

Venture Capital in the Innovation Economy

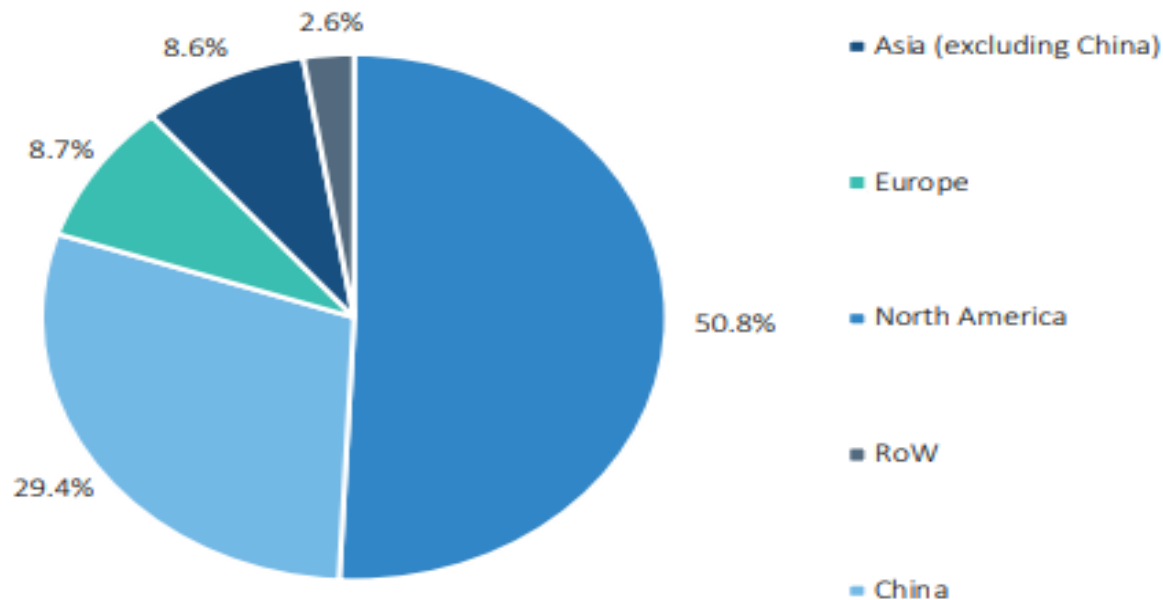
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Spark Festival
10 October 2019

Why Use US Data?

Scale of Australian VC/PE Combined

2018 global VC deals (\$B) by company HQ location



Source: PitchBook

Source: Pitchbook, "Venture Capital in China," 3/19/2019, available at

https://files.pitchbook.com/website/files/pdf/PitchBook_1Q_2019_Analyst_Note_Venture_Capital_in_China.pdf

Why Use US Data?

Only Data that Is NOT Self-Reported

“In this paper, we use a new research-quality data set of private equity fund-level cash flows from Burgiss. We refer to private equity as the asset class that includes buyout funds and venture capital (VC) funds. We analyze the two types of funds separately. The data set has a number of attractive features that we describe in detail later. **A key attribute is that the data are derived entirely from *institutional investors* (the limited partners or LPs) for whom Burgiss’ systems provide record-keeping and performance monitoring services.** This feature results in detailed, verified and cross-checked investment histories for nearly 1400 private equity funds derived from the holdings of over 200 institutional investors.”

(R.S. Harris, T. Jenkinson, S. N. Kaplan, “Private Equity Performance: What Do We Know?” *Journal of Finance*, 69:5, October 2014, p. 1851)

Why Does Venture Capital Matter?

Table 3: VC-backed Companies Among Public Companies Founded After 1974

This table provides summary statistics on the number and impact of VC-backed companies as a fraction of independent U.S. public companies founded after 1974. All measures are as of 2014.

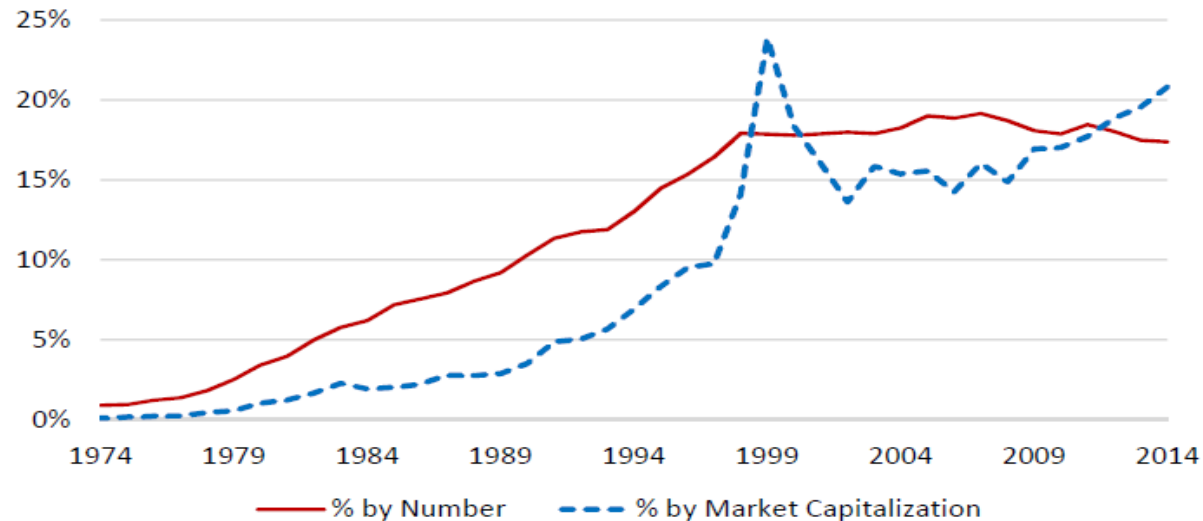
	VC-backed	%	Total
Number	556	42%	1,339
Enterprise Value \$b	4,136	58%	7,200
Market Capitalization \$b	4,369	63%	6,938
Employees	3,083,000	38%	8,121,000
Revenue \$b	1,222	38%	3,224
Net Income \$b	151	61%	247
Research and Development \$b	115	85%	135
Total Taxes \$b	57	59%	98

(W. Gornall and Strebulaev, I. A., "The Economic Impact of Venture Capital: Evidence from Public Companies," p. 6 available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2681841)

Why Does Venture Capital Matter?

Figure 1: Percentage of Public Companies with VC Backing by Year

This figure shows the percentage of independent U.S. public companies active in each year that were VC-backed. The solid red line is the percentage of VC-backed companies among those that were active in each year. The dashed blue line is the percentage on a market capitalization weighted basis.

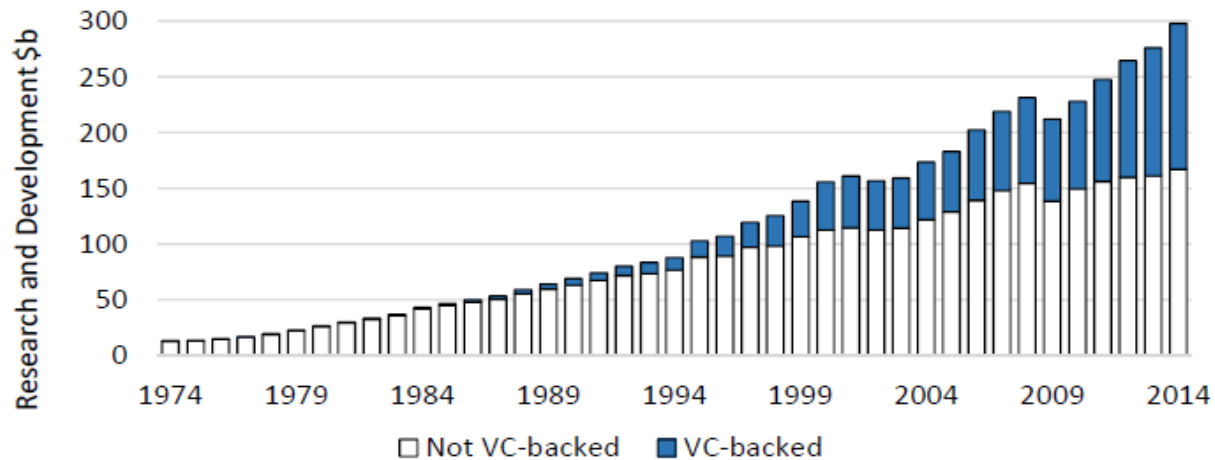


(W. Gornall and Strebulaev, I. A., "The Economic Impact of Venture Capital: Evidence from Public Companies," p. 7.)

Why Does Venture Capital Matter?

Figure 3: R&D Spending by VC-backed Public Companies

This figure shows total R&D spending by VC-backed and non-VC-backed U.S. public companies. See the Appendix for data sources, definitions, and all other details.



(W. Gornall and Strebulaev, I. A., "The Economic Impact of Venture Capital: Evidence from Public Companies," p. 9.)

The First Statistical Fact: VC Returns Are Hugely Skewed

“[T]he actual distribution of returns in such ventures has a low median value but very high variance. Most new ventures fail badly, but some turn out to be wildly successful. Second, even for professional investors or managers making resource allocation decisions, it is impossible to know in advance which ideas will work....[V]enture capital investors make their returns on the one investment out of many that turns out to be a wild success like Google or Airbnb. **The vast majority of venture capital investments, however, return less than the face value of the investment.”**

(R. Kerr, Nanda, R., Rhodes-Kropf, M., “Entrepreneurship as Experimentation,” *Journal of Economic Perspectives*, 28:3, Summer 2014, p. 25)

The First Statistical Fact: The Data

	Mean	Med.	St. Dev.	Skew	25 th Percent	75 th Percent	Max.	Min.
Nasdaq Multiple	2.42	2.38	0.83	0.39	1.96	2.82	5.05	0.63
- Excluding top decile	2.23	2.27	0.63	-0.69	1.92	2.71	3.27	0.63
- Excluding top quintile	2.12	2.21	0.58	-0.90	1.86	2.58	2.92	0.63
Nasdaq IRR	16%	15%	10%	-0.24	11%	21%	45%	- 24%
- Excluding top decile	14%	14%	8%	-1.50	11%	19%	28%	- 24%
- Excluding top quintile	13%	13%	7%	-2.02	11%	17%	23%	- 24%
Nasdaq PME	1.59	1.00	3.67	10.33	0.57	1.68	42.36	0.14
- Excluding top decile	1.02	0.93	0.57	0.66	0.57	1.33	2.48	0.14
- Excluding top quintile	0.88	0.83	0.43	0.44	0.54	1.19	1.85	0.14

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(M. D. McKenzie and Janeway, W. H., "Venture capital funds and public equity markets," *Accounting and Finance*, 51:3 (2011))

The Second Statistical Fact of VC: Performance is Persistent

“We find strong persistence in fund returns across different funds for the same GP.... The coefficients imply that a 1% increase in past performance is associated with a combined 77 basis point increase in performance in subsequent funds....[O}ur persistence results are not caused by either investment overlap or time period overlap.... Overall, the results in Table VII suggest a statistically and economically strong amount of persistence in private equity, particularly for VC funds.”

(S. N. Kaplan and Schoar, A., “Private Equity Performance: Returns, Persistence, and Capital Flows, *Journal of Finance*, Vol. LX, No. 4, August 2005, pp. 1808-9)

The Persistence of Persistence

“For VC funds, we find that performance persistence post-2000 remains as statistically and economically persistent as pre-2000. Partnerships whose previous VC funds are below the median for their vintage year subsequently tend to be below the median and have returns below those of the public equity markets (S&P 500). Partnerships in the top two VC quartiles tend to stay above the median and their returns exceed those of the public markets.”

(R. S. Harris, Jenkinson T., Kaplan S. N., Stucke, R., “Has Persistence Persisted in Private Equity? Evidence from Buyout and Venture Capital Funds,” available at <http://ssrn.com/abstract=2304808>, p.2)

The Persistence of Persistence: The Data

Panel B: Venture Capital Funds

		Current Fund Quartile					Average Current Fund IRR	Average Current Fund MOIC	Average Current Fund PME
	1	2	3	4	N				
Whole Sample									
Previous Fund Quartile	1	48.5%	16.7%	24.2%	10.6%	132	33.1%	3.28	2.26
		64	22	32	14				
	2	28.9%	34.2%	20.2%	16.7%				
		33	39	23	19				
NA, but not first fund	3	22.0%	29.4%	29.4%	19.3%	114	10.4%	1.74	1.19
		24	32	32	21				
First funds	4	14.8%	17.3%	29.6%	38.3%	109	-0.3%	1.00	0.79
		12	14	24	31				
NA, but not first fund		22.0%	21.2%	27.3%	29.5%	260	7.6%	1.53	0.98
		52	62	72	74				
First funds		23.6%	22.1%	24.4%	29.9%	156	9.7%	1.86	1.26
		40	39	33	44				
Pre-2001 Funds									
Previous Fund Quartile	1	48.7%	14.1%	23.1%	14.1%	78	47.7%	4.41	2.79
		38	11	18	11				
	2	33.3%	27.0%	27.0%	12.7%				
		21	17	17	8				
NA, but not first fund	3	26.8%	35.7%	17.9%	19.6%	63	18.2%	2.33	1.40
		15	20	10	11				
First funds	4	8.7%	19.6%	26.1%	45.7%	56	-0.3%	1.00	0.71
		4	9	12	21				
NA, but not first fund		19.9%	21.9%	30.1%	28.1%	167	10.9%	1.78	1.00
		30	43	50	44				
First funds		24.3%	23.0%	24.3%	28.4%	88	16.0%	2.36	1.40
		25	20	20	23				
Post-2000 Funds									
Previous Fund Quartile	1	48.1%	20.4%	25.9%	5.6%	54	12.1%	1.65	1.49
		26	11	14	3				
	2	23.5%	43.1%	11.8%	21.6%				
		12	22	6	11				
NA, but not first fund	3	17.0%	22.6%	41.5%	18.9%	51	2.2%	1.11	0.96
		9	12	22	10				
First funds	4	22.9%	14.3%	34.3%	28.6%	53	-0.3%	1.01	0.90
		8	5	12	10				
NA, but not first fund		25.9%	19.8%	22.2%	32.1%	93	1.9%	1.08	0.94
		22	19	22	30				
First funds		22.6%	20.8%	24.5%	32.1%	68	1.6%	1.21	1.08
		15	19	13	21				

The Third Statistical Fact: VC Returns Track the Public Equity Markets

“The purpose of this paper is to move beyond the anecdotal and formally investigate the presence of any link that may exist between public and private equity markets. To this end, we access a unique proprietary database of the venture capital fund investments made by two major limited partners (LPs) over the period 1980–2007. These LPs have invested in a combined total of 205 venture funds that are either terminated or effectively terminated, providing a rich database of information for analysis. Dated cash-flow information is provided on all takedowns and disbursements throughout the life of each fund.

“Using this database, we attempt to link VC investing and harvesting activities to the state of the public equity market, which is characterized in a way that directly relates to VC activity. The results suggest that the public equity market substantially influences venture returns....”

(McKenzie and Janeway, “Venture capital Funds”

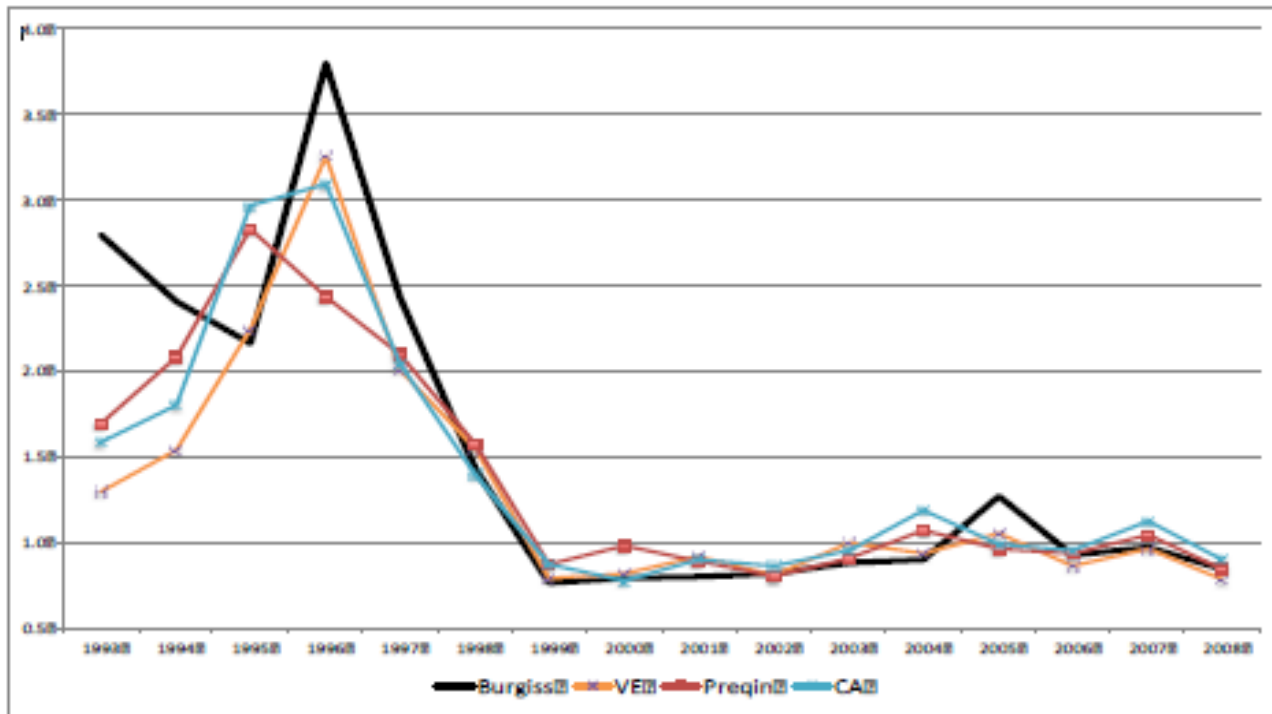
The Third Statistical Fact: The Data

The following table summarises the performance of the 205 venture funds in the database by IRR. To highlight the skewness of the data and the influence of a select group of high performing funds, these metrics are also presented when the top decile and quintile of performing funds are excluded. Finally, the performance of the funds is summarised across different periods of time.

	Mean	Med.	St. Dev.	Skew	25 th Percent	75 th Percent	Max.	Min.
IRR	47%	24%	72%	2.74	9%	61%	515%	-94%
- Top decile only	215%	193%	92%	1.97	155%	254%	515%	133%
- Excluding top decile	27%	20%	35%	0.69	7%	41%	125%	-94%
- Excluding top quintile	18%	16%	24%	-0.46	6%	31%	76%	-94%
- 1980 – 1984	17%	9%	23%	2,10	4%	20%	92%	-5%
- 1985 – 1989	23%	19%	26%	2.06	11%	32%	155%	-57%
- 1990 – 1994	42%	37%	40%	-0.37	17%	64%	125%	-94%
- 1995 – 2006	86%	55%	107 %	1.48	4%	136%	515%	-34%

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The Third Statistical Fact: More Data



(Harris, Jenkinson and Kaplan, Figure 2, Panel B)

The Fourth Statistical Fact: Limited Scope of VC Investments

Amount (\$billion)	1980	1985	1990	1995	2000	2005	2010	2015	2018
ICT	0.2 (44%)	1.9 (70%)	1.4 (53%)	4.0 (54%)	75.4 (75%)	13.6 (60%)	10.8 (49%)	42.1 (71.2%)	
Healthcare/ Biotech	0.1 (16%)	0.4 (13%)	0.7 (26%)	1.8 (23%)	7.6 (8%)	6.6 (28%)	6.3 (29%)	10.9 (18.4%)	
Other	0.2 (39%)	0.4 (16%)	0.5 (20%)	1.6 (21%)	17.6 (17%)	2.7 (12%)	4.9 (22%)	6.1 (10.3%)	
Total	0.5	2.6	2.6	7.4	100.5	22.9	22.0	59.1	

Source: NVCA Yearbook 2016

ICT						11.2 (60%)	12.4 (40%)	34.5 (42%)	44.5 (36%)
Healthcare/ Biotech						7.0 (17%)	9.1 (29%)	18.2 (22%)	30.0 (24%)
Other						5.4 (24%)	9.8 (31%)	30.1 (36%)	50.4 (40%)
Total						23.6	31.3	82.8	124.9

Source: NVCA Yearbook 2019

NOTE: Shift in NVCA data source from Thomson Reuters to Pitchbook

Pitchbook data includes corporate VC: 2005 - \$6.0B, 2010 - \$7.8B, 2015 - \$31.2B, 2016 - \$30.3B

The Fourth Statistical Fact: an Explanation

“Just why has it been in the world of information technology and, secondarily, biomedicine that venture capital has been so successful, in striking contrast with the nearly continuous record of failure across so many other frontiers of scientific discovery and technological innovation? In brief: **only in these sectors of research did the state invest at scale in the translation from scientific discovery to technological innovation.** Through the Defense Department and the NIH, that is, **the [US] federal government funded construction of platforms on which entrepreneurs and venture capitalists could dance.**”

(W. H. Janeway, *Doing Capitalism in the Innovation Economy* (2nd ed.), (Cambridge University Press, 2018), p.97).

VC and IT: What is New and Different

“The maturation of the **open source software** movement;

“The emergence of “**the Cloud**” as an abstracted computing environment for development and deployment....

“...[T]ogether, [these] mean that **the absolute and, even more, the risk-adjusted cost of launching a new offering has been radically reduced.** With software tools available for free and computing resources available for rent, **the upfront cost of building enterprise-class software has declined by a decimal order of magnitude**....And agile development of programs that have been broken down into discrete deliverables radically increases the likelihood that what is being coded will actually work and satisfy the target customer’s expectations. **Moreover, cloud-hosted business software requires minimum friction in deployment** and lends itself to the delivery of rapid bug-fixes, performance improvements and incremental functionality without the technical and marketing risks to customers and vendors alike of major, discrete releases delivered after intervals of a year or more. **Above all, of benefit to suppliers and users alike, only one version of the software exists at any time.**”

(Janeway, *Doing Capitalism*, pp. 146-7.)

VC Response: “Spray and Pray”

...[T]he venture capital investment model has evolved in fundamental ways over the last decade, particularly in the early stage financing of software and service oriented startup ventures. For these sectors, we document an increased prevalence of an investment strategy that has been colloquially referred to as “spray and pray,” where early stage investors provide a little funding and limited governance to an increased number of startups, most of which they abandon after their initial investment. **The “spray and pray” investment approach is a significant shift away from the traditional value-added ‘governance’ in the early stages of a venture's life** and is particularly significant because venture capital investors are not just passive, but typically play a central role in monitoring and governing new ventures through a successful exit.”

(M. Ewens, Nanda, R. and Rhodes-Kropf, M., “Cost of Experimentation and the Evolution of Venture Capital,” NBER Working Paper 24523, April 2018, p. 2.)

SaaS Software Public Companies

As of 08/05/19

Company	Stock Price	% of 52-Week		Market Cap.	Cash & Equiv.	Total Debt	Ent. Value	EV / Rev	
		High	Low					CY19	CY20
Software									
<u>SaaS Software - At Scale</u>									
Adobe Inc.	\$280.36	(10%)	37%	\$136,098	\$3,479	\$4,137	\$136,755	12.2x	10.4x
Atlassian Corporation Plc	\$133.19	(11%)	104%	\$32,107	\$1,713	\$854	\$31,247	22.7x	17.9x
Box, Inc.	\$14.78	(46%)	2%	\$2,165	\$231	\$395	\$2,329	3.4x	3.0x
Cornerstone OnDemand, Inc.	\$53.89	(14%)	17%	\$3,215	\$403	\$377	\$3,201	NA	NA
Dropbox, Inc.	\$21.81	(38%)	18%	\$8,968	\$915	\$693	\$8,746	5.3x	4.6x
LogMeIn, Inc.	\$71.30	(26%)	5%	\$3,525	\$112	\$312	\$3,725	3.0x	2.8x
Medidata Solutions, Inc.	\$91.25	(7%)	52%	\$5,498	\$206	\$193	\$5,485	7.4x	6.4x
Paycom Software, Inc.	\$221.17	(10%)	106%	\$12,751	\$95	\$61	\$12,716	17.4x	14.1x
RealPage, Inc.	\$57.18	(14%)	33%	\$5,292	\$262	\$708	\$5,738	5.8x	5.2x
salesforce.com, inc.	\$142.82	(15%)	26%	\$124,684	\$6,379	\$6,768	\$125,073	7.7x	6.4x
ServiceNow, Inc.	\$256.81	(15%)	74%	\$47,642	\$1,653	\$1,107	\$47,096	13.6x	10.6x
Shopify Inc.	\$321.39	(8%)	173%	\$36,178	\$2,013	\$115	\$34,279	22.3x	16.6x
Splunk Inc.	\$122.47	(15%)	46%	\$18,392	\$2,675	\$1,872	\$17,588	7.8x	6.4x
Twilio Inc.	\$124.52	(18%)	101%	\$16,921	\$1,882	\$625	\$15,663	14.0x	10.5x
Veeva Systems Inc.	\$155.99	(12%)	99%	\$22,972	\$1,330	\$19	\$21,662	20.6x	17.4x
Workday, Inc.	\$187.84	(17%)	60%	\$42,526	\$1,892	\$1,529	\$42,163	11.8x	9.6x
Zendesk, Inc.	\$76.45	(19%)	68%	\$8,485	\$427	\$591	\$8,649	10.7x	8.2x
							Mean	11.6x	9.4x
							Median	11.2x	8.9x
							High	22.7x	17.9x
							Low	3.0x	2.8x

The Biotechnology Paradox

“From 1975 to 2004, . . . while revenues have grown exponentially, . . . profit levels essentially hover close to zero throughout the life of the industry. Furthermore, the picture becomes even worse if we take the largest and most profitable firm, Amgen, out of the sample. Without Amgen the industry has sustained steady losses throughout its history The analysis includes no privately held firms, almost all of which lose money. Therefore, the data presented here are just for the most profitable part of the industry populations.

“...[T]he average time to first year of positive cash flow [from date of IPO] was approximately eleven years.”

(G. Pisano, *Science Business: Promise, Reality and the Future of Biotechnology*, (Boston: Harvard Business School Press, 2006) p. 117.)

Biotechnology IPOs

US VC backed IPOs by Sector (Company Count)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Commercial Services	6	5	5	6		1	4	4	2	3	1	3	1	2	1
Consumer Goods & Recreation	4		1	1					1	3	2	3		1	
Energy	1		2	2				4	4	2	1	1			1
HC Devices & Supplies	16	8	9	13	3		1	3	4	8	15	9	4	5	10
HC Services & Systems	1	2	1	5	2		1	3	2	3	7	5	3		
IT Hardware	11	5	5	22		2	5	5	5	8	5	3	6	5	1
Media	1		3	1	1	1	1	1	2	1	1			2	1
Other	11	6	9	11	3	2	9	3	6	4	9	2	1	9	8
Pharma & Biotech	22	12	21	17	1	3	14	8	14	38	63	40	20	23	48
Software	8	5	4	12	2	2	6	13	22	17	21	13	8	11	15

Pisano's Explanation

“While the aggregate returns to biotechnology are poor, **investors are focusing on the “tails” of the distribution**. The phenomenal stock returns for a company like Amgen provide a beacon for investors . . . Never mind that the probabilities are very low and, on a risk adjusted basis, it may not be a good bet. The promise is there.”

(G. Pisano, *Science Business: Promise, Reality and the Future of Biotechnology* (Boston MA: Harvard University Press, 2006), p. 129.)

Janeway's Explanation

“When a target molecule is identified as a potential therapeutic response to a disease state, the population of potential patients--the “addressable market”—is known. So is the approximate charge per treated patient based on drugs already in the market. And because demand is funded by third party payers and is consequently inelastic, a plausible projection of revenue can be projected contingent, of course, on successful clinical trials and approval by the Federal Drug Administration.

Thus, **a biotech start-up is unique: only in this instance is it possible to estimate a fundamental value, the present value of the net cash flows from the investment—if, and it is a huge if—the scientific and regulatory hurdles to market entry are overcome.** The fact that investors have repeatedly chosen to bet on that contingency demonstrates, as well, the weight that the risks of marketing bear versus scientific and technological risks: the biotech exception exemplifies the value attached to the minimization of marketing risks in a domain where scientific and technological risks are enormous.

(Janeway, *Doing Capitalism*, p. 100.)

Financing the Innovation Economy

“ ...Over some 250 years, economic growth has been driven by successive processes of trial and error and error and error: upstream exercises in research and invention, and downstream experiments in exploiting the new economic space opened by innovation. Each of these activities necessarily generates much waste along the way: dead-end research programs, useless inventions and failed commercial ventures. **In between, the innovations that have repeatedly transformed the architecture of the market economy, from canals to the internet, have required massive investments to construct networks** whose value in use could not be imagined at the outset of deployment. **And so at each stage, the Innovation Economy depends on sources of funding that are decoupled from concern for economic return.**

(Janeway, *Doing Capitalism in the Innovation Economy*, 2nd ed., p.1)

The Role of the State: Demand Side

“War Made the Industrial Revolution”

“Britain was in major military operations for eighty-seven of the years between 1688 and 1815....War was the norm in this period. And it shaped the economy...”

“[T]he British state did much more than minimalistically provide the financial and transportation infrastructure for industrial revolution;...it consumed metal goods in the mass quantities that industrial revolution necessary and possible. Just its bulk demand for guns alone stimulated innovations in industrial organization and metallurgical technology with enormous ripple effects. **At the start of the eighteenth century, it contracted for tens of thousands of guns; by the early nineteenth century its needs were in the millions.** That shift in magnitude signifies industrial revolution in the metallurgical world....”

(P. Satia, *Empire of Guns: The Violent Making of the Industrial Revolution* (Penguin Press, New York: 2018),pp. 1, 6)

The Role of the State: Supply Side

The American System of Manufacturing

“The history of the United States is no different from that of other modern countries; **fighting wars and preparing for wars have been an absolutely critical spur of economic growth and development.** Many of the key industrial and organizational breakthroughs of the late eighteenth and nineteenth centuries came in industries that were developing weapons or other supplies, such as ships or uniforms, that were being procured on a large scale by the military. Starting with the Revolutionary War, continuing with the War of 1812, the wars against the Native Americans, and the Civil War, some of the most important innovations in production and organizational technologies came in the manufacture of guns and other weapons. In fact, **the rifle figures prominently in manufacturing history as one of the first instances of the use of interchangeable parts to facilitate expanded production. Moreover, the machine tools developed for weapons production then migrated to industries producing sewing machines, bicycles, and ultimately automobiles.**”

(F. Block (2011), “Innovation and the Invisible Hand of Government” in F. Block and Keller, M.R. *State of Innovation: The U.S. Government’s Role in Technology Development*, Boulder CO: Paradigm Publishers, p. 6)

The Role of the State: Both Sides

US DoD and the Digital Revolution

“One mechanism through which defense-related R&D investments can aid innovation is **military funding for new bodies of scientific or engineering knowledge that supports innovation in both defense-related and civilian applications**....This channel...is likely to produce the greatest benefits...in basic and applied research, rather than development.

“A second important channel through which defense-related R&D affects civilian innovative performance are **the classic ‘spin-offs,’**...[C]ivilian spin-offs...appear to be most significant in the early stages of development of new technologies...[before] civilian and military requirements...diverge....

“A third important channel...is **procurement**....The US military services...have played a particularly important during the post-1945 period as ‘lead purchaser’....

“Defense-related research spending contributed to **the creation of a university-based US ‘research infrastructure’** during the postwar period that has been an important source of civilian innovations, new firms, and trained scientists and engineers....”

(D. C. Mowery, “Military R&D and Innovation,” in B. W. Hall and Rosenberg, N., *Handbook of the Economics of Innovation* (Amsterdam: Elsevier, (2010), pp. 1236-7)

As Recognized in Australia

“More generally the US policy experience shows that governments can:

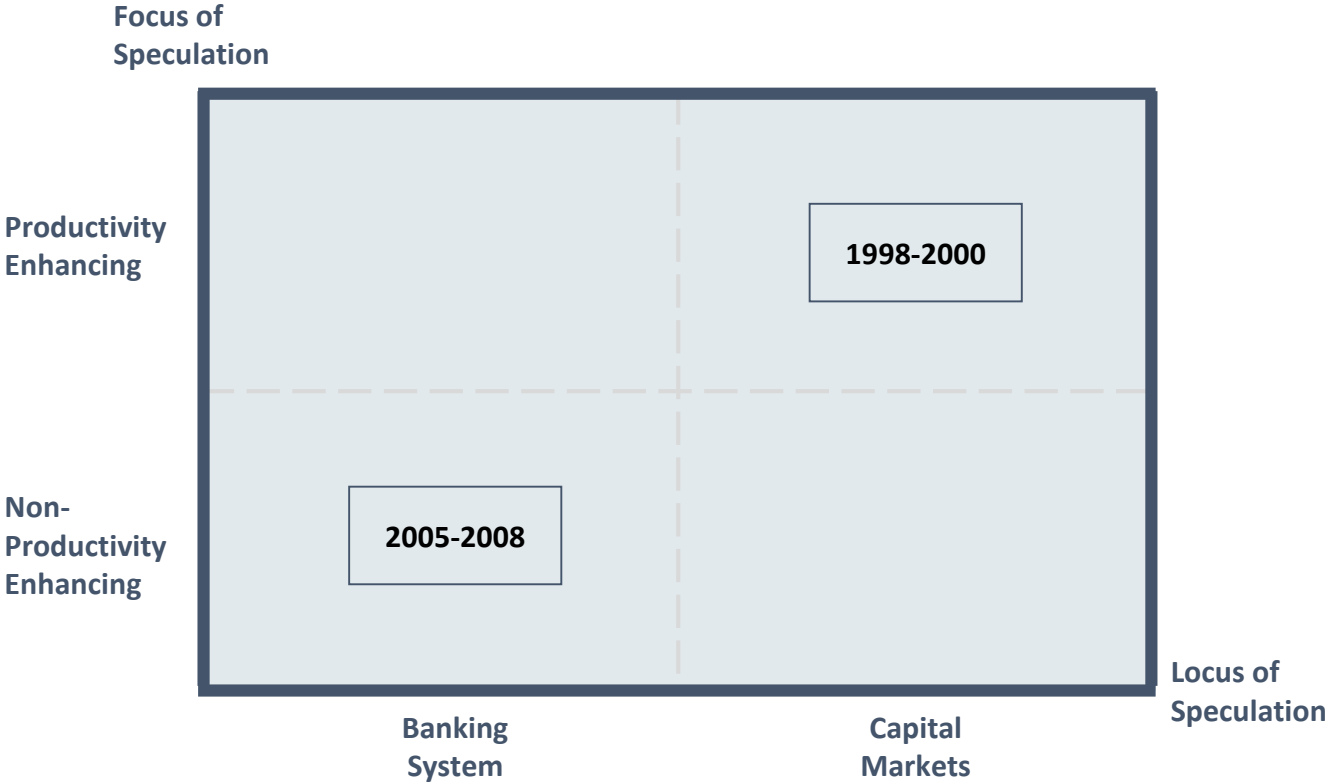
- play a major and effective role in facilitating knowledge transfer and value creation from university and public-sector research
- effectively develop approaches, drawing on relevant expertise, that identify research priorities and guide the direction of innovative effort at the level of the innovation system

“The US experience suggests that when markets are not effective institutions for supporting entrepreneurship and innovation in emerging technologies and industries, governments need to play the supporting role...”

“Drawing on the US experience, and recognising the particular challenges of the Australian context, we propose four initiatives to energise and strengthen the fragmented Australian innovation system:

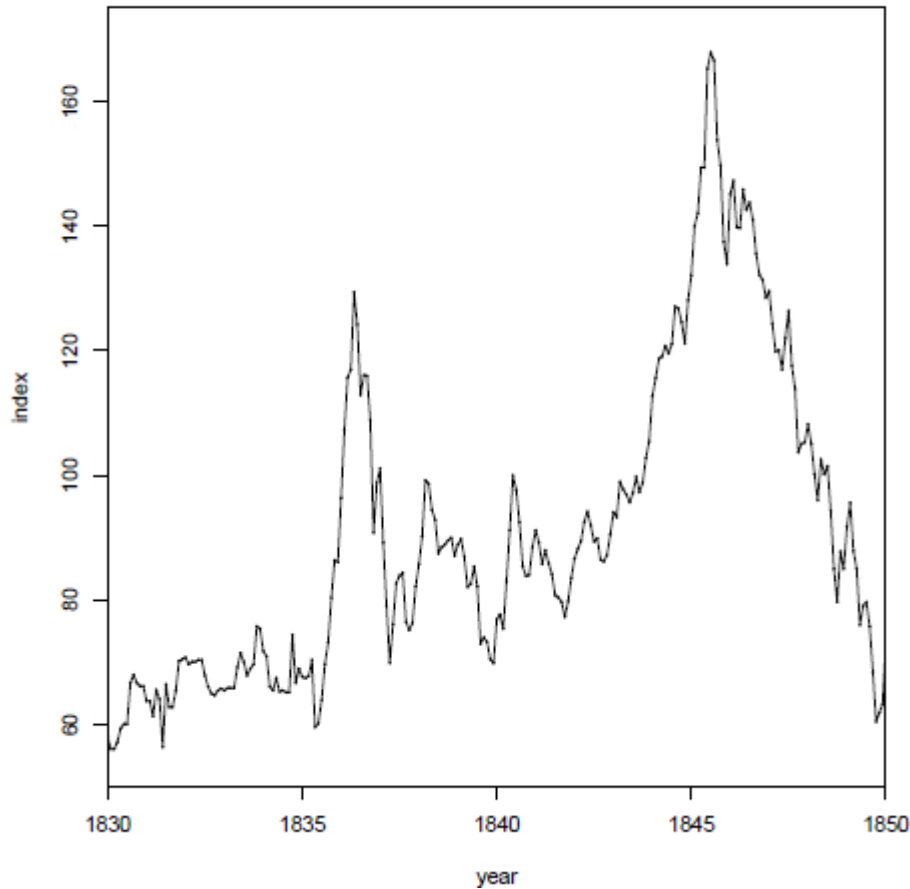
- Increase direct and selective funding of R&D. The R&D Tax Incentive cannot be the central mechanism of innovation policy where most business R&D is incremental and focused on adaptation of technology.
- **Develop ambitious national missions, rather than vague and inclusive “priorities”, to focus investments on innovation and capability-building rather than research.** “

Productive versus Unproductive Bubbles

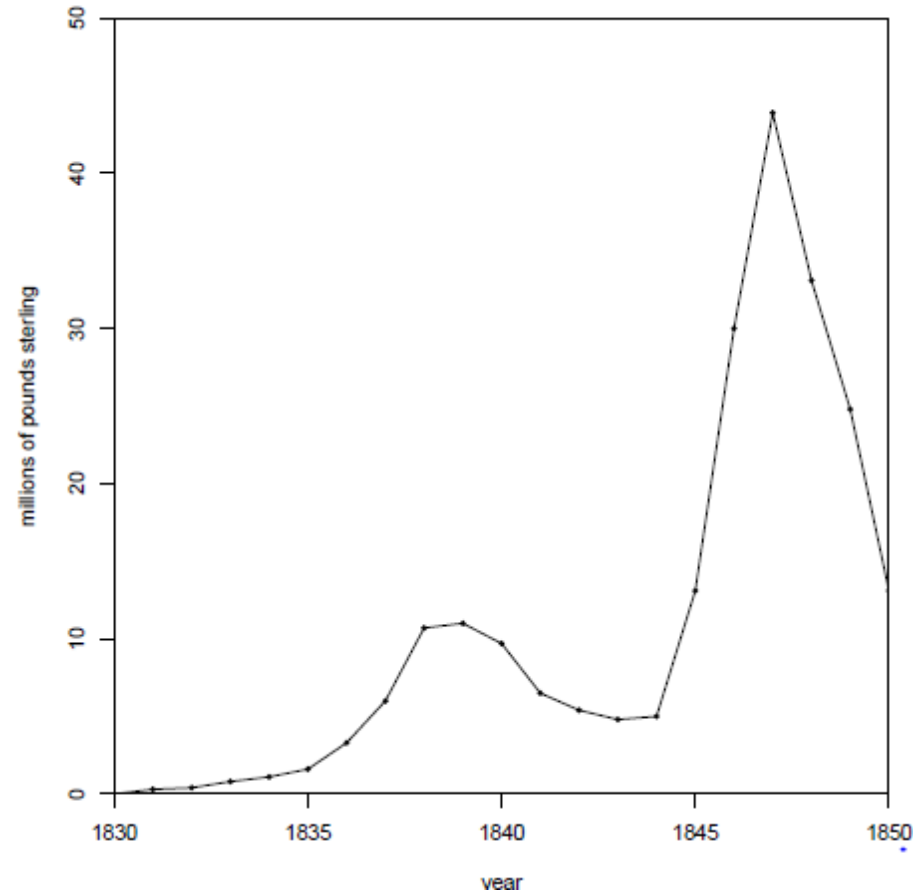


The British Railway Manias

Index of British railway share prices



British railway capital investment



(Source: A. Odlyzko, "Collective hallucinations and inefficient markets: The British Railway Mania of the 1840s," available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1537338)

Financing the American Railroads

“The demands of the railroads during the 1850s on American financial intermediaries and on construction contractors were unprecedented. Railroads required far larger amounts of capital to build than did canals. The total expenditures for canals between 1815 and 1860 reached \$188 million, of which 73 percent was supplied by state and local governments....**By 1859 the investment in the securities of private railroad corporations had passed the \$1,100 million mark, and of this amount close to \$700 million had been raised in the previous ten years....**

“As soon as the American capital market became centralized and institutionalized in New York City, all the present-day instruments of finance were perfected; so too were nearly all the techniques of modern securities marketing and speculation....

“By the outbreak of the Civil War, the New York financial district, by responding to the needs of railroad financing, had become one of the largest and most sophisticated capital markets in the world...” (Chandler, pp. 90-2)

Financing Electrification

- “During the 1920s, **the public equity and debt markets played the critical role in funding the build-out of the systems that delivered electricity to industry and to households**, regionally and at length nationally. The public utility holding companies, initially created to transfer technical expertise to local generating and distribution companies, evolved into vehicles for providing the necessary finance for an industry whose capital intensity rivaled that of the railroads.
- “So **electrification evolved through a dynamic feedback process that delivered, generally at the state and local level, both speculative capital and governmental regulation, the latter invoked to protect the prospective returns on the former**....As the level of electrification for manufacturing industry and (nonrural) residential uses passed 50 percent in the early 1920s, consolidation of the industry into regional and even national holding companies was enabled by a frenzy on Wall Street terminated only by the Crash of 1929. **Before the frenzy ended, installed generating capacity in the United States had risen from 13 million to 33 million kilowatts.**” (Janeway, *Doing Capitalism*, 2nd ed., p. 227)

The Tech Bubble and The R&D Boom of the Late 1990s

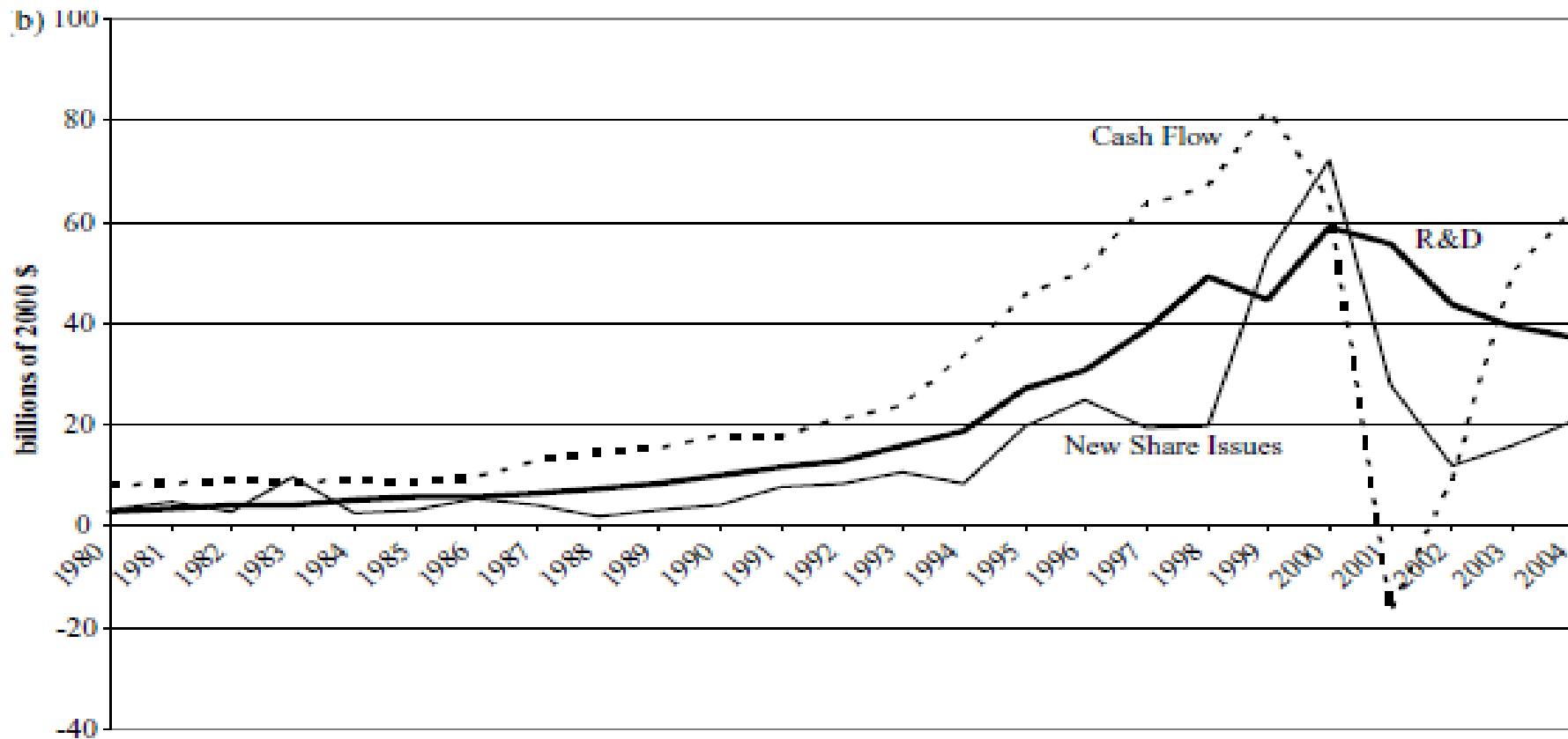


Figure 2b. High-tech R&D, cash flow, and new share issues (young firms). The sample is all young high-tech firms with coverage in Compustat. A firm is classified as young for the first 15 years following the year it first appears in Compustat with a stock price. The high-tech industries are SICs 283, 357, 366, 367, 382, 384, and 737. The heavy line plots the sum of R&D for all young high-tech firms, the dashed line plots the sum of gross cash flow, and the thin line plots the sum of net new stock issues with negative net issues set equal to zero.

Post-2008 Speculation: The Unicorn Bubble

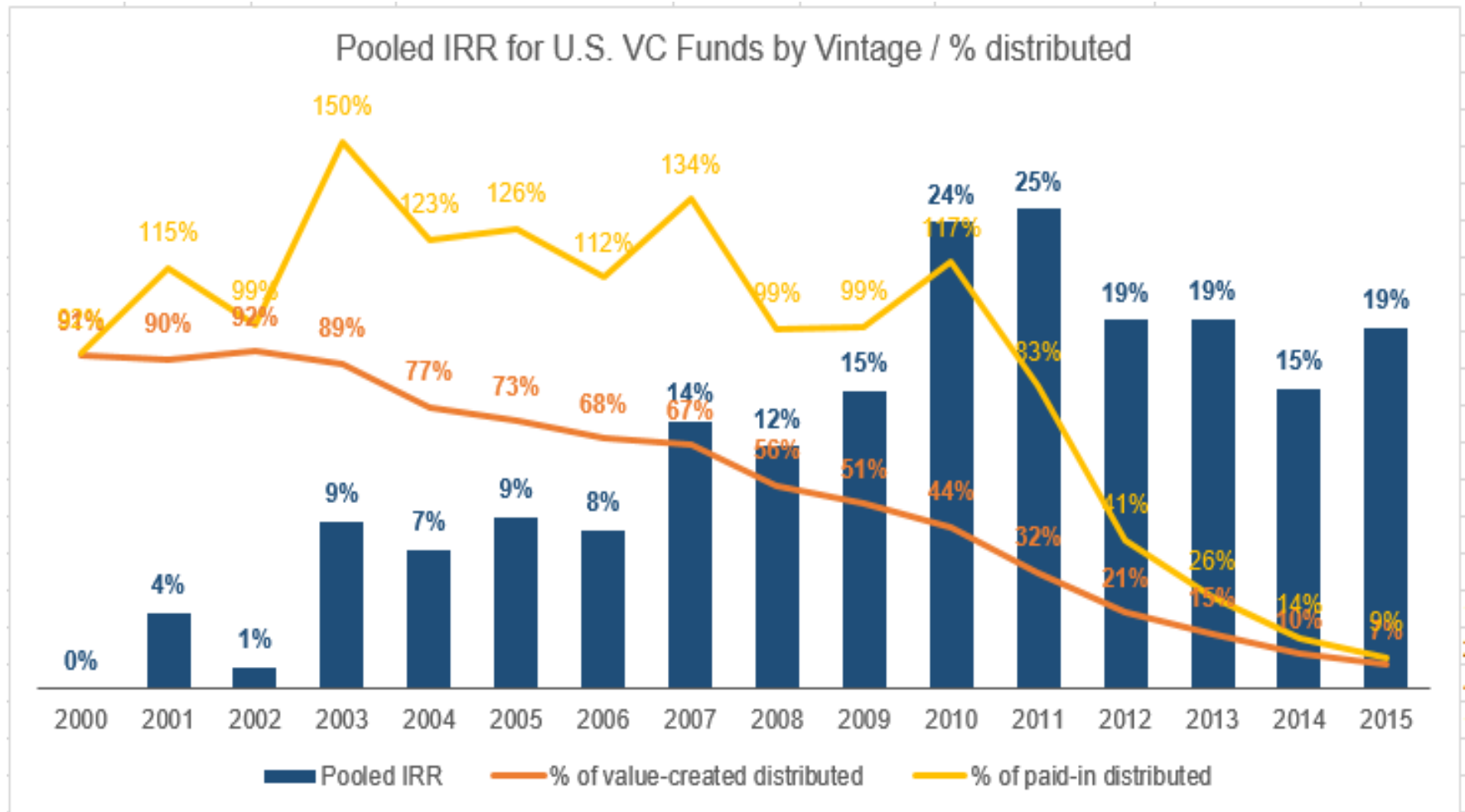


The Global Unicorn Club

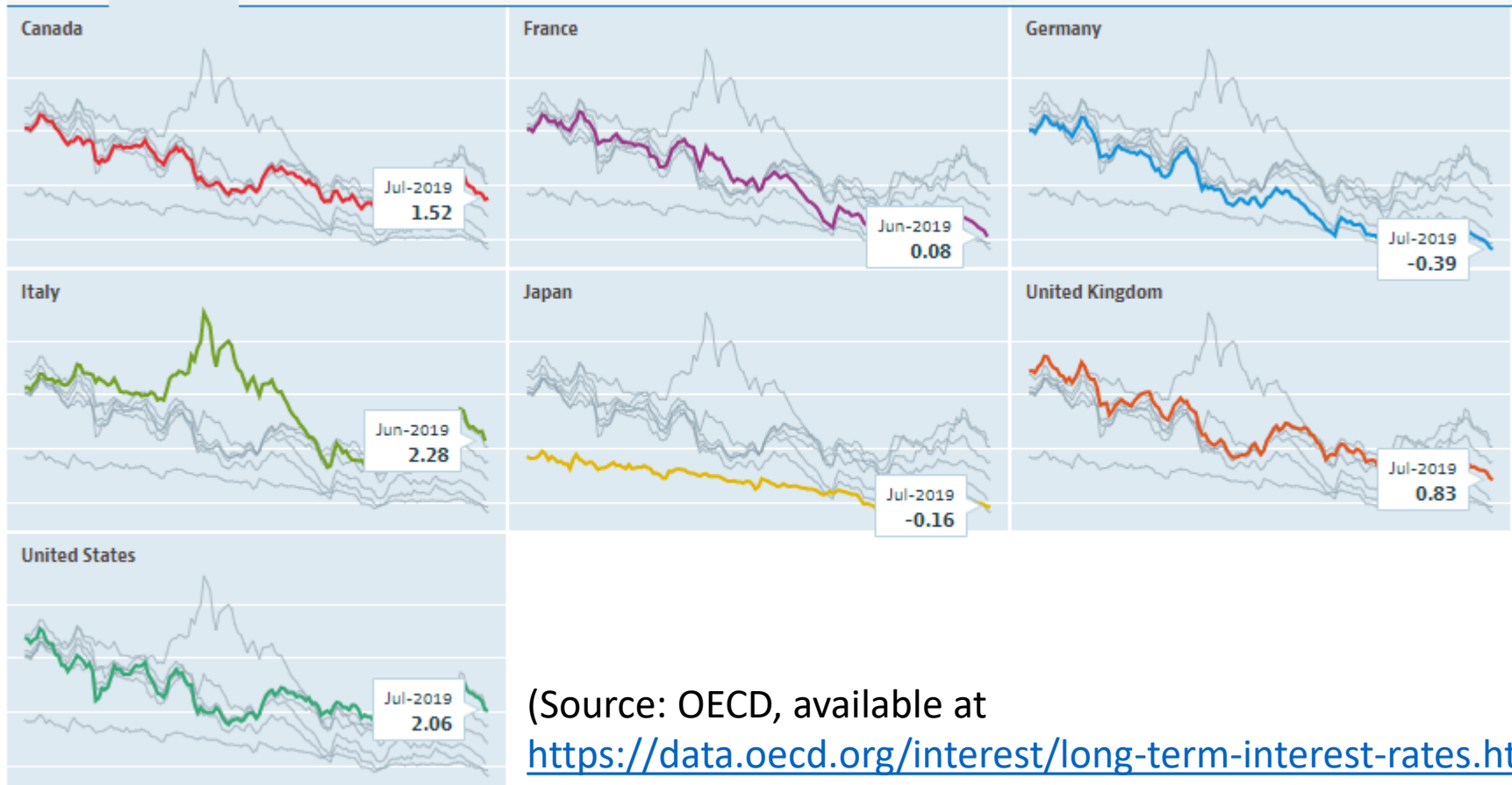
Current Private Companies Valued At \$1B+
(including whisper valuations)

Total Number of Unicorn Companies: **403**
Total Cumulative Valuation: ~ **\$1,287B**

Recent VC Funds Reporting Very High IRRs BUT almost all UNrealized



10-Year Government Bond Yields: January 2007-June 2019



(Source: OECD, available at <https://data.oecd.org/interest/long-term-interest-rates.htm>)

The Two Fundamental Theorems of Venture Capital

“Cash and Control”

“Corporate Happiness is Positive Cash Flow”

The US IPO Market: 1990-2017

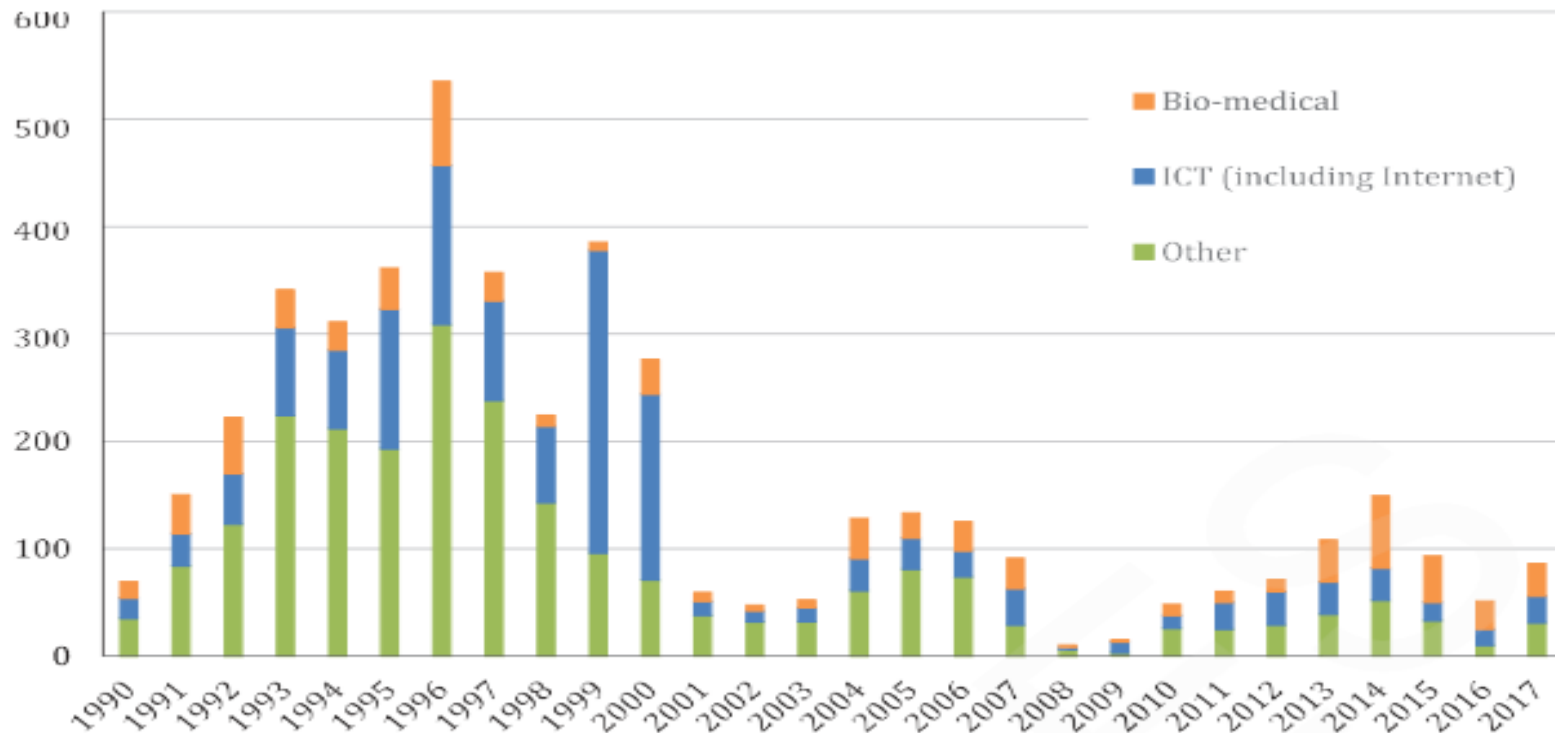


Figure 2. Emerging growth firm IPOs per year by sector, 1990–2017. Source: Kenney and Patton IPO database.

M. Kenney and J. Zysman, “Unicorns, Cheshire Cats, and the new dilemmas of entrepreneurial finance, *Venture Capital* (forthcoming), Fig. 2)

The Unicorn Bubble: Two Vulnerabilities

“...at the micro-level, to the ‘marks to reality’ generated by active trading markets for those that do go public.”

“...at the macro-level, from a return to traditional levels of interest rates and credit spreads as the major central banks normalize credit spreads.”

(Janeway, *Doing Capitalism*, 2nd. Ed., p. 34)

The Next Technological Revolution

“Human-induced warming reached approximately 1°C ($\pm 0.2^\circ\text{C}$ likely range) above pre-industrial levels in 2017, increasing at 0.2°C ($\pm 0.1^\circ\text{C}$) per decade (*high confidence*).

“Warming greater than the global average has already been experienced in many regions and seasons, with average warming over land higher than over the ocean (*high confidence*)....

“1.5°C-consistent pathways can be identified under a range of assumptions about economic growth, technology developments and lifestyles. However, **lack of global cooperation, lack of governance of the energy and land transformation, and growing resource-intensive consumption are key impediments for achieving 1.5°C-consistent pathways**. Governance challenges have been related to scenarios with high inequality and high population growth in the 1.5°C pathway literature.”

(Intergovernmental Pact on Climate Change, “Global Warming at 1.5C°”: Technical Summary, p. TS-4, 6, available at <http://www.ipcc.ch/report/sr15/> .)

The Next Tech Revolution: Where is VC?

US VC CleanTech Investments by Year

	Capital Raised (\$M)	# of Deals Closed	Average Capital Raised (\$M)
2004	30.0	2	15.0
2005	2.7	1	2.7
2006	7.9	1	7.9
2007	70.5	3	35.3
2008	234.3	5	46.9
2009	180.5	8	25.8
2010	19.5	5	3.4
2011	61.9	9	7.7
2012	88.6	12	8.1
2013	212.7	17	13.3
2014	35.5	10	3.9
2015	206.5	14	15.9
2016	63.0	16	4.2
2017	309.3	16	20.6
2018	127.9	34	4.7

(NVCA 2019 Yearbook, p. 14 Appendix)

“The Irreversible Momentum of Clean Energy”

“Since 2008, the United States has experienced the first sustained period of rapid GHG emissions reductions and simultaneous economic growth on record. Specifically, CO₂ emissions from the energy sector fell by 9.5% from 2008 to 2015, while the economy grew by more than 10%. In this same period, the amount of energy consumed per dollar of real gross domestic product (GDP) fell by almost 11%, the amount of CO₂ emitted per unit of energy consumed declined by 8%, and CO₂ emitted per dollar of GDP declined by 18%.”

(Barack Obama, *Science*, 13 January 2017)

American Government Abdicates

Statement by President Trump on the Paris Climate Accord

— ENERGY & ENVIRONMENT | Issued on: June 1, 2017



“As President, I can put no other consideration before the wellbeing of American citizens. **The Paris Climate Accord is simply the latest example of Washington entering into an agreement that disadvantages the United States to the exclusive benefit of other countries**, leaving American workers — who I love — and taxpayers to absorb the cost in terms of lost jobs, lower wages, shuttered factories, and vastly diminished economic production.

“**Thus, as of today, the United States will cease all implementation of the non-binding Paris Accord and the draconian financial and economic burdens the agreement imposes on our country.** This includes ending the implementation of the nationally determined contribution and, very importantly, the Green Climate Fund which is costing the United States a vast fortune.”

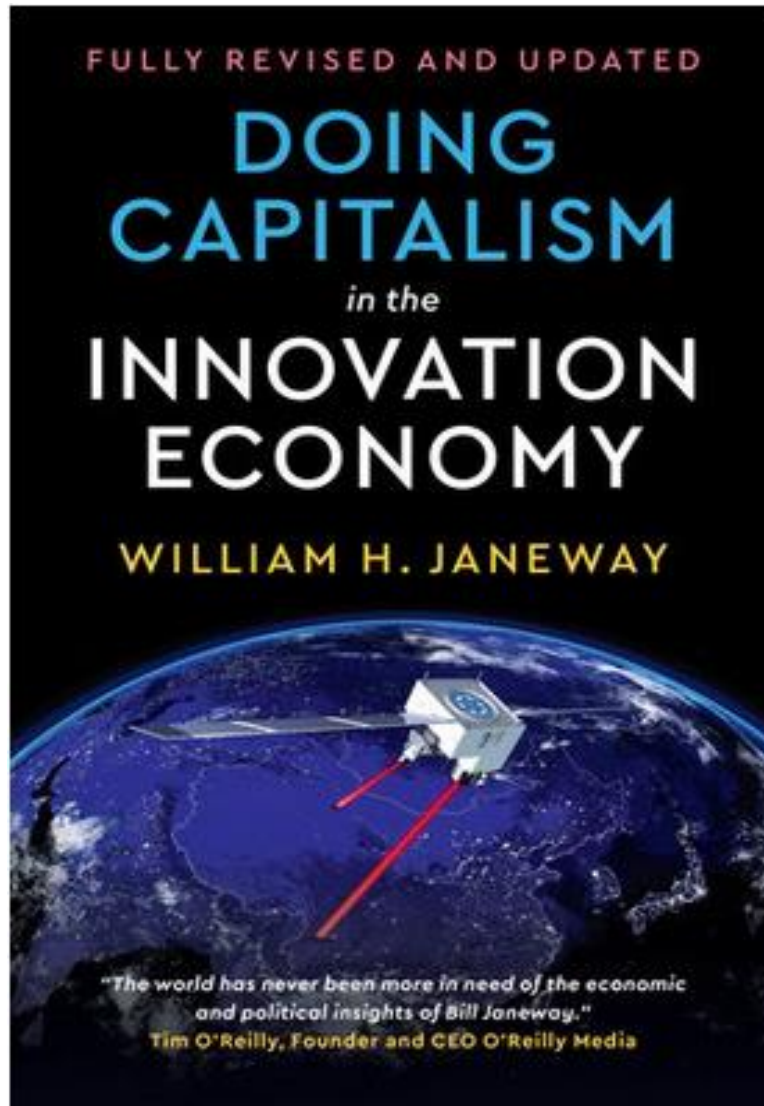
Will China Lead?

China emerges as global climate leader in wake of Trump's triumph

With the US president-elect threatening to withdraw from the Paris Agreement, Beijing is ready to lead world's climate efforts, reports [Environment 360](#)



i Xie Zhenhua, China's special representative for climate change affairs, delivers a speech. Photograph: Abdeljalil Bounhar/INBAR/AP



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