all of the assets.

Table 3-1: Semiconductor Returns Summary

	TXN		AMAT		INTC		XLNX		PLXT		AATI	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
1990-1995	44.08%	0.8575	57.17%	0.9442	35.52%	0.3585	78.14%	1.1740	-	-	-	-
1995-2000	40.06%	0.8806	29.20%	1.0316	24.10%	0.4248	40.66%	1.1215	-37.67%	-	-	-
1998-2000	20.96%	0.4572	22.41%	0.7297	15.29%	0.4854	29.96%	0.2891	-37.67%	-	-	-
1990-2000	31.85%	0.6774	32.11%	0.8448	25.32%	0.3534	43.13%	0.9444	-37.67%	-	-	-
2000-2008	-7.95%	0.2401	2.28%	0.8404	-5.08%	0.5347	-2.16%	0.7422	-11.50%	1.3659	-40.93%	0.9206
2007-2009	16.69%	0.4848	5.63%	0.2534	10.58%	0.3414	7.00%	0.3036	-26.65%	0.5956	-14.53%	0.8778

	IXIC		RUT		SOX		Thomson Semi		PCS	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
1990-1995	35.52%	0.3003	11.46%	0.2641	32.87%		27.55%	0.2415	18.63%	0.1254
1995-2000	24.10%	0.3207	6.31%	0.1259	25.20%	0.0021	51.55%	0.5861	41.81%	0.0292
1998-2000	15.29%	0.4862	-2.26%	0.0519	25.32%	0.0021	51.06%	0.8114	40.60%	0.0193
1990-2000	25.32%	0.3067	7.74%	0.2073	-13.10%	0.0021	33.61%	0.4214	28.83%	0.1510
2000-2008	-5.08%	0.3704	5.47%	0.3001	-9.64%	0.0102	2.20%	0.5415	16.01%	0.1188
2007-2009	10.58%	0.3465	-8.11%	0.2841	32.87%	0.0035	-10.34%	0.4446	18.25%	0.0073

During 1995-2000, the Thomson Semi returns outperformed the public market semi stocks, the SOX index, as well as the broader market indices, reflecting a period of rapid growth and significant changes in the industry. However post-2007, semi venture returns have turned negative and under-performed the larger established companies. During 1998-2000, with the proliferation of start-up Fabless companies, increased equipment and EDA software sales, all of the assets in the semiconductor industry performed exceedingly well. The flow of funds into semiconductor venture investments also rose substantially during the 1990s. From 1995 until 2000, the dollars invested by

VCs increased by 17.32x, and the number of investments increased from 60 annually to 265 companies.

The next section examines the correlation coefficients of returns among assets. During 1990-1995, a high growth period for semiconductor companies, the correlation coefficient of the stocks included to the broader market indices ranged from .5132 to .5749 to the IXIC and .3990 to .4370 to the RUT. The Thomson Venture correlation was within a range of .1211 to .4131 to all of the public stocks assets. Between 1990-1995, the correlation of the TS to PC sales was .9750, the R^2 was .9507, demonstrating the strong relationship between venture returns and innovation in the PC market that attracted new purchases. The public companies do not demonstrate the same behavior although they benefitted from the increase in PC sales directly or indirectly.

Table 3-2: Semiconductor Correlation Coefficient Matrix 1990-1995

Correlation	TXN	AMAT	INTC	XLNX	IXIC	RUT	TS	PC Sales
TXN	1.0000	0.4349	0.4954	0.4025	0.5254	0.4008	0.4131	0.5065
AMAT	0.4349	1.0000	0.3939	0.3625	0.5132	0.4040	0.2897	0.2743
INTC	0.4954	0.3939	1.0000	0.3385	0.5749	0.3990	0.2870	0.3555
XLNX	0.4025	0.3625	0.3385	1.0000	0.5185	0.4370	0.1211	0.2212
IXIC	0.5254	0.5132	0.5749	0.5185	1.0000	0.9169	0.1273	-0.1298
RUT	0.4008	0.4040	0.3990	0.4370	0.9169	1.0000	0.1371	-0.5075
TS	0.2750	0.3997	0.3062	0.3208	0.3932	0.3197	1.0000	0.9750
PC Sales	0.5065	0.2743	0.3555	0.2212	-0.1298	-0.5075	0.9750	1.0000

The period of 1995-2000 includes the SOX Index, which began trading in 1994 is included in the analysis from 1995 onward. The correlation coefficients for TXN, AMAT, INTC and XLNX increased from the 1990-1995 levels as their stock returns begin to converge to the broader market indices. Their correlations to the IXIC >.6122 to .6724,

less correlated to the RUT >.4630-.5324. However they are negatively correlated to the SOX index, a reflection of the composition of the SOX index, which was heavily weighted toward manufacturing companies. The Thomson venture correlation remains relatively low to all. The semiconductor market peaked in 1995, hit the trough in 1996 and then begin its upturn in 1997 during the Asian financial crisis, which impacted the market.

Table 3-3: Semiconductor Correlation Coefficient Matrix 1995-2000

Correlation	TXN	AMAT	INTC	XLNX	IXIC	RUT	SOX	TS	PC Sales
TXN	1.0000	0.6341	0.5525	0.5937	0.6346	0.5324	-0.3411	0.2547	0.3015
AMAT	0.6341	1.0000	0.5741	0.5873	0.6321	0.5093	-0.6776	0.3181	0.3974
INTC	0.5525	0.5741	1.0000	0.5462	0.6724	0.4630	-0.8516	0.2824	0.6714
XLNX	0.5937	0.5873	0.5462	1.0000	0.6122	0.4952	-0.9597	0.2596	-0.0663
IXIC	0.6346	0.6321	0.6724	0.6122	1.0000	0.8806	-0.9122	0.4735	0.1062
RUT	0.5324	0.5093	0.4630	0.4952	0.8806	1.0000	-0.7494	0.3538	0.3693
SOX	-0.3411	-0.6776	-0.8516	-0.9597	-0.9122	-0.7494	1.0000	0.3189	-
TS	0.2399	0.2509	0.2650	0.3143	0.4684	0.3544	0.3189	1.0000	-0.1922
PC Sales	0.3015	0.3974	0.6714	-0.0663	0.1062	0.3693	-	-0.1922	1.0000

In examining the specific period between 1998-2000, the bubble period, there was an increase in the correlation coefficients of all assets, excluding the SOX, to the Nasdaq Composite and the Russell 2000. PLXT, a small Fabless company founded with less than $5 million of venture capital, was added to the analysis to determine if the behavior of a recent smaller IPO company was different than the more mature companies. PLXT's correlation to the larger semiconductor companies is lower and also negatively correlated to the TS. During the bubble years, the correlation coefficients and R^2 of the semiconductor companies and the TS to PC sales was in the range of .8595 to 1.0000. There were strong PC sales in preparation for the Y2000 transition.

The TS correlation to PC sales was .9523. The R^2 for all of the assets to PC sales ranged from .7387 to 1.0000.

Table 3-4: Semiconductor Correlation Coefficient Matrix 1998-2000

Correlation	TXN	AMAT	INTC	XLNX	PLXT	IXIC	RUT	SOX	TS	PC Sales
TXN	1.0000	0.6494	0.5400	0.6153	0.2975	0.6642	0.5792	-0.3411	0.2172	1.0000
AMAT	0.6494	1.0000	0.5834	0.6322	0.3226	0.6641	0.5475	-0.6776	0.5133	0.9431
INTC	0.5400	0.5834	1.0000	0.5611	0.2317	0.6790	0.4765	-0.8516	0.2123	0.8595
XLNX	0.6153	0.6322	0.5611	1.0000	0.3083	0.6629	0.5643	-0.9597	0.4057	0.9621
PLXT	0.2975	0.3226	0.2317	0.3083	1.0000	0.4243	0.4107	-0.7652	-0.2201	
IXIC	0.6642	0.6641	0.6790	0.6629	0.4243	1.0000	0.8805	-0.9122	0.5125	0.9831
RUT	0.5792	0.5475	0.4765	0.5643	0.4107	0.8805	1.0000	-0.7494	0.3029	-0.2649
SOX	-0.3411	-0.6776	-0.8516	-0.9597	-0.7652	-0.9122	-0.7494	1.0000	0.4158	-
TS	0.4344	0.5053	0.3186	0.5334	-0.2436	0.5115	0.2896	0.4158	1.0000	0.9523
PC Sales	1.0000	0.9431	0.8595	0.9621		0.9831	-0.2649	-	0.9523	1.0000

In summary, during the decade of 1990-2000, the returns for an investor buying public market semiconductor securities in 1990, as the market for semiconductor applications was growing rapidly, were impressive. During the period between 1990 and 2000, TXN returned 4,931%, AMAT 8,765%, INTC 5426%, XLNX 6093%. During this same period, $100 investment into the Thomson Semi would have yielded $673 in 2000. Between 2000-2009, $100 invested in TS would have generated a negative return of 25%. TXN negative 53.26%, AMAT negative 62.34%, INTC negative 56.32%, XLNX negative 47.90%, and PLXT were down -85.65%.

The next period of 2000-2009 was difficult for the semiconductor market as it encountered a long cyclical downturn after the technology crash. The correlation coefficients of the more mature companies such as TXN, AMAT, and INTC increased further to the broader markets as they matured and earnings growth slowed down. The Thomson Semi continued to demonstrate a low correlation to the industry, PC sales and

as well as to the broader markets. Between 2000 -2008, the average return for VC backed semiconductor investments was -.11%. From 2002 to 2008, venture capital investments into private semiconductor companies remained relatively constant at approximately 50% of the capital in 2000, reflecting the relatively poor returns and the diminishing opportunities for start-ups to differentiate themselves against the market leaders. In 2009, as a result of poor returns over the last decade, venture capital investments into the semiconductor market was down to $1.6 billion and only 47 companies received funding globally. The market has matured and technology innovation has slowed impacting returns in both the public market as well as new investments. In the analysis between 2000-2008, AATI, a venture -backed company was added to the list of assets.

Table 3-5: Semiconductor Correlation Coefficient Matrix-2000-2008

Correlation	TXN	AMAT	INTC	XLNX	AATI	PLXT	IXIC	RUT	SOX	TS	PC Sales
TXN	1.0000	0.6956	0.6476	0.6871	0.3567	0.3980	0.6968	0.5694	-0.0658	-0.3389.	0.8436
AMAT	0.6956	1.0000	0.7052	0.7170	0.3967	0.4054	0.7427	0.5913	-0.0781	-0.2044	0.8654
INTC	0.6476	0.7052	1.0000	0.6807	0.4259	0.3864	0.7671	0.6020	-0.0487	-0.2769	0.8237
XLNX	0.6871	0.7170	0.6807	1.0000	0.4222	0.3992	0.7447	0.5897	-0.0812	-0.2032	0.8699
AATI	0.3567	0.3967	0.4259	0.4222	1.0000	0.3171	0.5318	0.5307	0.4994	0.1143	-0.2804
PLXT	0.3980	0.4054	0.3864	0.3992	0.3171	1.0000	0.4914	0.4452	-0.1170	-0.2201	0.2638
IXIC	0.6968	0.7427	0.7671	0.7447	0.5318	0.4914	1.0000	0.8718	-0.1642	-0.2684	0.7822
RUT	0.5694	0.5913	0.6020	0.5897	0.5307	0.4452	0.8718	1.0000	-0.0119	-0.1265	0.4431
SOX	-0.0658	-0.0781	-0.0487	-0.0812	0.4994	0.2494	-0.1642	-0.0119	1.0000	0.0955	-0.2690
TS	0.2402	0.2462	0.1004	0.0539	0.3279	0.1081	0.1813	0.2576	0.0955	1.0000	-0.0434
PC Sales	0.8436	0.8654	0.8237	0.8699	-0.2804	0.2638	0.7822	0.4431	-0.2690	-0.0434	1.0000

The correlations of the large semi companies are highly correlated to the broader markets. The Thomson Semi correlation to the public companies turns negative despite

15 successful exits for VC backed companies between 2005 and 2009. In September 2009, only 1 of those venture- backed companies was trading above its opening share price. The last semiconductor IPO was in December 2007. The 800+ remaining private companies must rely upon M&A, even for a positive outcome, valuations (Teknovus, Dune in 2010) is in the $100 million compared to $400 million prior to 2000. AATI and PLXT, market capitalizations below $500 million, are less correlated than the larger more mature companies. All assets show a low correlation to PC sales.

By 2007-2008, the public market semiconductor companies are significantly more correlated to the broader market indices and the industry leaders such as INTC, TXN and AMAT signaling maturity of the industry segment. The Thomson Semi remains either negatively correlated or just slightly correlated to the public comparables. The correlation to PC sales has diminished, except for TS,which remains highly correlated.

Table 3-6: Semiconductor Correlation Coefficient Matrix 2007-2008

Correlation	TXN	AMAT	INTC	XLNX	AATI	PLXT	IXIC	RUT	SOX	TS	PC Sales
TXN	1.0000	0.6597	0.7210	0.6853	0.4086	0.4221	0.6952	0.6396	0.9411	-0.3418	0.1305
AMAT	0.6597	1.0000	0.6989	0.6798	0.4226	0.4386	0.7250	0.6819	0.6468	-0.1771	0.4424
INTC	0.7210	0.6989	1.0000	0.7159	0.4763	0.4520	0.8254	0.7407	-0.0658	-0.1187	0.4930
XLNX	0.6853	0.6798	0.7159	1.0000	0.4855	0.4405	0.7449	0.6862	0.9033	0.1548	0.1155
AATI	0.4086	0.4226	0.4763	0.4855	1.0000	0.3688	0.5669	0.5665	0.4442	0.1939	0.2785
PLXT	0.4221	0.4386	0.4520	0.4405	0.3688	1.0000	0.5347	0.5666	0.1617	-0.3457	0.4263
IXIC	0.6952	0.7250	0.8254	0.7449	0.5669	0.5347	1.0000	0.9467	0.1403	0.1118	0.4646
RUT	0.6396	0.6819	0.7407	0.6862	0.5665	0.5666	0.9467	1.0000	0.6723	-0.0098	0.2740
SOX	0.9411	0.6468	-0.0658	0.9033	0.4442	0.1617	0.1403	0.6723	1.0000	0.4630	-0.8360
TS	0.6905	0.6864	0.4728	0.3083	0.4442	0.6885	0.5464	0.4650	0.4630	1.0000	0.7828
PC Sales	0.1305	0.4424	0.4930	0.1155	0.2785	0.4263	0.4646	0.2740	-0.8360	0.7828	1.0000

The semiconductor industry has matured and market growth has slowed. The opportunity to identify a start up that could create a new market segment will be quite

difficult unless new applications emerge related to a new industry such as CleanTech since there is substantial overlap in skills. Venture activity in the sector has declined dramatically since 2000. In 2009, venture investment in the semiconductor space totaled $1.16 billion. The number of investments paled in comparison to other categories such as biotech, Internet, and CleanTech. Capital efficiency, industry cyclicality and the relatively low exit multiples are three obvious reasons. It can cost perhaps as much as $100 million to get a leading-edge digital chip to the market, in what becomes a bet-the-company bid to hit a market just as it’s taking off.

CHAPTER 4
CLEANTECH INDUSTRY

Over the past 30 years, the VC industry has shifted its focus from time to time to find the dynamic, fast growing, high potential return industries for investment. The computer hardware, computer software, medical devices and Internet-specific companies all for a relatively brief period of time were the single largest recipient of venture capital investments. The focus has now shifted to the CleanTech industry.

In the early 1980s, in the immediate aftermath of the energy crises of the 1970s and early 1980s, energy-related venture capital investments were the largest recipient of U.S. venture capital. Since 1999, oil prices have increased from a low of $17 per barrel to over $50 per barrel in 2005, reaching their peak in July 2007 of $147.27 per barrel that attracted significant amounts of investment and attention. Between 2005 and 2008, the VC CleanTech sector attracted $14.8 billion of capital. [20] Between 2004-2008, VC increased the dollars invested in CleanTech by 53% CAGR.[21] However in 2009, the investment in the global CleanTech sector was approximately $5.613 billion down 33% from 8.4 billion in 2008.[22] Since 2005, as a reaction to the increase in oil prices in 2003-2004, VCs shifted their focus to the “Green” or CleanTech sector. The media attention and government focus surrounding the industry has been significant driver of investment activity. Financial incentives in the form of grants, tax credits and subsidies from governments around the world are critical for market development. Favorable Renewable Energy policies are part of the attraction for VCs, along with

[20] Cleantech Group LLC.

[21] Cleantech Group LLC.

[22] Cleantech Group LLC.

rising global demand for energy, resource constraints, increasing environmental pressure high oil prices and urbanization. The challenge for VCs is that the CleanTech sector although undergoing rapid transformation, in many facets, is different and more challenging; capital efficiency, the time and scale necessary to develop projects, as well the involvement from the government to set favorable policies to support the economics is unparalleled.

In emerging countries such as China, the government is focused on increasing renewable energy generation to 20% by 2020 to reduce its dependency upon traditional energy sources, which is necessary for continued economic growth. The government is therefore a participant in the market development, fostering new company development and coordination. Over the last decade, China has experienced a significant surge in electricity and oil usage fueled by urbanization and the growth of the middle class, which is expected to continue for at least the next decade. China's mandate for renewable energy has positive economic implications for its future and for the development of the sector in China.

VCs returns in the U.S. are dependent upon three conditions first, oil prices rise to a sufficient level to inflict economic pain on the consumer, enterprises, the usage of oil and coal increases beyond a "normal" growth rate due to the strains of emerging economies such as China and India, government intervention into the economic equation with incentives to adopt renewable energy and new energy bills mandating certain objectives.

By the early 1990s, energy investments were attracting less than 3% of all U.S. venture capital and by 2000 these investments accounted for only 1% of the $119 billion

invested that year by the U.S. venture capital community.[23] The significant increase in oil prices from 2002-2004 correlates with a revived interest in the sector by venture capital firms. In 2002, VC invested approximately $883 million and by 2008 the dollar invested increased to $8.4 billion.[24] The significant increase was between 2005 and 2006, when the amount invested increased from $2.07 billion to $4.5 billion. However, in 2009, almost 20 years later, the CleanTech sector represented 27%, approximately $5.9 billion, of all venture investments in the U.S.[25] The number of firms investing and building dedicated resources has also increased. The number of firms between 2004 and 2008 that invested in CleanTech increased from 30 to 117.[26] In 2004, there were 9 dedicated CleanTech funds, rising to 39 by the end of 2008.[27]

The CleanTech sector has once again attracted investment by corporate venture funds including BP, Chevron, Applied Materials, GE and DuPont. The corporate VC re-emerged in the CleanTech sector as large companies seek to diversify their products and services and offer venture-backed companies access to the market. In 2007, for instance, Chevron Texaco Technology Ventures invested in three CleanTech companies: BrightSource Energy, a developer of utility-scale solar plants; Konarka Technologies, a developer of photovoltaic materials; and Southwest Windpower, a producer of small wind turbines. Semiconductor equipment manufacturer AMAT,

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[23] The Price Waterhouse Coopers, data used in the analysis, defines the Energy/Industrial sector to include environmental, agricultural transportation, manufacturing, construction of utility related products and services.

[24] The Cleantech Group LLC - www.cleantechgroup.com.

[25] The Cleantech Group LLC - www.cleantechgroup.com.

[26] 2009 Preqin Private Equity Cleantech Review.

[27] 2009 Preqin Private Equity Cleantech Review.

diversified into the solar industry by a series of acquisitions coupled with internal development. AMAT's acquisitions in CleanTech include Italian microelectronics maker Baccini, for $334 million in early 2008 Switzerland-based HCT Shaping Systems SA, a producer of thin-film silicon wafer technology, for $438 million in 2007; and Applied Films Corp a Colorado-based producer of thin-film technology, for $464 million in 2006.[28]

Venture Capital Returns in Cleantech Industry

In 2009, venture investments in CleanTech were down 33% from the record level of 2008. However, investment in the CleanTech sector declined less than other venture-backed sectors. The top CleanTech sectors for investment included solar 21%, transportation including electric vehicles and batteries 20%, energy efficiency 18%, biofuels, and Smart Grid and water were all less than 10% of the overall amount. A study conducted by the CleanTech Venture Network found that between 1999 and 2005, more than $7.3 billion of venture capital was invested in CleanTech companies in 1,085 investment rounds going to 628 companies in the US and Canada. The average investment amount per round was $6.7 million, and by 2008 the amount had risen to $16.2 million, which can be misleading given the amount of capital invested in some of the more high profile companies.

The development of market leaders in the CleanTech industry has been unlike other venture-backed industries. The CTIUS index includes 78 CleanTech companies of which less than five were U.S venture backed companies. The majority of the companies, which are heavily weighted in the industry indices, have been in business

[28] www.cleantech.com; www.appliedmaterials.com.

for more than 20 years or were incubated in large companies before being divested. First, Solar, founded in 1999, had a history of technology development that goes back decades. Harold McMaster, who made his first fortune in the late 1940s with Permaglass, founded FirstSolar. McMaster was one of the world's experts on tempered glass. He began working on solar cell development in the 1980s. The primary and early investor in First Solar remained with the company through the difficult early years when the company did not generate any significant revenue and the market was still nascent.

In contrast to First Solar, Yingli Solar and Suntech (discussed below) both started with financial support from various local Chinese governments before the initial VC round. The Baoding Government originally backed Yingli, founded in 1998. One year before it was listed on Nasdaq, Yingli issued $17 million of Series A Preferred Shares to a local Chinese VC firm at a price of US$2.10 per share. In 2007, Yingli issued Series B Preferred shares at $4.835 per share. The mezzanine investors in Yingli, at the IPO price, recorded cash on cash return of 5.0x for the Series A and 2.17x for the Series B investors. Subsequently, Yingli's stock rose from its first day closing price of $10.50 to a high of $31.83.

Suntech, the leading Chinese solar company, was founded in 2001 and received a seed investment of $5.0 million from the Wuxi Government. Suntech raised an additional $80 million from an investor group including Goldman Sachs, Actis China as well as Dragontech Energy. The Series A investment round was completed at $2.30 per share and at STP's IPO price of $15.00 per share the Series A investors generated a cash on cash return of 6.52x.

In order to determine whether there is a consistency in the return spectrum across the various segments of the CleanTech market and to highlight any differences in returns between China and the U.S, a few other companies were examined. EnerNOC was founded in 2001 with a seed investment of less than $100,000. The company then issued an additional $17.75 million in preferred shares and at the IPO price in 2007; those VCs generated 5.96x cash on cash return. Foundation, a later stage investor, invested in EnerNOC in 2005 and generated a 2.62x return at the IPO price. A123 is a venture-backed company in the battery market that raised more than $350 million from more than 15 investors over 11 rounds of investment. Since 2001, the largest A123 venture investor, North Bridge Venture Partners, which holds 8.86 million shares, or 9% of the total, was valued at about $146 million as of February 23, 2010.[29] North Bridge invested an estimated $41.3 million over seven rounds, according to Thomson Reuters, for a paper return multiple of 3.53x. The company's six largest VC shareholders held a combined 32.9 million shares at the IPO, which were worth $541 million based on the price as of February 25, 2010. That same group invested at least $161 million in the company, according to Thomson Reuters, which means the group saw an unrealized return multiple of 3.36x on their investment.

Over the past 2 years, the CleanTech sector has seen some very large venture investments; $550 million for Project Better Place, a start-up designed to electrify large segments of the transportation sector by having consumers subscribe to electric transportation services; $100 million for Serious Materials LLC, which is developing a process to manufacture drywall that produces "no carbon dioxide" emissions; and $286

[29] Data is from Thomson Reuters publication PeHUB.

million for U.S. solar panel maker Solyndra, which enabled the company to secure a $535 million loan backed by the Energy Department to build a second manufacturing plant. In 2009, there were 5 venture-backed companies that raised $100 million or more in additional funding.

In 2009, CleanTech public offering proceeds totaled an estimated $4.7 billion in 32 IPOs. This constituted a year-on-year increase of 11% in volume and 2% in the amount raised. China accounted for 72% of the global IPO proceeds, according to data tracked by the CleanTech group. Between 2005 and 2007, 14 renewable energy companies went public, including solar companies LDK, Trina Solar, JA Solar, Suntech, Sunpower, Yingli, First Solar, Canadian Solar, Akeena Solar, Renesolar, Spire, Solarfun Power Holdings and several others related to the solar industry ecosystem.

Several solar companies accessed the IPO markets between 2006 and 2007, including Canadian Solar (2006), LDK (2007), Renesolar (2007) and Trina Solar (2006). In 2008, solar stocks performed very well, oil prices were high, discussions of carbon caps to favor clean energy companies occurred and investors pursued companies green companies in anticipation. Governments globally provided financing and subsidies to make these technologies cost competitive. In 2009, oil prices dropped, reflecting the global recession. Government subsidies were cut and worst of all, solar companies that had ramped up production to meet anticipated demand were seeing sales dry up and industry overcapacity. In 2009, solar panels experienced a steep price drop, rising inventory levels while the cost of production and materials dropped despite an increase in installed capacity.

Today there are still over 1,500 venture-backed companies addressing the solar industry, and at least 50 of the companies are direct competitors to the public companies. Between 2002 -2009, $4.8 billion was invested by VCs into the solar market[30] with emphasis on cost reduction and improvement in cell efficiency. The VCs in these companies expect to generate the multiples that the early entrants realized when prospective growth rates were high fueled by subsidies and financial projections.

According to a KPMG report,[31] the value of CleanTech M&A increased from $1.4 billion in 2004 and 2005 to $19.1 billion in 2008. Interestingly, more than 45% of the acquirers were adding capabilities to their existing businesses, while 70% of the M&A activities were in energy generation. Valuations were approximately 1.2x Enterprise value/ revenue. In 2009, there were an estimated 505 clean-technology M&A transactions globally, totaling $31.8 billion. However, this number could be misleading as an indication that VCs are directly benefiting from global M&A activity. Many of the reported transactions have been large divestitures of assets. For example, Bord Gais, the Irish energy provider, acquired SWS Natural Resources (Ireland), a large wind operator, for $720 million. Another example is Panasonic, which acquired a majority stake in Sanyo Electric, the world's largest rechargeable-battery maker, for $4.6 billion. The takeover makes Panasonic a dominant player in the fast-growing market for hybrid car batteries.

[30] Estimated investment amount determined by VantagePoint Venture Partners.

[31] KPMG Webinar April 2,2009.

Cleantech Industry Public vs. Private Investment Returns

The CleanTech analysis includes comparing the Thomson Energy/Industrial (TI) quarterly returns to the Nasdaq Composite (IXIC), the Russell 2000 Index (RUT), Zoltek (ZOLT), Yingli (YGE), First Solar (FSLR), Suntech Power (STP), Crude Oil Index (OIX), The S&P Global Clean Energy Index (SPGTCLNT), EnerNOC (ENOC) and the CleanTech Index (CTIUS). In order to understand the lifecycle of the venture opportunity in the CleanTech Sector, it was important to compare and contrast the venture returns to industry benchmarks and the public market securities. The time periods analyzed included 2000-2009 and 2007-2008. There was insufficient data prior to 2000.

Table 4-1 summarizes the time T-Mean, A-Mean and the SD for the components included in the sector analysis. The SD confirms the market volatility in the sector as the companies went public in an enthusiastic market for CleanTech and now are trading at multiples reflecting their financial performance. The most volatile have been in the area of renewable energy generation and energy efficiency.

Table 4-1: Mean Returns and Standard Deviation for the Cleantech Sector

CleanTech	ZOLT		YGE		FSLR		STP	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
2000-2008	0.84%	0.7813	70.47%	-	-176.71%	4.7451	-19.07%	1.1137
2007-2009	-9.17%	0.7286	-19.79%	1.3320	95.24%	3.8806	-28.71%	1.0567

CleanTech	ENOC		IXIC		RUT		OIX	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
2000-2008	-52.89%	-	1.52%	0.3704	5.47%	0.3001	5.78%	0.1867
2007-2009	36.96%	2.4822	2.16%	0.3465	-8.11%	0.2841	21.88%	0.1277

CleanTech	ECO		CTIUS		TE		M_Cell	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
2000-2008	4.95%	0.4275	2.70%	0.4166	16.25%	0.8014	-0.89%	0.0865
2007-2009	-1.04%	0.5099	11.34%	0.3256	16.50%	0.3293	-3.71%	-

The CleanTech stocks underperform the market, similar to the semiconductor companies during this period. Both industries are extremely capital intensive and today dominated by large companies with revenues in excess of $1 billion. The stock returns for CleanTech stocks and the industry has dropped since 2007, the returns are significantly below the early gains after the IPOs in the sector. The equity return calculation matrix summarizes the returns that a public market investor would realize depending upon the purchase date and exit data. Assuming that the investor purchased the shares at the time of the IPO, the returns peaked between Q3 2007 and Q2 2008. The returns were as follows from the IPO date to the peak, STP (172.88%), YGE (169.58%) and FSLR (854.42%).

Between 2000-2009, the Thomson Energy (TE) is negatively correlated to the majority of stocks included in the analysis. In the early days of venture funding, the expectations were for the CleanTech industry to achieve rapid expansion at Internet speeds of adoption. The early solar and wind companies did achieve rapid sales growth, supported by government policy and subsidies. However, the expectations for public companies was extremely high and as actual results were reported, valuations began to significantly decline further than the private company valuations, which were still based upon frothy expectations. According to Cambridge Research Associates, the Energy Sector vintage funds of 2002, 2003, 2005, 2006 and 2007 have significant dollar

weighted internal rate of returns of 45.29%, 48.14%, 38.48%, 37.51% and 26.87% respectively.

In analyzing the returns of the solar stocks, they are more interrelated to the ECO than CTIUS due to the composition allocation. The CTIUS has a 30.9% sector weighting to energy generation and included FSLR (2.77%) and STP (2.05%) but does not include YGE. The ECO assigns a 30% weighting to the Renewable Energy Harvesting segment with a 2.54% weighting to each FSLR, STP and YGE. ENOC's weighting in the CTIUS are less than 1% and they are not a component of the ECO.

Table 4-2: CleanTech Correlation Coefficient Matrix 2000-2008

Correlation	ZOLT	YGE	FSLR	STP	ENOC	IXIC	RUT	TE
ZOLT	1.0000	0.4600	0.4454	0.4361	0.3964	0.2683	0.3612	0.2552
YGE	0.4600	1.0000	0.6104	0.7278	0.3620	0.5689	0.5457	0.5799
FSLR	0.4454	0.6104	1.0000	0.5898	0.3156	0.5167	0.4923	-0.2319
STP	0.4361	0.7278	0.5898	1.0000	0.3253	0.5753	0.5543	-0.1053
ENOC	0.3964	0.3620	0.3156	0.3253	1.0000	0.4805	0.4886	0.4179
IXIC	0.2683	0.5689	0.5167	0.5753	0.4805	1.0000	0.8718	0.0327
RUT	0.3612	0.5457	0.4923	0.5543	0.4886	0.8718	1.0000	0.0976
OIX	0.2475	0.5959	0.5023	0.3986	0.8968	0.8968	0.4487	0.1134
ECO	0.6177	0.7477	0.6794	0.7358	0.5157	0.8441	0.8543	0.1756
CTIUS	0.3386	0.6710	0.6239	0.6730	0.4866	0.8510	0.8602	-0.2467

Correlation	OIX	ECO	CTIUS	TE	P_Modules	P_Cells
ZOLT	0.2475	0.6177	0.3386	-0.0175	-	-
YGE	0.5959	0.7477	0.6710	-0.1899	-	-
FSLR	0.5023	0.6794	0.6239	-0.2841	-	-
STP	0.3986	0.7358	0.6730	-0.0134	-1.0000	1.0000
ENOC	0.8968	0.5157	0.4866	-0.3997	-	-
IXIC	0.8968	0.8441	0.8510	-0.0292	-	-
RUT	0.4487	0.8543	0.8602	0.0091	-0.1935	0.3490
OIX	1.0000	0.2951	0.1599	0.1134	-0.1134	0.3458

ECO	0.6291	1.0000	0.9119	0.0896	0.7773	-0.9467
CTIUS	0.8133	0.9119	1.0000	0.0379	-0.3438	0.4796

Examining the shipment of solar PV cells had a perfect correlation for STP, but module shipments were perfectly negatively correlated. Additional analysis needs to be done to further understand the relationship.

The periods between 2005 and 2008 and then 2007 and 2008 showed very similar results. The Thomson Energy index is negatively correlated to the other components. The three solar companies become slightly more correlated to the industry benchmarks in the range of .6280 to .7664, with FLSR being on the low end.

Table 4-3: CleanTech Correlation Coefficient Matrix 2007-2008

Correlation	IXIC	RUT	OIX	ECO	CTIUS	TE
ZOLT	0.6661	0.6788	0.5874	0.7001	0.6773	-0.0932
YGE	0.5689	0.5457	0.5969	0.7477	0.6710	-0.5799
FSLR	0.5202	0.4959	0.5023	0.6834	0.6280	-0.2319
STP	0.6101	0.5819	0.4707	0.7664	0.7063	-0.0977
ENOC	0.4805	0.4886	0.8968	0.5157	0.4866	0.4799
IXIC	1.0000	0.9467	0.8761	0.8684	0.8623	-0.2674
RUT	0.9467	1.0000	0.7670	0.8712	0.8445	-0.3177
OIX	0.2513	0.2419	1.0000	0.3347	0.3678	-0.0703
ECO	0.8684	0.8823	0.3347	1.0000	0.9153	-0.2423
CTIUS	0.8623	0.9275	0.3678	0.9153	1.0000	-0.2251

Favorable sustainable economics are ultimately the driving force behind innovation and development in the CleanTech industry. Various governments have implemented policies to support the renewable energy industry by supporting feed in tariffs to support the adoption during the formative development period, which is necessary to compete with conventional industry suppliers that are some of the most subsidized industries

globally. The solar public companies valuations have declined, reflecting the sentiment of expected for future growth. Fewer companies have been able to access the IPO market, and adoption cycles are longer than originally expected. Venture capitalists must find solutions to the capital intensity required by these companies as well as demonstrate patience to scale the manufacturing in order to achieve the pricing targets that is associated with economies of scale.

CHAPTER 5
INTERNET INDUSTRY

The greatest influx of capital into the venture industry occurred during the Internet boom. The Internet revolution was not a single invention but a series of developments of interlinked technologies, protocols and standards for networking between computers. The appearance that the Internet was rapidly commercialized is misleading. It was only after decades of technology development by DARPA (the U.S. Defense Research Agency) and the release of the restriction for commercial use that the Internet was widely commercialized, enabling new business models, services and communication applications for business and consumers alike. The development of the TCP/IP technology and its adoption as a standard enabled every PC to become an Internet portal. This was pivotal in the market development. The non-proprietary, open nature of Internet protocols encouraged interoperability, making it feasible and easy for start - ups to enter the market. By the time the word Internet became mainstream to the public and private investors, the enabling technologies associated with the Internet were already 20 years old. The opening of the network truly began in 1988, when the U.S. Federal Networking Council approved interconnection of NSFNET to the commercial MCI mail system. Companies such as AOL, Prodigy, CompuServe and Netscape were formed, and this was the beginning of the client server revolution.

During the 1990s, the Internet grew by 100% per year, with explosive growth between 1996 and 1997. Venture-backed companies identified new business models and applications including e-commerce, online communities, email, search, gaming, news and online collaborative software among many other applications, and by the late 1990s, demand for Internet services was growing rapidly. Investors responded by

investing heavily in Internet infrastructure. Several hundred billions of dollars were spent on installing network capacity to meet not only current demand but also optimistic expectations of potential future demand. While Internet usage continued to grow, it did so much less quickly than originally anticipated. As a result, network capacity greatly exceeded demand, and many companies suffered financial problems or went out of business. From 1990-2000, world Internet usage grew 380.3%.[32]

During this period of enormous growth, businesses entering the Internet market scrambled to find economic models that worked. Free services supported by advertising shifted some of the direct costs away from the consumer but only temporarily. Services such as free web pages, chat rooms and message boards for community building were available but not monetized. Online sales grew rapidly for books, music CDs and computers, but the profit margins were slim.

The arrival of Internet start-ups had a dramatic impact on venture capital investments. The industry went through a period of unprecedented growth throughout the 1990s and a virtual explosion during the two years between 1998 and 2000, with a fivefold increase of investments in those two years alone. In 2000, more than 45% of all venture capital investments had been made in internet-related companies. According to Thomson Financial and the NVCA, Internet investment totaled $720 million in 1999 and exploded to $7.9 billion in 2000, but dropped down to $2.5 billion in 2001 and down yet again to $1.1 billion in 2002. Internet-specific companies attracted $2.9 billion going into

[32] www.internetworldstats.com.

629 deals in 2009, which represented a drop off of 39%in dollars, and a 30% decline in deals from 2008, when $4.8 billion went into 902 companies.[33]

There were many start-ups that pioneered new Internet applications. One of the early companies in the Internet space was WebCrawler in 1994. Before WebCrawler, only Web page titles were searched. Another early search engine, Lycos, was created in 1993 as a university project and was the first to achieve commercial success. During the late 1990s, both Web directories and Web search engines were popular; Yahoo (1994) and AltaVista (1995) were the respective industry leaders. By August 2001, the directory model had begun to give way to more sophisticated search engines, giving rise to the formation of Google (1998), which had developed new approaches to relevancy ranking.

Suddenly, the low cost of reaching millions worldwide, coupled with the possibility of selling to those people at the same moment they were reached, offered an opportunity to overturn established businesses in advertising, mail-order sales, customer relationship management and many more areas. The web was the new killer application, and it could bring together unrelated buyers and sellers in seamless and low-cost ways. Entrepreneurs from around the world developed new business models and ran to the nearest venture capitalist for funding. While some of these entrepreneurs had business experience, the majority were simply people with ideas who didn't manage the capital influx prudently. Many Internet companies at this time were solely dependent upon advertising revenue that never materialized and simply raised capital based upon the number of “clicks” to the site. Additionally, many dot-com business plans were

[33] According to the MoneyTree Report by PricewaterhouseCoopers and the National Venture Capital Association (NVCA), based on data from Thomson Reuters.

predicated on the assumption that by using the Internet, they would bypass and displace the distribution channels of existing businesses and therefore not have to compete with them. When the established businesses with strong existing brands developed their own Internet presence, these hopes were shattered. Since 2000, the start-up survivors have refined their business models such that they can demonstrate earnings and profitability. Companies such as Amazon expanded aggressively during the late 1990s to offer books, CDs, videos, DVDs, electronics, toys, tools, home furnishings, apparel and kitchen gadgets. Amazon entered in agreements with brand name retailers including Toys R' Us, Inc., Target Corporation, Circuit City Stores, Inc. and the Borders Group and made them partners.The success of Google shows that a dominant market position in the Internet era was often contestable. In the case of the market for web searches, one could argue that switching costs for a single end-user are low relative to other market segments such as Internet auctions, where a coordinated move among most or at least some of the agents linked to the network would be required to justify the decision by a single customer to switch to a competitor giving EBay a defensible market position. The value added by Google's technology had a huge impact on consumer usage and justified switching from leading portals such as Yahoo and Microsoft's MSN to a new company.

Venture capital returns in the Internet sector for vintage funds 1996, 1998 and 1998 were stellar, according to Cambridge Research Associates LLC. In the Internet e-Commerce segment, the IRR in 1996, 1997 and 1998 was 225.68%, 702.99% and 270.75% respectively. In the Internet e-Business, the IRR for the same periods was 82.21%, 138.84% and 107.76% respectively. The vintage years of 2000 and 2001

generated low returns, but since 2002 the returns have exceeded the overall venture industry, reflecting the liquidity availability for Internet companies. Between 2005 and 2009, there were 88 M&A exits and between 2004 and 2008, there were approximately 53 Internet IPOs.

In1999, Kleiner Perkins and Sequoia had the foresight to each invest $12.5 million in Google for a 10% stake. In the summer of 2004, these investments by Kleiner Perkins and Sequoia were worth $2.03 billion at Google's IPO price of $85 per share. While they originally intended to sell about 10% of their stakes in the IPO, both Kleiner Perkins and Sequoia did not sell at the IPO. In the case of Kleiner Perkins, they made their first large distribution of shares to limited partners on November 17, 2004, when they distributed about 5.7 million shares, about a quarter of their total stake, at $172.50 per share, which equates to about $983 million. They made another distribution of 11.4 million shares, about 54% of their stake, at $203.66 per share for $2.3 billion. In May 2004, they made another distribution of 1.1 million shares worth $247 million. In total, to date they have distributed shares worth $3.549 billion[34]. EBay also produced significant returns for Benchmark Capital. In 1997, Benchmark invested $6.7 million, and by the spring of 1999, their stake was worth $5 billion.[35]

Investors that bought public stocks of the Internet companies at the time of the IPO also generated impressive returns. If you purchased the following companies at the time of their respective IPOs then sold the stocks at December 31, 2009, the returns were as follows; Yahoo (1348.33%), Sina (59.81%), EBay (1145.92%), Amazon

[34] The information on Sequoia Capital and Kleiner Perkins' investment in Google is from the website www.billburnam.blogs.com (6/24/2005).

[35] Benchmark Capital, Wikipedia.com.

(8435.96%), Google (399.81%). Priceline was the only stock in the analysis that declined in value, dropping 60.43%. Investors that purchased shares of the companies listed above in the IPO and sold prior to the technology decline in 2000, except for Priceline, generated returns ranging from 1000% to 7800% on their money. Investors that purchased shares post crash also generated very good returns.

Table 5-1 summarizes the time T-Mean, A-Mean and the SD for the components included in the sector analysis. Also included were PC Sales (PCS), Domain Names Registered (DN) and Households with Internet Connections (Inet)

Table 5-1: Mean Returns and Standard Deviation for the Internet Sector

Internet	**GOOG**		**YHOO**		**SINA**		**EBAY**		**AMZN**	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
1998-2000	-	-	52.29%	3.5266	-	-	-9.82%	0.5198	68.85%	4.9752
2000-2009	24.73%	0.8420	-4.54%	0.9811	47.49%	1.5582	31.00%	1.3148	21.97%	1.4581
2007-2009	25.92%	0.6106	-2.61%	0.3222	27.17%	0.5649	4.54%	0.4650	46.91%	1.1216

Internet	**PCLN**		**MOX**		**IXIC**		**RUT**	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
1998-2000	-96.75%	-	-	-	13.97%	0.4862	-2.26%	0.0519
2000-2009	22.49%	7.1408	18.07%	0.7184	1.52%	0.3704	5.47%	0.3001
2007-2009	135.16%	0.5155	21.37%	0.5899	2.16%	0.3465	-8.11%	0.2841

Internet	**TI**		**PCS**		**DN**		**Inet**	
Time Period	T-Mean	SD	T-Mean	SD	T-Mean	SD	T-Mean	SD
1998-2000	35.96%	0.4533	40.60%	0.0194	-	-	-	-
2000-2009	-10.02%	0.1618	16.01%	0.1188	14.30%	0.8659	130.56%	0.5256
2007-2009	-7.71%	0.1135	18.25%	0.0012	15.50%	0.1134	12.07%	0.0103

In the period 2000-2001, a drastic correction occurred that hit all dot.com and Internet-based stocks alike. This adjustment expressed the newfound skepticism that

the hoped-for effects that had driven those high valuations would not materialize. Starting in late 2002, rehabilitation occurred for a selective group of surviving Internet stocks. In the 2002-2004 periods, Internet companies that were clear market leaders and managed to convincingly assert their leadership position and, above all, start to generate profits, outperformed the general market.

The correlation summaries were assembled to determine the relationship between VC returns, the benchmark indices and a sample of public companies. Even though the Internet started to be commercialized in the early 1990s, there were already several companies by the mid and late 1990s. The initial period examined was 1995-2000, and since this period covers the technology bubble, the returns are highly correlated >.50 with the Nasdaq Composite and the MOX Index, except for China-based Sina and Amazon. Similar to the semiconductor and the CleanTech venture returns, the Thomson Internet has a low correlation to the public companies, the Nasdaq Composite, the Russell 2000.

Table 5-2: Internet Correlation Coefficient Matrix 1995-2000

Correlation	YHOO	SINA	EBAY	AMZN	PCLN	MOX	IXIC	RUT	TI	PCS
YHOO	1.0000	0.3469	0.5383	0.5927	0.3956	0.7399	0.5373	0.4543	0.2607	-0.4053
SINA	0.3469	1.0000	0.3480	0.2965	0.2307	0.4164	0.3976	0.3915		
EBAY	0.5383	0.3480	1.0000	0.5121	0.4501	0.6853	0.5369	0.4673	-0.2501	
AMZN	0.5927	0.2965	0.5121	1.0000	0.4001	0.6527	0.4721	0.4104	0.1857	-0.2866
PCLN	0.3956	0.2307	0.4501	0.4001	1.0000	0.5588	0.4020	0.3867		
MOX	0.7399	0.4164	0.6853	0.6527	0.5588	1.0000	0.8559	0.7543		
IXIC	0.5373	0.3976	0.5369	0.4721	0.4020	0.8559	1.0000	0.8806	0.3663	0.9831
RUT	0.4543	0.3915	0.4673	0.4104	0.3867	0.7543	0.8806	1.0000	0.2921	-0.2649
TI	0.5508		0.2360	0.2893	0.7208	0.8857	0.7346	0.5443	1.0000	0.7769
PCS	-0.4053			-0.2866			0.1062	0.3693	0.7769	1.0000

For the period between 1998 and 2000, the height of the technology bubble, the correlation is similar to the period between 1995-2000.

Table 5-3: Internet Correlation Coefficient Matrix: 1998-2000

Correlation	YHOO	SINA	EBAY	AMZN	PCLN	MOX	IXIC	RUT	TI	PCS
YHOO	1.0000	0.3469	0.5383	0.6431	0.3956	0.7399	0.6014	0.4987	0.2607	-0.3359
SINA	0.3469	1.0000	0.3480	0.2965	0.2307	0.4164	0.3976	0.3915		
EBAY	0.5383	0.3480	1.0000	0.5121	0.4501	0.6853	0.5369	0.4673	-0.2501	
AMZN	0.6431	0.2965	0.5121	1.0000	0.4001	0.6527	0.4897	0.4174	0.1857	-0.2866
PCLN	0.3956	0.2307	0.4501	0.4001	1.0000	0.5588	0.4020	0.3867		
MOX	0.7399	0.4164	0.6853	0.6527	0.5588	1.0000	0.8559	0.7543		
IXIC	0.6014	0.3976	0.5369	0.4897	0.4020	0.8559	1.0000	0.8805	0.3663	0.9831
RUT	0.4987	0.3915	0.4673	0.4174	0.3867	0.7543	0.8805	1.0000	0.2921	-0.2649
TI	0.5558		0.2360	0.2679	0.7208	0.8857	0.7737	0.5537	1.0000	0.7769
PCS	-0.3359			-0.2866			0.9831	-0.2649	0.7769	1.0000

The period between 2000-2008 shows that the stocks and the benchmark indices are all highly correlated. Thomson Internet remains lowly correlated to the public comparables. Priceline, due to the performance of the business, begins to diverge; Sina remains less correlated to the other public stocks; and the overall correlation among the assets drops from previous levels.

Table 5-4: Internet Correlation Coefficient Matrix 2000-2008

Correlation	GOOG	YHOO	SINA	EBAY	AMZN	PCLN	MOX	IXIC	RUT	TI	PCS
GOOG	1.0000	0.3516	0.3930	0.4440	0.4060	0.3220	0.6184	0.6065	0.5250	0.3857	0.5007
YHOO	0.3516	1.0000	0.3331	0.5327	0.4656	0.3111	0.6810	0.6066	0.4885	.-0.1803	0.3562
SINA	0.3930	0.3331	1.0000	0.3179	0.2663	0.2417	0.4359	0.4022	0.3718	-0.0036	0.3401
EBAY	0.4440	0.5327	0.3179	1.0000	0.4783	0.3630	0.6973	0.6585	0.5440	-0.0035	0.0518
AMZN	0.4060	0.4656	0.2663	0.4783	1.0000	0.3077	0.6088	0.5439	0.4562	-0.0986	0.0236
PCLN	0.3220	0.3111	0.2417	0.3630	0.3077	1.0000	0.4846	0.4338	0.3927	-0.0320	0.0467
MOX	0.6184	0.6810	0.4359	0.6973	0.6088	0.4846	1.0000	0.9250	0.7758	0.0708	0.8110
IXIC	0.6065	0.6066	0.4022	0.6585	0.5439	0.4338	0.9250	1.0000	0.8718	0.2188	0.7990
RUT	0.5250	0.4885	0.3718	0.5440	0.4562	0.3927	0.7758	0.8718	1.0000	0.2122	0.5356
TI	0.5909	0.3239	0.1566	0.2842	0.2597	0.2505	0.6316	0.6370	0.4595	1.0000	-0.3136

PCS	0.5007	0.3562	0.3401	0.0518	0.0236	0.0467	0.8110	0.7990	0.5356	-0.3136	1.0000

The Thomson Internet correlation coefficients between 2007-2008 changed dramatically as the returns began to converge to the indices and the public stocks.

Table 5-5: Internet Correlation Coefficient Matrix 2007-2008

Correlation	GOOG	YHOO	SINA	EBAY	AMZN	PCLN	MOX	IXIC	RUT	TI	PCS
GOOG	1.0000	0.3464	0.5032	0.5469	0.5340	0.4073	0.7422	0.7419	0.6449	0.3846	0.7160
YHOO	0.3464	1.0000	0.4370	0.4334	0.2913	0.2669	0.5643	0.5158	0.4846	0.0573	0.4032
SINA	0.5032	0.4370	1.0000	0.4752	0.4151	0.3716	0.6903	0.6105	0.5471	0.6547	0.3372
EBAY	0.5469	0.4334	0.4752	1.0000	0.5120	0.4124	0.7288	0.7313	0.6917	0.4312	0.6401
AMZN	0.5340	0.2913	0.4151	0.5120	1.0000	0.3903	0.6814	0.6374	0.5586	0.8599	0.7341
PCLN	0.4073	0.2669	0.3716	0.4124	0.3903	1.0000	0.5831	0.5372	0.5177	.-0.0111	0.4534
MOX	0.7422	0.5643	0.6903	0.7288	0.6814	0.5831	1.0000	0.9477	0.8886	0.6566	0.7678
IXIC	0.7419	0.5158	0.6105	0.7313	0.6374	0.5372	0.9477	1.0000	0.9467	0.6626	0.5437
RUT	0.6449	0.4846	0.5471	0.6917	0.5586	0.5177	0.8886	0.9467	1.0000	0.6990	0.3819
TI	0.5618	0.4254	0.5701	0.4670	0.8447	0.6794	0.5968	0.5834	0.4687	1.0000	0.5216
PCS	0.7160	0.4032	0.3372	0.6401	0.7341	0.4534	0.7678	0.5437	0.3819	0.5216	1.0000

The Internet has become an integral part of everyday life and it is likely that it will continue to transform, although at a much slower rate, over the next decade, with new applications transforming traditional industries and further linking the consumer and business globally. The required capital for Internet start-ups has historically been low compared to other sectors, making multiple returns more achievable in an environment with lower exit multiples.

CHAPTER 6
WINDOW OF CONVERGENCE

This chapter summarizes the behavior of the public stocks compared to the indices, based upon daily returns grossed up quarterly. Exit timing can dramatically impact venture capital returns and since the VC usually has a lock-up period of 180 days and cannot sell or distribute shares to the LPs during this period, they are exposed to ongoing to market risk. The "Time to Convergence" for the purpose of this analysis was defined as the time period between the IPO date for more recent IPOs or analysis commencement date and when the returns are correlated >.50 for more than three quarters to the benchmark indices or other assets. It is the period when investors can still generate returns uncorrelated to the overall market. This analysis was completed for the three sectors, and the findings were consistent. Within approximately 2-3 years after the IPO, the returns of the new issuances will begin to converge to the respective indices. This finding is important in determining an exit strategy post IPO, since the VC will essentially have a positive exit window for18 -24 months depending upon their ownership level.

In the semiconductor market, given the level of maturity, the group of stocks was broken down into two sections, the more mature companies and the more recent IPOs. Texas Instruments, Intel, Xilinx and Applied Materials were compared with the SOX index, with each other and then the broader market benchmark indices. PLX and AnalogicTech were compared separately due to their more recent IPO dates.

The convergence observations were as follows for the semiconductor industry:

Texas Instruments (TXN)

- Publicly traded in 1974

- Converges with Nasdaq Composite in Q2 1992
- Converges with Russell 2000 in Q2 2001
- No signs of convergence with SOX
- Converges with AMAT in Q1 1994
- Converges with INTC in Q2 1994
- Converges with XLNX in Q2 1995

Applied Materials (STP)

- Publicly traded in 1972
- Converges with Nasdaq Composite in Q4 1992
- Converges with Russell 2000 in Q4 1994
- No signs of convergence with SOX
- Converges with TXN in Q1 1994
- Converges with INTC in Q2 1995
- Converges with XLNX in Q2 1995

Intel (INTC)

- Publicly traded in 1971
- Converges with Nasdaq Composite in Q1 1990
- Converges with Russell 2000 in Q4 2000
- No signs of convergence with SOX
- Converges with XLNX in Q1 1995

Xilinx (XLNX)

- Publicly traded on 6/12/1990
- Converges with Nasdaq Composite in Q1 1993
- Converges with Russell 2000 in Q4 1999
- Converges with SOX Q2 2000

AnalogicTech (AATI)

- Publicly traded on 8/4/2005

- Converges with Nasdaq Composite in Q2 2007
- Converges with Russell 2000 in Q3 2007
- No signs of convergence with SOX
- Converges to PLXT in Q2 2007
- Converges to INTC in Q4 2007
- Converges to XLNX and TXN in Q1 2008
- Converges to AMAT in Q3 2008

PLXT Technology (PLXT)

- Publicly traded on 4/6/1999
- Converges with Nasdaq Composite in Q1 2001
- Converges with Russell 2000 in Q1 2003
- No signs of convergence with SOX Q2
- Converges to INTC, XLNX and TXN in Q3 2001
- Converges to AMAT in Q3 2003

The convergence of the large capitalized stocks occurred in 1994 and 1995. Interestingly, there are few signs of convergence with the SOX, which has been regarded as the industry benchmark indices. XLNX, AATI and PLXT converged to the Nasdaq Composite in approximately in 7 -11quarters.

The next part of the analysis examined the convergence of assets in solar. Suntech, First Solar and Yingli were compared with the industry and broader market benchmark indices.

The Convergence Observations were as follows for the solar industry*:*

Suntech Power (STP)

- Publicly traded on 12/14/05
- Converges with Nasdaq Composite in the 12th quarter
- Converges with Russell 2000 in the 13th Quarter

- No Signs of Convergence with Crude Oil prices
- Converges with WilderHill Clean Energy Index in the 6th quarter
- Converges with CleanTech Index in the 6th quarter
- Converges with S&P Global Clean Energy Index in the 1st quarter, since its inception in Q4 2008.

First Solar (FSLR)

- Publicly traded on 11/17/06
- Converges with Nasdaq Composite in the 8th quarter
- Converges with Russell 2000 in the 8th Quarter
- No Signs of Convergence with Crude
- Converges with WilderHill Clean Energy Index in the 4th quarter
- Converges with CleanTech Index in the 4th quarter
- Converges with S&P Global Clean Energy Index in the 1st quarter (since its inception in q4 2008)

Yingli (YGE)

- Publicly traded on 6/8/07
- Converges with Nasdaq Composite in the 7th quarter
- Converges with Russell 2000 in the6th Quarter
- No Signs of Convergence with Crude Oil
- Converges with WilderHill Clean Energy Index in the2nd quarter
- Converges with CleanTech Index in the 2nd quarter
- Converges with S&P Global Clean Energy Index in the 1st quarter, since its inception in Q4 2008
- Converges with STP in the 3rd quarter
- Converges with FSLR in the 4th quarter

The solar stocks returns first converge within 2-6 quarters to the industry benchmark. There appears to be a time convergence in 2008 for the solar stocks,

signaling that the market began to evaluate the companies on a consistent methodology. The solar stocks then converge to the Nasdaq Composite and the Russell 2000 within 7-12 quarters.

The Internet returns of Google, Yahoo, Sina, Amazon and Priceline were compared with the industry and broader market benchmark indices.

The Convergence Observations were as follows for the Internet industry:

Google (GOOG)

- Publicly traded on 8/19/2004
- Converges with Nasdaq Composite in Q1 2006
- Converges with Russell 2000 in Q1 2006
- No signs of convergence with MOX in Q1 2006
- Converges with YHOO in Q2 2005
- Converges with Sina in Q1 2006
- Converges with EBay in Q3 2006
- Converges with Amazon in Q2 2006
- No signs of convergence with PCLN

Yahoo (YHOO)

- Publicly traded on 4/12/1996
- Converges with Nasdaq Composite in Q3 1996
- Converges with Russell 2000 in Q1 1998
- No signs of convergence with MOX in Q1 1999
- Converges with Sina in Q3 2000
- Converges with EBay in Q4 2000
- Converges with Amazon in Q1 1998
- Converges with PCLN in Q3 2000

Sina (SINA)

- Publicly traded on 4/12/2000
- Converges with Nasdaq Composite in Q1 2001
- Converges with Russell 2000 in Q4 2002
- Converges with MOX in Q1 2001
- No signs of convergence with EBay
- Converges with Amazon in Q1 2001
- Converges with PCLN in Q2 2001

EBay (EBAY)

- Publicly traded on 9/21/1998
- Converges with Nasdaq Composite in Q2 2001
- Converges with Russell 2000 in Q1 2001
- Converges with MOX in Q3 2000
- Converges with Amazon in Q1 2001
- Converges with PCLN in Q2 1999

Amazon (AMZN)

- Publicly traded on 5/15/1997
- Converges with Nasdaq Composite in Q1 1998
- Converges with Russell 2000 in Q1 1998
- No signs of convergence with MOX in Q1 2001
- Converges with PCLN in Q2 1999

Priceline (PCLN)

- Publicly traded on 3/30/1999
- Converges with Nasdaq Composite in Q2 2000
- Converges with Russell 2000 in Q2 2000
- No signs of convergence with MOX in Q2 2000

The convergence time period for the Internet industry was more rapid in some cases than observed in CleanTech and Semiconductors. The time to convergence ranged from 1 quarter to 8 quarters, depending upon the sector. For VC investors that have substantial ownership, managing the exit strategy is important based upon the above convergence observations.

CHAPTER 7
CHINA EMERGING VENTURE CAPITAL SECTOR

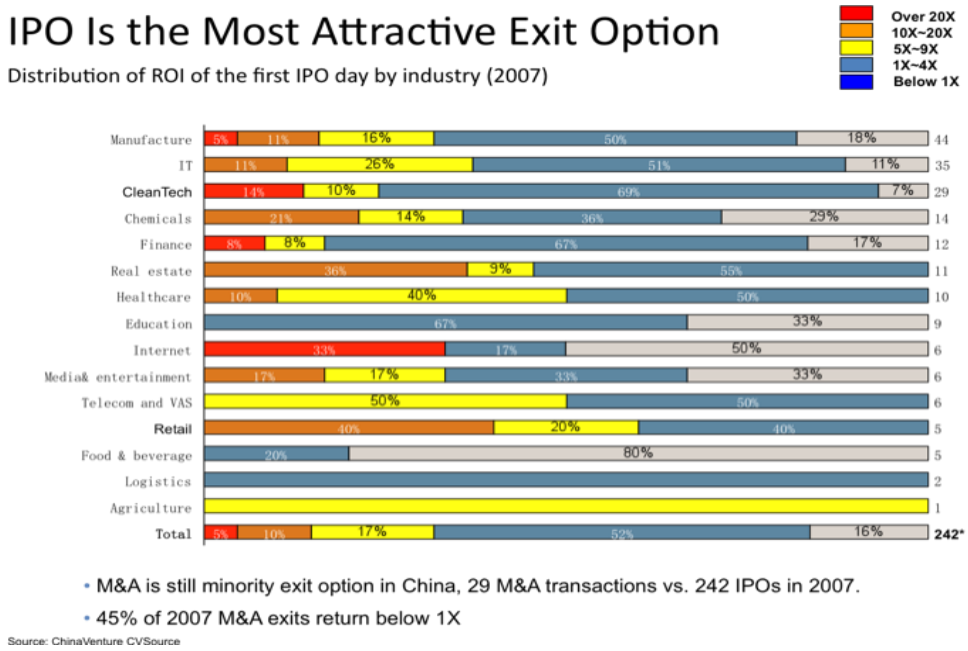
China's modern history began six decades ago with a grand experiment aimed at national development through a planned economic system based on public ownership. It failed miserably, marked by inefficient state-owned enterprises and waste. The central government stopped tinkering with its centrally planned economic system and began a transformation to a market economy. The three fundamental elements of a market economy: property rights, an open market and private enterprise, are absent in a planned economy. However, in China over the last 30 years, the government implemented various economic reforms, including limited property rights and personal incentives, developing a market system while maintaining the system of public ownership and a planned economy. The Chinese economic liberalization, which culminated at the WTO accession in 2001, has produced miraculous growth and development. GDP has grown at an average growth rate of close to 10% per year for the past 30 years. The rapid pace of development has enabled China to become the world's third-largest economy.

China's economy is undergoing a transformational shift from made in China to sold in China. Real GDP growth is shifting from investment to consumption based driven by an increase in the middle class. China's emerging economy between 2005-2009 produced 356 IPOs, which raised $114.96 billion.[36] In 2008, VantagePoint Venture Partners analyzed 2007 liquidity events in China. An IPO is the preferred exit path for most CEOs, so it is not surprising that in 2007, there were 242 IPOs compared to 29 M&A transactions, of which 45% returned less than 1x capital. Of the 272 IPOS, 44

[36] Zero2Ipo Research.

IPOs were for manufacturing, 35 for IT, 29 for CleanTech and 6 for the Internet companies. The exit distribution for the 2007 companies was as follows:

Figure 7-1. China Exit Multiples



In 2007, based upon the IPO price, Chinese VCs did very well on Internet investments, which generated on average a return of 9.3x on invested capital. The returns for retail companies was 7.9x, CleanTech was 3rd at 7.8x, while IT returned 5.0x on invested capital. The top 10 venture capital exits included Goldwind at 53.0x, China High Speed Transmission at 51.9x, and the Internet companies Perfect World and Alibaba at 31.2x and 30.3x respectively. Others included in the list were Cinsure, Western Mining, China Digital TV, Air Media, Belle International and e-house.

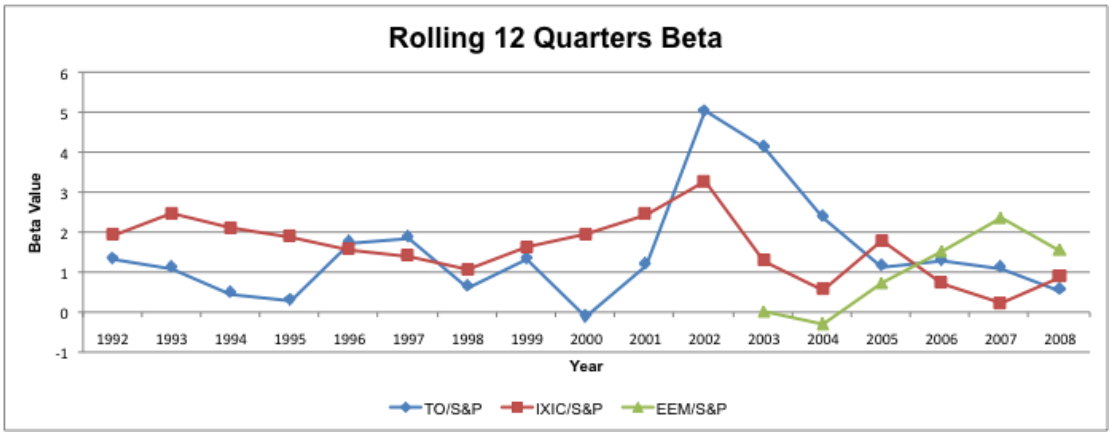
The inflow of venture capital in China has grown from $1.298 billion in 2002 to $5.85 billion in 2009 representing a mere .012% of GDP. In the first 11 months of 2009, 133 Chinese companies went public on 3 domestic and 9 foreign exchanges, raising a

combined US$40.70B or an average US$306.04M. Of the 133 Chinese enterprises listed between Jan. and Nov. 2009, VC backed 58, or 43.6% of the total, or Private Equity Funds. The destinations of overseas-listed Chinese enterprises were diversified. There were 62 Chinese enterprises listed on nine overseas markets including HKMB, NASDAQ and NYSE.

In 2009, the domestic A-share market underwent tremendous changes such as the completion of IPO system reform and the resumption of domestic IPO. The launch of ChiNext marks an important milestone for capital formation for small and mid-sized enterprises (SMEs) in China as well as for the venture capital community, which were dependent upon overseas IPOs early on in the industry's development. The ChiNext exchange is favorable for driving economic growth and enhancing the development of the venture capital industry by stimulating enthusiasm for entrepreneurship and innovation. Since the launch of ChiNext in October 2009, 61 companies have gone public, with a total market capitalization of Yuan 266,123,872,461. The current P/E ratio is 82.65, compared to 35.71 for the Shanghai Stock Exchange. Regardless of the high valuations, the ChiNext has provided venture capitalists and entrepreneurs with a liquidity option for domestic companies. Of the initial 28 companies which began trading on October 30, research from Chinese private equity data provider Zero2IPO shows that 23 were venture capital- or private equity backed. Four of these companies had received funding from foreign firms.

CHAPTER 8
ROLLING BETA

In this section, the rolling beta of the Thomson Venture Overall Periodic IRR returns from 1990 until 2008 were calculated on a 12-quarter rolling basis using the S&P 500 as the market benchmark. Additionally, the rolling beta was calculated for the IXIC as well as iShares the MSCI Emerging Markets Index Fund again using the S&P 500 as the benchmark for the same interval. The VC rolling 12-quarter beta oscillates around 1, which is an expected sine venture capital returns are highly dependent upon the exit multiples driven by the overall public markets. The rolling beta was calculated using the covariance between Thomson data's prior 12 quarter rolling periodic IRRs and the rolling point-to-point quarterly return of S&P 500 from the past 12 quarters.



The increased volatility post-2000 for Thomson overall venture data relative to the S&P 500 is related to the technology crash in 2000-2001, the devaluation of venture-backed companies and an increase in liquidations impacting overall venture returns during this period. Since 2005, the rolling beta has hovered around 1, reflecting the dependency on IPOs, instead of M&A events, to drive positive returns.

CHAPTER 9
CONCLUSION

Over the last 10 years, overall venture capital returns have been impacted by the technology crash in 2000, the events of 2008 and an overall slowdown in innovation relative to the 1960s until the late 1990s. Although the overall outcome for the industry has been disappointing for the LPs over the last 10 years, there have some been bright spots for venture capitalists globally.

Venture returns are highly dependent upon the rate of innovation and the development of new industries, not just technology development. VCs have a window of opportunity to invest that is dependent upon the market development cycle and extraneous conditions.

The semiconductor market matured over a 40-year period. As the industry developed, venture capitalists had an opportunity to fund innovation during the transitional phases. Today, the semiconductor market is no longer an attractive market for venture capital as it unlikely that a revolutionary change in technology or application will be discovered.

In the CleanTech sector, which is still undergoing a transformational change, other challenges exist: government support, subsidies and capital efficiency. Some segments of the CleanTech industry have already matured, while others are in the early stages of deployment. It is always a possibility that a company will emerge that can change the cost equation in the solar market or have a significant technology breakthrough which will be rewarded by the public markets or via an acquisition. The CleanTech sector today requires government policy and financial intervention to support the current economic model until scale can be achieved. In order for VCs to generate the required

returns, three conditions must be present for favorable market conditions: oil prices rise to a sufficient level to inflict economic pain on the consumer and governments, the usage of oil and coal increases beyond a “normal” growth rate due to the strains of emerging economies such as China and India, or government intervention into the economic equation to incentives the consumer to adopt renewable energy such as feed in tariffs.

The Internet sector is still undergoing market changes as companies and start-ups identify new revenue models and markets driven by the communization of the end users and the consumer demand for mobility. The Internet sector has produced stellar returns both pre and post the 2000 technology crash. The VC returns in the Internet space are more highly correlated to the public markets and the benchmark indices, which is a reflection of a more robust liquidity market and shortened time horizon holding period from date of initial investment.

It is not easy to pick out a dominant theme for the future when so much has happened in so many sectors to so many companies over the past 40 years in the U.S. It is highly evident that the venture capital industry will need to go back to the basics: long-term plays, focus on creating value through developing new lasting markets, managing the amount of capital invested and not investing in a hype or bubble.

LIST OF REFERENCES

Cambridge Associates LLC, U.S. Venture Capital Index® and Benchmark Statistics, Non-Marketable Alternative Assets, September 30, 2009.

Chen, P., GT Baierl, & PD Kaplan. (2002). Venture Capital and its Role in Strategic Asset Allocation, *The Journal of Portfolio Management*.

Cochrane, John H. (2001). "The Risk and Return of Venture Capital." Working paper, University of Chicago.

Cochrane, John H. (2003). “The Risk and Return of Venture Capital” Graduate School of Business, University of Chicago.

Cringely, R. X. (1992). *Accidental Empires*. Reading, MA: Addison-Wesley.

Dooley, J.J., U.S. Department of Energy 2008: Trends in U.S. Venture Capital Investments Related to Energy: 1980-2007

Friedman, A. & D. Cornford. (1989). *Computer Systems Development: History, Organization and Implementation*. Chichester: Wiley.

Gilder, George. "Computer Industry." *The Concise Encyclopedia of Economics.* David R. Henderson, ed. Originally published as *The Fortune Encyclopedia of Economics,* Warner Books. 1993. Library of Economics and Liberty [Online] available from http://www.econlib.org/library/Enc1/ComputerIndustry.html; accessed 17 February 2010; Internet.

Gompers, P. (1995). Optimal Investment, Monitoring, and the Staging of Venture Capital, *Journal of Finance, 50(5),* 1461-1489.

Gompers, P., & Lerner, J. (March 22, 1997). “The Valuation of Private Equity Investments,” paper presented at the Stanford Conference on The Economic Foundations of Venture Capital.

Gompers, Paul, & Lerner, Josh. (2001). *The Money of Invention*. Massachusetts: Harvard.

Gompers, Paul, Kovner, A., Lerner, J. & David Scharfstein, (2006). Specialization and Success: Evidence from Venture Capital, Unpublished working paper, Harvard University.

Gompers, Paul. (1996). Grandstanding in the Venture Capital Industry. *Journal of Financial Economics, 42*, 133-156.

Gompers, Paul A. & Josh Lerner. (2000). Money Chasing Deals? The Impact of Fund Inflows on Private Equity Valuations, *Journal of Financial Economics, 55,* 281-325.

Gompers, Paul A. & Josh Lerner (1997). Risk and Reward in Private Equity Investments: The Challenge of Performance Assessment, *Journal of Private Equity, 1,* 5-12.

Gompers, Paul, Anna Kovner, Josh Lerner, & David Scharfstein* December 2005: Venture Capital Investment Cycles: The Impact of Public Markets.

Gompers, Paul, Anna R. Kovner, Josh Lerner, & David Scharfstein. "Skill vs. Luck in Entrepreneurship and Venture Capital: Evidence from Serial Entrepreneurs." NBER Working Paper Series, No. 12592, 2006.

Greenstein, S. (2000). Building And Delivering The Virtual World: Commercializing Services For Internet Access. *Journal of Industrial Economics, 48*, 391-411.

Greenstein, S. (1998). Commercializing the Internet, *IEEE Micro, 18*, 6-7.

Hellmann, Thomas F. & Puri, Manju, The Interaction between Product Market and Financing Strategy: The Role of Venture Capital (May 1999). Sauder School of Business Working Paper.

Hellmann, Thomas & Manju Puri (2002), On the Fundamental Role of Venture Capital. *Economic Review* (published by the Atlanta Federal Reserve Bank, 87, No. 4THOMAS).

Hochberg, Yael, Johnson School of Management Cornell University; Alexander Ljungqvist, Stern School of Business New York University and CEPR; Yang Lu, Stern School of Business New York University, April 20, 2005: “Whom You Know Matters: Venture Capital Networks and Investment Performance”

Kedrosky, Paul, Right-Sizing the U.S. Venture Capital Industry (June 10, 2009). Kauffman Foundation Small Research Projects Research.

Keung, M. (2003). A New Empirical Study of Grandstanding in the Venture Capital Industry.

Kortum, S. & Lerner, J. (2000). Assessing the contribution of venture capital to innovation, *RAND Journal of Economics, 31*, 674-692.

Lecuyer, Christophe. (2005). *Making Silicon Valley: Innovation and the Growth of High Tech, 1930-1970*. Cambridge, MA: MIT Press.

Lerner, J. (2002). Boom and Bust in the Venture Capital Industry and the Impact on Innovation, *Economic Review.*

Masayuki Hirukawa, Northern Illinois University Masako Ueda, University of Wisconsin, Madison and CEPR: VENTURE CAPITAL AND INNOVATION: WHICH IS FIRST?

McCarthy, Jonathan, What Investment Patterns across Equipment and Industries Tell Us about the Recent Investment Boom and Bust. Current Issues in Economics and Finance, Vol. 10, No. 6, May 2004. Available at SSRN: http://ssrn.com/abstract=597121 .

Meyer, T. & Mathonet, Y.P. (2005). *Beyond the J Curve: Managing a Portfolio of Venture Capital and Private Equity Funds*, London: John Wiley & Sons.

Parker, N. Cleantech Group, June 2008: "Cleantech in 2008: Accelerating Innovation in China."

Quigley, John M., & Susan E. Woodward. 2003. ""An Index for Venture Capital"". University of California, Berkeley. July.

Quigley, J. & Woodward, S. (2003). "An Index for Venture Capital," Department of Economics, Working Paper Series 1059, Department of Economics, Institute for Business and Economic Research, UC Berkeley

Sagari, Silvia B. & Guidotti, Gabriela (1991). Venture Capital Operations and their Potential Role in LDC Markets. World Bank Working Paper No. WPS540.

Sieling, Mark Scott. Semiconductor productivity gains linked to multiple innovations

Sorensen, Morten. (2004). How Smart is Smart Money? A Two-Sided Matching Model of Venture Capital, Unpublished working paper, University of Chicago,. Spremann, Dr. Klaus, (s/bf-HSG), University of St. Gallen, Doctoral Seminar, International Finance WS2000/01: Valuation of dot.com

The Economist, (1997, January 25). Venture Capitalists: A really big adventure. *The Economist.*

The Industrial Era 1970-1971: http://www.thocp.net/timeline/1970.htm.

Winston, B. (1998). *Media Technology and Society: A History: From the Telegraph to the Internet*. Routledge.

Woodward, S. & Robert E. Hall, R.E. (2004) "Benchmarking the Returns to Venture,"NBER Working Papers 10202, National Bureau of Economic Research, Inc.

Woodward, S. (2009) and Sand Hill Econometrics, August 2009, Measuring Risk for Venture Capital and Private Equity Portfolios.

Tian, X. & Wang, T. (2009).Tolerance for Failure and Corporate Innovation, Available at SSRN: http://ssrn.com/abstract=1399707.

BIOGRAPHICAL SKETCH

Melissa Cannon Guzy was born in 1965. She grew up in Woodbridge, Connecticut and graduated from the Hopkins School in 1983. She attended Wellesley College and earned her Bachelor of Science in finance from the University of Florida in 1986.

Upon graduating with her B.S. in finance, Melissa worked for Prudential Securities in the Investment Bank in a variety of positions. In 2001, Melissa joined VantagePoint Venture Partners and is the Group Leader of the Emerging Markets-Asia Investment Team. She has 19 years of experience within the semiconductor industry as an entrepreneur, CEO and investor. Before joining VantagePoint, she founded and served as CEO of a VantagePoint-backed semiconductor packaging company, where she oversaw the development of leading-edge 3-D packaging that set new industry standards for high-density backplanes. Melissa is a Hopkins Fellow and participated in the Women's Leadership Program at Harvard University.

Upon completion of her M.S. in finance, Melissa continued as a Partner at VantagePoint Venture Partners.