Quantitative Venture Capital:
How to close the innovation gap

A 3-part article

by John Bhakdi

Part 1:
The Innovation Gap in Venture Capital

When we think about Venture Capital (VC), we think about great entrepreneurs, secret deals, and the adrenaline rush of hitting the "next big thing". Silicon Valley is in many respects the financial cousin of Hollywood: full of great successes, grand failures, of divas, heroes and villains. Financially not very pleasing, but a real fun sport.

But in the larger and more sober world of economics and asset management, VC assumes a role much more fundamental than these fun headlines imply.

Let's leave the hoodies and turtlenecks behind for a moment and tune in to Ray Dalio, the founder of Bridgewater associates and one of the great macro-thinkers of our time. As a sideline in a discussion, Ray once dropped one of the most profound economic comments ever made. He said: "In the long run, income can never grow faster than productivity." And productivity, as we all know from economics class, is a direct function of technology innovation – whose largest growth comes from technology startups.

This means: while VC looks like an unproductive fun sport, it actually represents the financial core engine of all economic growth.

This is the big rift between VC reality and VC promise – on the one side, a failing and marginal asset class that has flat-lined in volume over the past 10 years at a negligible size of less than $30B p.a. US volume, and dismal returns of 6.9% p.a., a negative alpha of 2.8% below the Russell 2000 that tops it out with full liquidity and a lower risk.

On the other side, a $70t global economy, an unprecedented technology framework and millions of potential entrepreneurs standing ready to ignite a new phase of universal growth.

How is possible that VC with its pivotal role in fueling global growth fails to completely to ignite and capitalize on large scale innovation?

After a long period of studying startup from several sides, I find the answer in a paradigm that I call "Seeking Nuggets vs. Breeding Pioneers".

Seeking Nuggets: Conventional VC uses the PE playbook – and fails.

The conventional approach to VC looks like something like this: a VC raises a fund and looks for pioneers that have dug out a big technology nugget. He does so by screening potential candidates, and evaluating their nugget, its market potential, and the quality of the company. It's pretty much like doing private equity, only with assuming slightly more risk.

The problem with this approach is that technology nugget are not very hard to identify once you see them: a big new market, a rapidly growing product, a good team. And this means with a dramatically increased number of VC funds, too many VCs are seeking too few nuggets, inflate their prices and screw up asset returns.

Conventional VC has lean-back approach to picking their nuggets: they wait until one appears, and do nothing to help entrepreneur to dig more of them out.

At the same time, there is overwhelming evidence that a rapidly advancing global technology framework, in combination with a series of Macro trends (difficult job market, growing social acceptance of entrepreneurship, new youth mindsets) are creating a giant goldmine right under our feet. There is a gap between the growing and massive number of potential startup pioneers and the few nuggets that are actually being funded by the old VC system.

Breeding pioneers: a new approach to convert entrepreneurial potential into growth

It is like sitting on top of a giant technology goldmine surrounded by hundreds of thousands of hungry pioneers. Instead of providing them with cheap shovels, we wait until a few find their own tools, and an even smaller subset returns with a few technology nuggets. This conventional system ignores a massive opportunity; waits too long; overpays; and disappoints. This is the seed stage gap: a gap at the very beginning of the innovation funnel that prevents hundreds of thousands of potential entrepreneurs to enter the innovation race.
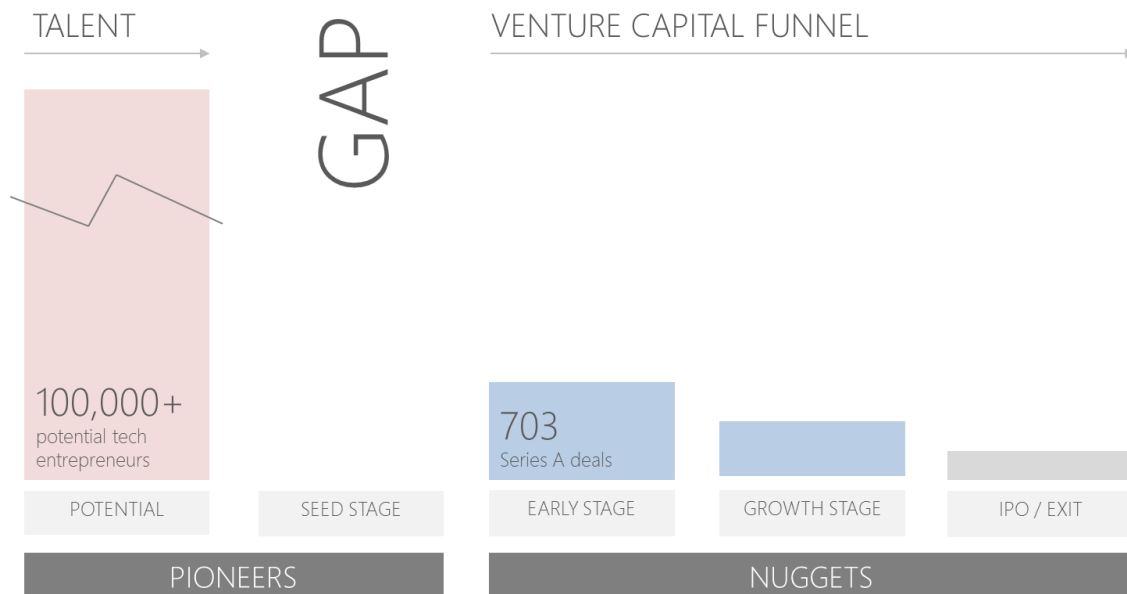
NUGGETS V.S. PIONEERS

FIG A: While conventional VCs wait for technology nuggets to appear at a Series A level, a gap at the very beginning of the innovation funnel prevents the largest share of technology pioneers to enter the innovation race.

What we need is an approach that realizes that startup innovation today can be more easily and massively achieved than in the past. That stops trying to find "good" investments, and embraces the fact that breeding pioneers is a game of probabilities and large quantities.

By changing the approach from seeking nuggets to breeding pioneers, we can make VC more predictable, more profitable, and much less risky.

To succeed, we have to fundamentally re-think the VC investment process. Instead of doing due diligence on individual companies, and trying to deploy the largest possible amount of capital per deal, we have to learn to assess the probabilities of success for large clusters of pioneers. We have to put systems in place that train and educate these pioneers how to generate technology gold. And we have to switch from a deal-maker mindset to that of engineers who build an exploration infrastructure.

This means to leave the drama, magic and pixie dust of conventional VC behind, and build this system around scientific investment principles. We need a framework that assesses probabilities, returns, risk and volume with high accuracy, and systematically extracts innovation alpha from the entirety of technology pioneers.

If we do so, we will achieve something remarkable: the ability to turn innovation into a new asset class that creates a self-propelling system of economic growth.

But to succeed, we first need to understand the Innovation Machine: the combination of factors that drive seed stage startup success.

Part 2:
Understanding the Innovation Machine

When we start studying innovation on a more scientific level, one central paradigm emerges: innovation doesn't occur randomly, but is a function of a series of elements that when combined form a reliable framework of progress. I call this framework the Innovation Machine.

To understand how it works, we can start by looking at the long-established Venture financing funnel. Once a company can show a proven, fast growing product in a huge market, conventional VC and PE investors jump in and finance its rapid expansion. This current process works great for fast-growing startups who have proven their disruptive nature, but generates two losers: VC firms, whose decision to invest into the obvious leads to inflated prices and bad returns; and seed-stage entrepreneurs who don't have a successful fast growing company yet.

Conventional VCs and PE investors often argue that entrepreneurs who can't show massive growth are not entrepreneurs worth investing in. But from a systemic macro-perspective, this argument is flawed: every startup, including the most successful ones, goes through an initial traction-less phase.

This phase – the phase in that pioneers unpack their technology shovel and start digging for business gold – represents the true key lever for creating new economic growth. Because in this phase, our society succeeds in converting talent into high growth businesses – or fails at it. It is here that this game of innovation is lost or won.

To understand the innovation machine and how we can convert capital into economic growth, we have to understand the factors and processes that govern this conversion. I describe them as talent, technology, culture and capital.

Talent

Talent is the initial ingredient of startup innovation. It's often described in terms of mostly of young individuals with high skills in science, math, business, engineering or technology who are driven by an entrepreneurial attitude and high ambition. On a macro-level, we see a massive growth in the entrepreneurial talent in the US: technological progress leads to a continuously tightening job market that sets more and more high potentials free to innovate; and a rapidly increasing social appeal of technology entrepreneurship makes the choice of becoming an entrepreneur more prevalent in our young elites.

THE INNOVATION MACHINE

TALENT

VENTURE CAPITAL FUNNEL

SEED STARTUPS

TECHNOLOGY
CULTURE
CAPITAL

100,000+
potential US tech
entrepreneurs
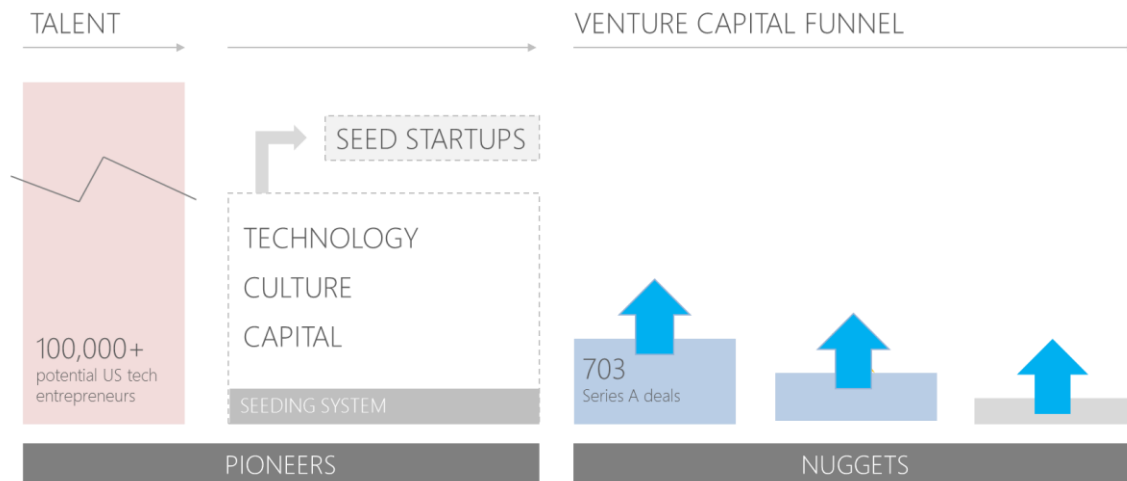
SEEDING SYSTEM

703
Series A deals

PIONEERS

NUGGETS

FIG B: building the seeding system increases the total number of successful technology startups in the economy, and with it, the size and returns of the VC industry.

Technology

Technology is an integral part of the innovation machine. The higher the cost-adjusted power of technology is, and the more widely it is available, the easier it is to build new innovation. During the last 10 years, we have seen an exponential growth trajectory in cost-adjusted technology power, leading to an unprecedented and rapidly increasing technology infrastructure at the disposal of technology entrepreneurs.

Culture

Innovation culture is correctly translated into technology startup culture: technology startups is where innovation happens on the most massive and capital efficient scale.

To make "culture" a component of the innovation machine, we have to dissect the blurry concept of culture into precise and tangible element. These elements are the hacker mindset; the lean startup methodology; and super-dense networks.

The "hacker" mindset originated as a concept at MIT in the 70s and described a new way of thinking: instead of accepting conventional wisdom, the "hacker" thinks outside the box and uses his creativity and engineering skills to find new ways of achieving his

goal much faster (or cheaper). Being a good hacker requires two opposing traits: a high level of playfulness that allows for new and imaginative solutions, and a dead-serious determination to accomplish the goal. Companies like Facebook and Google try to incorporate these contradicting forces in their culture: everything is playful, open, creative, relaxed – but within a management system that is quite focused about delivering results.

The lean startup methodology is a process innovation that has spread across Silicon Valley and other innovation hubs over the last 5 years, and is best described in Eric Ries' bestselling book "The Lean Startup". At its core stand a new way of managing innovation: an iterative process of "build, measure, learn" allows teams to rapidly and systematically forge products and companies that meet big market needs. If this sounds familiar to you – customer centric leadership – here is the twist: the lean startup takes the older customer development process and adds a big element of "lean" to it. It introduces methods that not only align development to market needs, but does so in a radically lean way that drastically cuts costs and time.

Super-dense networks are the last element of the innovation culture. They consist of mentors, investors and fellow entrepreneurs who accelerate startup success by creating a matrix of constant feedback and knowledge growth around a startup. They need to be super-dense, because only then can entrepreneurs achieve the state of "flow" that enables them to achieve the unlikely: a new technology company that changes the world. These super-dense networks are an absolutely essential element of innovation culture, and potentially the hardest to implement on an ecosystem level. They require not only a critical mass of startup enthusiasts who provide constant feedback to entrepreneurs, but also a critical quality: advice is useless, if not detrimental, if it doesn't originate from a deep understanding of the growth process of disruptive technology startups.

The dawn of the Startup school: Accelerators

Over the last 8 years, something extraordinary has happened in this regard: a small number of thought leaders, before all a man called Paul Graham whose place in the history books is firmly reserved, have seen the need and grand opportunity in what I have described above, and taken action. They developed a new type of school that takes aspiring technology entrepreneurs and trains them in a super-intense 3 month program to turn their aspiration into a VC fundable product and company.

These new schools, or accelerators, also provide a small initial funding round – around $20k – to the entrepreneurs in exchange for ca. 5% equity. Paul Graham's concept basically took the three cultural components and packaged them into a program,

while solving the initial part of the funding problem. Suddenly, not only the privileged could start a company, but the smartest, most ambitious could, too.

The success of these new accelerators over the last 8 years is breathtaking: their number grew from 1 to over 150 in 2013, generating over 2000 companies a year. The leading 10 have generated far beyond $15b in market value as of today, with companies such as Heroku, Dropbox, Airbnb, OnSwipe and many others having been spawned from their classes.

This meaning of this break-through in startup production cannot be overstated. While many accelerator programs today still fail to deliver superior returns, a few have cracked the code. And with it, it has become clear to the attentive observer that startup innovation on a seed level can be systematically organized.

Capital

The final component of the innovation machine is capital: the availability of seed stage financing for startup pioneers.

The availability of financing always depends on two conditions: the accessibility of funds for the people who need capital; and the delivery of sufficient yield for the people who supply capital. In both respects, the current system of seed stage funding is a grandiose failure: investors lose a lot of money with angel returns at a -20% median return; and entrepreneurs face the near-impossible task to find investors who provide capital despite a total lack of evidence that they will make a positive return.

This is why capital today is the big challenge that holds back the innovation machine. With an unprecedented level of talent and technology, and a new system of startup culture quickly expanding across our innovation hubs, the field seems to be perfectly prepared for mass-producing innovation. But without a new system of VC financing, all this will be of little relevance.

Early on, I realized that something fundamental has to change in order to solve this challenge. And I also felt that by solving it, we could unlock a massive financial opportunity.

Looking at the challenge, it quickly became clear that financing seed stage pioneers and traditional VC are to fundamentally different games. The latter is Private Equity; the first is innovation capital. And innovation capital in a new world of opportunity and talent can only work in a macro-approach, not by applying a manual case-by-case process. No one can ever know which pioneer will succeed. But we can know at what

rate large clusters of pioneers succeed. We have to look at systems, not cases. We have to switch from gut feeling to rigorous analysis. We have to turn magic into science. And instead of building another seed or VC fund, we have to create a large scale infrastructure that mitigates risk and maximizes portfolio returns by giving more pioneers a chance to attempt success. (Fig C)
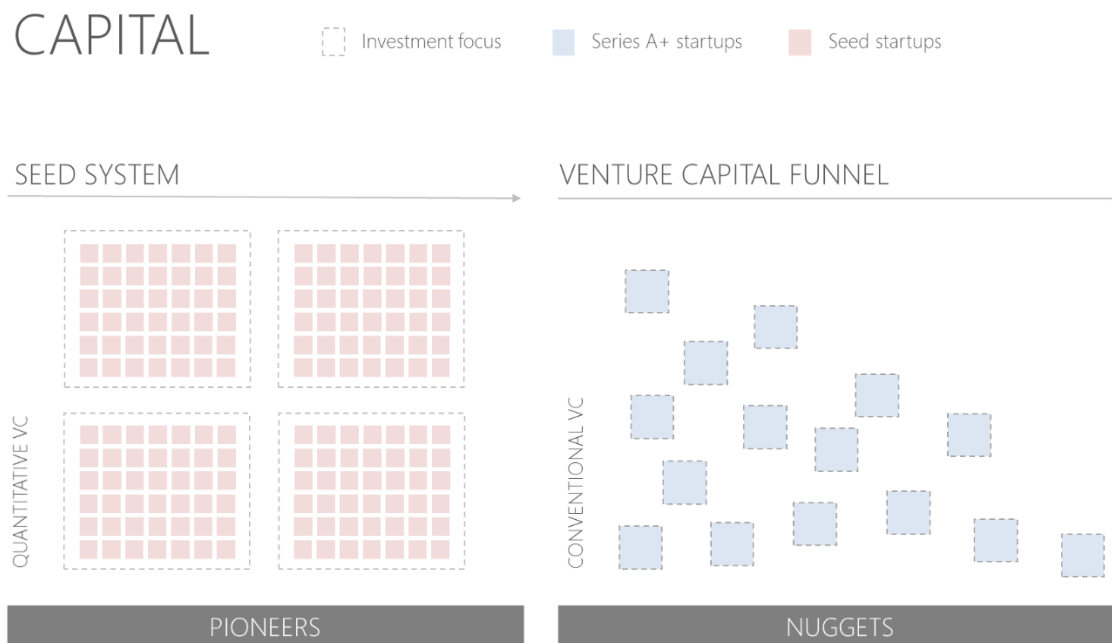

FIG C: To breed technology pioneers, a new financing approach needs to analyze seed stage startups in clusters, not case-by-case as the conventional VC approach attempts to.

It is the inherent nature of innovation that it is unpredictable for every specific instance. And therefore, we can only succeed in building a scalable and profitable innovation capital infrastructure if we learn how to address this issue in innovation financing.

In the next part, we will take a look at one model that shows how this can become possible.

Part 3:

Quantitative VC: Bringing scientific investment principles to Venture Capital

To create a framework that removes the seed stage financing gap, we already know that we can't apply the conventional VC approach. We need to breed pioneers; we need to do it on a large scale that becomes statistically significant; and we have to find innovation ecosystems that provides us with repeatable reference point for risk and return probabilities.

With these three elements as a starting point, I decided to gather some intelligence and data and see if we could arrive at something useful. The initially small project turned into a bigger effort when I realized that finding innovation alpha at scale is actually easier than expected once we leave the old VC thinking patterns behind.

Today, after over 2 years of data crunching and engine-building, I am excited to share some of the results with you.

Methodology

As a starting point, we identify a universe of startup ecosystems (in this specific case, startup accelerators) that allow us to gather comprehensive, non-biased data on the investment performance of their historic startup classes.

Since a lot of these data points are confidential, such as later stage round valuations, we had to build some workarounds that proved to be challenging, but ultimately successful.

The resulting data matrix provides us with a good understanding of each ecosystem's risk-return profile at a high resolution, including the performance of sub-clusters within each ecosystem such as industry verticals, vintages and so on.

We then look at overlays of different risk patterns across ecosystems to find the best balance of risk and return in a larger portfolio. After taking some additional factors into consideration - for example, ecosystem concentration and capacity (we have to consider how many startups are actually available in each vintage and sub-cluster), we arrive at a portfolio design that historically maximizes returns and minimizes risk.

This specific portfolio design tells us exactly which industries and vintages across what ecosystems we need, and what the concentration of startups (weight) should look like across these clusters.

We then use a simulation engine that takes this portfolio and simulates its exact return and risk – for example, how the risk-return profile of a 25 startup portfolio would look like with this specific design, vs. a 50 and 100 startup portfolio.

The simulation uses our data matrix and runs a large number of portfolios (in this specific case, 600) across the selected number of startups, using the specific portfolio design (ecosystems, # of vintages, industries etc.) by randomly picking historic startups at the specified quantity within the defined combination of clusters.

While this might sound a little boring, the results make up for it. Here is what they look like for our optimized portfolio that spans across 10 different startup ecosystems:

Results

Portfolio size, risk and return (Fig 3A.1 and 3A.2)

The scatterplots below show the results for a 5, 25 and 100 startup portfolio. Each blue dot represents the annualized returns of one portfolio. Moving from 5 to 25 to 100 startup portfolio, there is an interesting dynamic: the median return moves up dramatically from 4.4% to 23%, the spread of returns gets reduced from a 180% spread to a 75% spread, and the entire set of returns moves up.
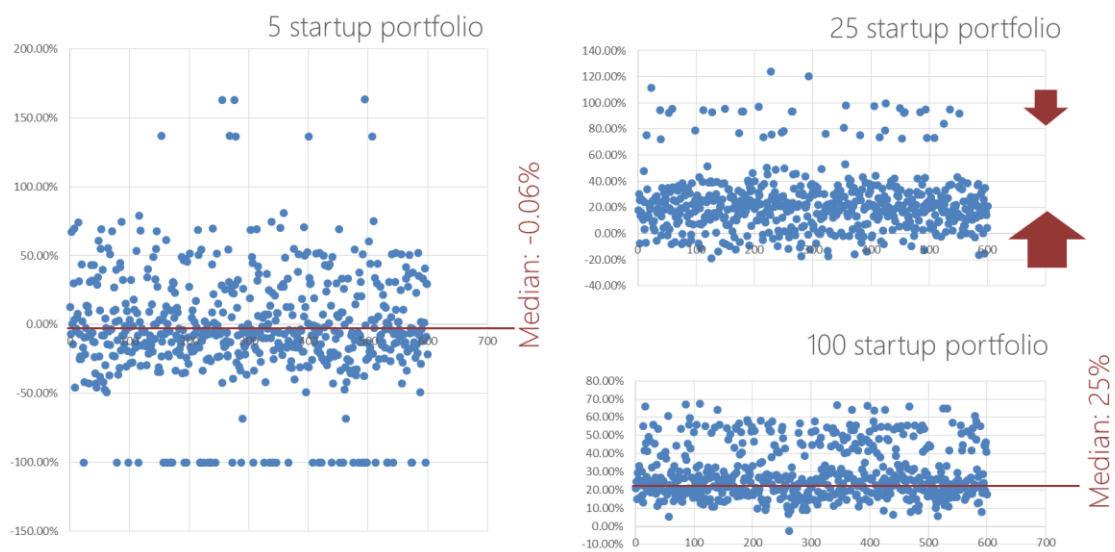
RETURN DISTRIBUTIONS

FIG 3.A.1: Within the specific portfolio design, the return spread decreases significantly between simulated portfolios with increasing number of startups within each portfolio. Each blue dot represents the annualized return for one randomly picked portfolio.
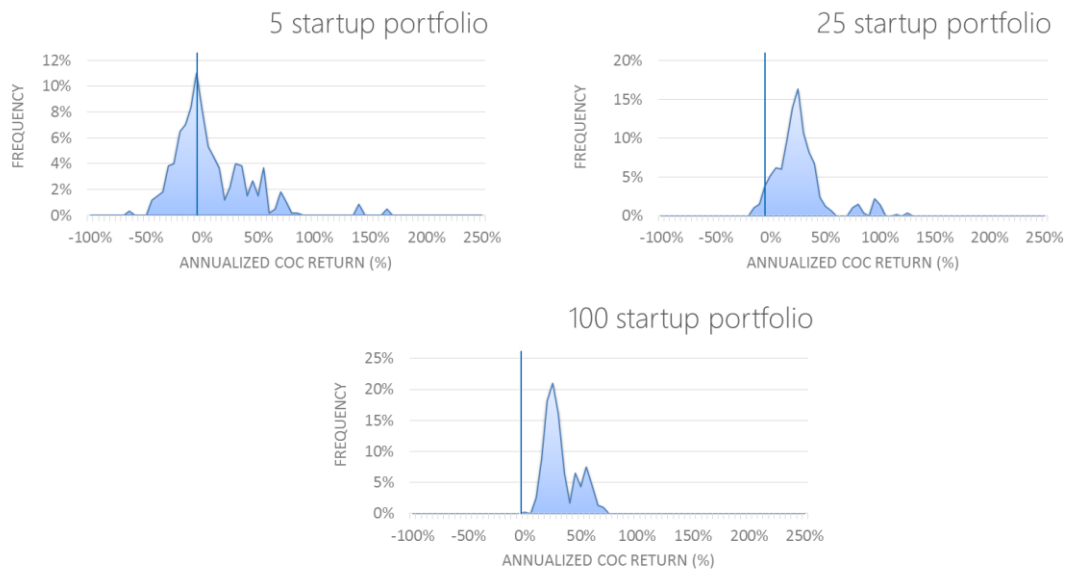
RETURN HISTORGRAMS

FIG 3.A.2 The histograms for the three different portfolio sizes provide another angle on the risk mitigation effect
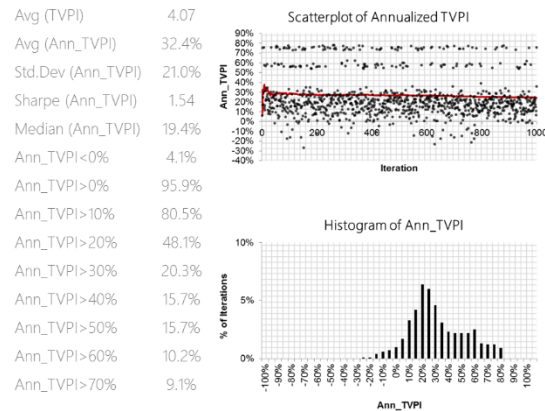
Vintage stability and risk (Fig. 3B)

Yet, cluster distribution and portfolio size alone are not sufficient to determine the risk of a portfolio – it is also important to understand vintage volatility and how risk evolves with the number of vintages covered. If we go deeper into the vintage stability analysis, the volatility in accelerator vintages is very high from vintage to vintage, but not cyclical – meaning over three or four vintages, it has already achieved a strong risk mitigation.

VINTAGE STABILITY

100 startup portfolio

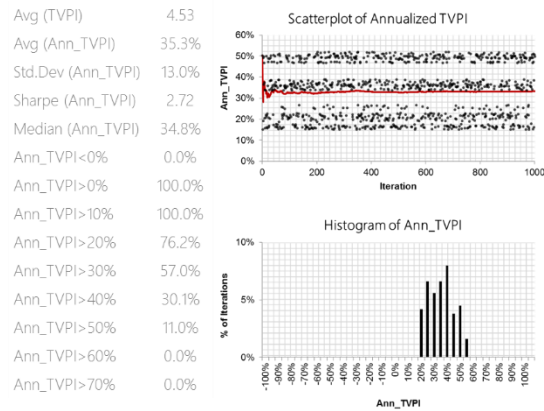|	Invested over 1 vintage		Invested over 3 vintages
Avg (TVPI)	4.07	Avg (TVPI)	4.53
Avg (Ann_TVPI)	32.4%	Avg (Ann_TVPI)	35.3%
Std.Dev (Ann_TVPI)	21.0%	Std.Dev (Ann_TVPI)	13.0%
Sharpe (Ann_TVPI)	1.54	Sharpe (Ann_TVPI)	2.72
Median (Ann_TVPI)	19.4%	Median (Ann_TVPI)	34.8%
Ann_TVPI<0%	4.1%	Ann_TVPI<0%	0.0%
Ann_TVPI>0%	95.9%	Ann_TVPI>0%	100.0%
Ann_TVPI>10%	80.5%	Ann_TVPI>10%	100.0%
Ann_TVPI>20%	48.1%	Ann_TVPI>20%	76.2%
Ann_TVPI>30%	20.3%	Ann_TVPI>30%	57.0%
Ann_TVPI>40%	15.7%	Ann_TVPI>40%	30.1%
Ann_TVPI>50%	15.7%	Ann_TVPI>50%	11.0%
Ann_TVPI>60%	10.2%	Ann_TVPI>60%	0.0%
Ann_TVPI>70%	9.1%	Ann_TVPI>70%	0.0%

FIG 3.B Scatterplots and histogram for a 100 startup portfolio design reveals the risk mitigation effects of investing across three vintages versus just one.

Total performance (Fig. 3C)

Using the different dimensions – accelerators, portfolio distribution, vintage spread and portfolio size – to optimize risk-adjusted return performance, i2X allows to systematically capture the upside of seed stage technology innovation with high precision. The results reveal the significant economic value hidden in early stage innovation: an optimized 100 startup portfolio delivers 32% annualized IRR at 14% volatility – that's a Sharpe ratio of 2.27, a 10x higher risk-adjusted return than the VC average – at a 0.17% risk of loss. This means that our historic chance of losing money in a portfolio is 1:600.

RETURN PROBABILITIES

	5 startups	25 startups	100 startups
TVPI ratio	3.24x	4.18x	4.07x
Avg (IRR)	0.27	0.33	0.32
Std. Dev (IRR)	0.41	0.23	0.14
Sharpe (IRR)	0.64	1.47	2.27
Ann_IRR<0%	61%	12%	0.17%
Ann_IRR>0%	39%	89%	99.83%
Ann_IRR>10%	29%	76%	97%
Ann_IRR>20%	25%	53%	70%
Ann_IRR>30%	18%	26%	33%
Ann_IRR>40%	13%	11%	25%
Ann_IRR>50%	9%	8%	14%
Median	-0.06%	21%	25%

FIG 3C: The 100 startup portfolio shows a dramatic improvement over the same portfolio design with less startups, with a Sharpe ratio of 2.27 vs. 0.64 for the 5 startup portfolio.

We can take another impressive perspective on this approach by looking at the returns of a simulated 5-year fund in the years from 2007-2011, and compare it to some key benchmarks during the same period:

ASSET CLASS CORRELATIONS
ANNUALIZED RETURNS 2007-2011

RETURN

-9.5% Real Estate idx[1]

-2% S&P 500

5% Hedge Fund idx[2]

32% Quantitative VC[3]
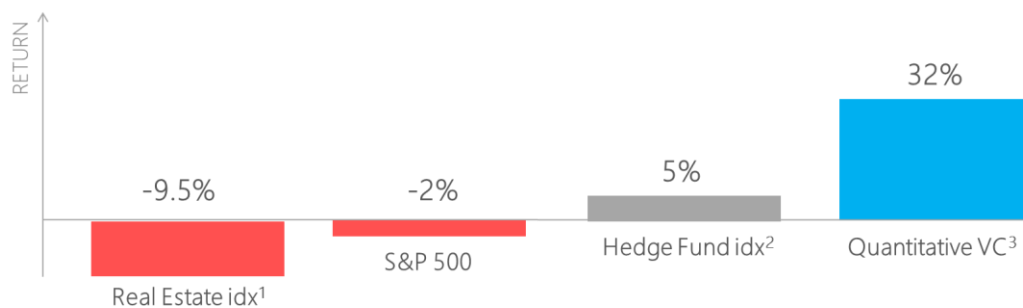
[1] Real estate performance based on First Trust FTSE EN Dev Mkts Rel Est Idx
[2] Hedge Funds index performance based on Credit Suisse Hedge Fund Idx
[3] Simulated annualized TVPI returns for a simulated Quantitative VC portfolio based on an optimized startup portfolio across ten best-in-class accelerators.

FIG 3D: Annualized returns across different asset classes during 2007-2011. Quantitative VC outperformed all other major asset classes in a time of extreme market volatility.

Now, these results are impressive to say the least. They demonstrate that using startup ecosystems as filters, and combining them in a scientifically optimized way generates significant innovation alpha on a seemingly reliable level.

But how realistic are these results? Is this simply a scientific exercise, or do we have a real-world investment strategy at our hands?

When we designed the data matrix and simulation engine, we actually made sure this hypothetical portfolio is also valid as a forward-looking model, and can be executed in the real world: Each ecosystem we picked not just produced successful startups in the past, but continues to generate similar types of startups through a similar process today. Our engine took into consideration changing risk and return patterns to account for trends and their potential impact on overall portfolio performance. On the operational side, we learned directly from the accelerator and incubator teams that deal access – a key obstacle in conventional VC investing – becomes a non-issue with a Quantitative VC approach. With instant investment decisions and first-check-in capacity, a Quantitative VC investor would take the lead in the earliest round – something every startup looks for, and no conventional VC investor wants to do.

While there are many more questions to be answered – for example, how willing are institutional investors to engage in a completely new form of Venture investing – the combination of superior portfolio performance and operational viability provides clear evidence for a viable new approach that could vastly improve VC performance, scalability and professionalism.

A Quantitative VC framework could enable large funds that perform above the top-quartile VC average. Most notably, it could lower the risk in VC investing far below the current levels, and below that of a public equity beta strategy.

But more important than mere size and performance is the reason behind this potential superiority. A scientific approach to VC funding enables institutional capital to fund technology startups on a large scale before they become visible for conventional VC and PE investors. This means lower prices, higher returns and less risk for investors – but it also means that large numbers of the best entrepreneurs will become empowered to change our world when all other sources deny them capital.

Together with an unprecedented wave of innovation technology, talent and culture, this is the great promise of Quantitative VC: to create an infrastructure that makes

Innovation Capital efficient, empowers entrepreneurs at scale, and unlocks the mass-production of progress.

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ABOUT THE AUTHOR

John is CEO of i2X, a new data-driven investment framework that brings scientific investment capabilities to Venture Capital. He combines deep startup experience with an extensive track record as innovation executive and has worked with C- and VP-level executives at WPP and Omnicom agencies, Deutsche Bank, Credit Suisse, MasterCard, Ebay, McDonald's, Dow Jones, Microsoft as well as leading Silicon Valley VC firms on new ways to incubate innovation.

John started the development of i2X in 2010 after realizing that a new startup and acceleration culture has created a historic opportunity to organize and finance startup innovation in more efficient ways.

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ABOUT i2X

i2X is a quantitative investment framework that brings scientific investment capabilities to Venture Capital (VC). A new analytics layer across major US startup ecosystems allows to aggregate large numbers of individual companies into blended portfolios that reduce risk far below that of public stock and outperform top-quartile VC and hedge funds. i2X is backed by co-founders of some of the world's most successful scientific hedge and VC funds.

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