

THE MAKING OF THE DIGITAL REVOLUTION

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While the public tends to regard venture capital as the shadowy and selective money behind today's overvalued tech startups, VC has actually been at the forefront of innovation for 200 years. Like the American state, it is an essential ingredient of the secret sauce of American capitalism.

What are the roots of the digital revolution? The two books under review here have adopted a distinctive approach to this question. Yet, they are extraordinarily complementary, and all the more compelling when read in tandem.

In *VC*, Tom Nicholas of Harvard Business School reaches back almost 200 years and marshals a wealth of quantitative evidence to track the evolution of high-risk investing in America. And in *The Code*, Margaret O'Mara of the University of Washington describes how professional venture capital (VC) found its Valhalla in the San Francisco Bay Area. Focusing primarily on the two generations after World War II, her history weaves a rich tapestry of individual experiences and accomplishments, especially those of women whose contributions were historically overlooked.

Together, the two books provide deep context for understanding the sources of a digital revolution that is now redefining economic, political, social, and cultural life around the world. The common subject in both books is the setting from which “the entrepreneur” emerged as the heroic engineer of transformational technological innovation. Both authors provide detailed accounts of the entrepreneur's dependence on two very different but equally essential partners. The first partnership, broadly recognized in the popular culture, is between the entrepreneur and his (it is almost invariably a male) financial backers – that is, the VC industry; the second is between the entrepreneur and the United States government.

Both books emphasize the second partnership's significance to the digital revolution. The US Department of Defense funded upstream research, and then became an early, collaborative purchaser of the technological fruits before they had become affordable or reliable enough for commercialization. The DOD's procurement role, for everything from microprocessors to mission-critical software, is often underestimated relative to the significance attributed to the Defense Advanced Research Projects Agency (DARPA). To their credit, neither Nicholas nor O'Mara neglects its indispensable part in the story.

Likewise, drawing on the language of the same Cold War crucible from which the DOD's technological sponsorship emerged, President Richard Nixon launched the “War on Cancer” in 1971, thereby positioning the National Institutes of Health to become the engine of the genetics revolution. As in the case of the digital revolution, it was the US government that built the platforms upon which entrepreneurs and VCs would later dance and take their bows.

THE MAGIC TOUCH

The American VC industry has been the subject of academic analysis for 30 years now. But particularly over the past decade, this scholarship has become more objective and authoritative. Unlike in many other areas of finance or wealth management, US venture capitalists' investment performance can be examined through data provided by their own investors; it is not self-reported by the VC funds themselves.

Such an examination reveals three basic facts about the industry. First, VC returns are highly skewed, with a small number of funds generating most of the excess returns relative to publicly available liquid investments. Second, there is persistence in VC returns, as opposed to the randomness one sees among investors in publicly traded financial assets. The performance of a VC fund's first investment “predicts” the performance of its next, such that a small number of firms are responsible for all of the outperformance. Lastly, VC funds have concentrated their investing activities and overwhelmingly earned their returns in just two sectors of the economy: information technology and biomedical technology.

That last fact, of course, corresponds with the leading role played by the state. In no other sectors of science and technology have political leaders crafted a legitimizing mission for such high-risk investments with such enormous potential returns. The other two facts also call for evaluation, even if causal explanations are necessarily challenging to establish.

Here, Nicholas's book renders an outstanding service. His deep historical inquiry begins with the financing of the American whaling industry in the nineteenth century. He compares the returns earned from whaling expeditions – which were funded by “agents” who mobilized the needed capital – with the returns generated by VC between 1985 and 2006. “The distributions are extraordinarily similar in shape,” he writes, “34.5 percent of whaling voyages ended up generating a return of zero or below, and ... 32 percent of venture funds generated a zero or negative [internal rate of return].” Moreover, while around two-thirds of whaling expeditions were profitable,

“very few were exceptionally so, with just 1.7 percent of them achieving profit rates in excess of 100 percent.” By comparison, “only 2.9 percent of VC funds had net IRRs in excess of 100 percent,” he finds.

Moreover, just as in the modern, professional VC industry, Nicholas shows that the “performance of whaling agents exhibited a high degree of persistence over time.” Like their modern equivalents, the persistently successful agents could charge high premiums for their services: outsize fees and commissions in the former case, a “carried interest” share in profits above the standard 20% in the latter.

In light of these findings, Nicholas looks for the source of the extreme asymmetry in returns to “long tail” investors who persistently earn a disproportionate share of the rewards. Delving into the available academic research, he finds that the “literature’s various explanations for these performance differences are contested, especially the relative importance of skill and luck.” But, generally speaking, “return differences are likely to be large and persistent due to high variations in general partner expertise, access to early stage investment opportunities, and momentum created by early investment success.”

What is so remarkable is that this phenomenon remains consistent even though the institutional context has changed so radically over the past 200 years. Nicholas tracks that structural evolution through the activities of Gilded Age “active intermediaries” such as J.P. Morgan (General Electric) and Andrew Mellon (Gulf Oil, Alcoa), and on to the venturesome scions of the twentieth-century 0.01%: Laurance Rockefeller (Eastern Airlines) and Jock Whitney (Technicolor).

HOW THE WEST WAS WON

Equally noteworthy is that all of these financial entrepreneurs and their peers were operating in an environment of “small government capitalism,” to use Hyman Minsky’s term. Yet when it came to constructing the transformational networks of physical infrastructure – namely, railroads and electricity grids – they were able to summon the resources of the state, whether through public-land grants, construction subsidies, or monopoly franchises to for-profit “public” utilities.

Then came World War II, from which emerged the enlarged American welfare and warfare state. Nicholas notes that this “marked an inflection point in the evolution of the American venture capital industry.” It is also where Nicholas’s narrative overlaps with O’Mara’s.

Both authors track the development and exploitation of digital technologies under US state sponsorship, and the attendant growth and professionalization of high-risk investing. Both pay appropriate homage to institutional entrepreneurs such as Georges Doriot, the founder of arguably the first independent VC firm, American Research and Development (AR&D), in post-war Boston, and Frederick Terman, the Stanford dean (later provost) who orchestrated the university’s pioneering sponsorship of entrepreneurial innovation. And both track the early computer industry’s development along Boston’s Route 128 corridor, followed by its migration to Silicon Valley.

In providing parallel accounts of Silicon Valley’s rise, Nicholas and O’Mara each draw on historian Christophe Lécuyer’s deep pre-history of the Bay Area, *Making Silicon Valley: Innovation and the Growth of High Tech, 1930-1970* (2005). The most striking feature of Lécuyer’s account is the sheer continuity of the industry’s development from its earliest days to the better-known post-war period.

Thanks to the introduction of radio more than 100 years ago and the emergence of a community of amateur techies (“ham” operators) interacting with the US Navy, a microelectronics components industry serendipitously emerged on the peninsula south of San Francisco. Before broadcasting had even been imagined, the killer app for wireless communications had been ship-to-ship and ship-to-shore interaction. And years before becoming the dean of engineering at Stanford after WWII, Terman, as a young professor of radio engineering, was already positioning the university as a critical third player in the interplay that created Silicon Valley.

Both books offer relevant anecdotes to show how engineers learned to operate as entrepreneurs outside the established corporate environment, and how financiers learned to manage the risks of investing in advanced technologies prior to commercial validation. In the event, 1957 turned out to be a seminal year on both coasts. In Boston, Doriot’s company backed the Digital Equipment Corporation (DEC) and its co-founder, Ken Olsen, in what may have been the single (relatively) most rewarding venture investment ever made. AR&D’s principal of \$70,000 in 1957 was worth \$355 million in 1971.

Meanwhile, in the technological ecosystem around Stanford, the “Traitorous Eight” semiconductor engineers who had been lured to California by William Shockley, the inventor of the transistor at Bell Labs, struck out on their own and founded Fairchild Semiconductor, followed by Intel. Their financial intermediary in the process was Arthur Rock, who would later achieve iconic status as the VC funder of not just Intel but also Apple Computer.

From the late 1950s to the 1980s, the emerging digital technologies, and the startups created to exploit their potential, all operated in the shadow of two giant incumbents: AT&T and IBM. From today’s perspective, it is difficult to appreciate just how dominant these firms once were, even for one who lived through the era of their supremacy and eventual fall. A different form of state intervention – distinct from the DOD’s activities – set the stage for the entrepreneurs and VC players at the center of Nicholas’s and O’Mara’s books.

We are now living through another era defined by the dominance of tech giants and the state’s virtual abdication of concern for the consequences of that dominance. It is worth remembering that it was litigation initiated by the US Department of Justice’s Antitrust Division that created the open space from which the digital revolution and its leading players could arise. In 1956, a generation before it consented to being broken up, AT&T settled a DOJ challenge by agreeing to license all of its patents royalty-free, and to limit its activities to the telecommunications industry. Thirteen years later, IBM agreed to “unbundle” the software that came with its computers, thereby enabling the emergence of an independent software industry. Some 50 years later, that industry has matured to the point that it can now “eat the world,” to use VC Marc Andreessen’s memorable description.

OPEN SESAME

A central theme in both books is the cultural contrast between Route 128 and Silicon Valley, with the latter demonstrating an openness and flexibility that afforded it an enormous competitive advantage – one that Lécuyer traces back to the community of technically minded amateur radio operators. Another difference, Nicholas notes, was labor-market regulation. In Massachusetts, non-compete clauses in employment contracts were actively enforced; in California, such clauses had been rendered void since as early as 1872.

But there was also a technological factor at work, one that neither Nicholas nor O'Mara explores in much depth. The first generations of computers – from IBM mainframes and DEC minicomputers to the workstations of the early 1980s – were proprietary, closed systems. Everything from the custom-designed hardware processors to the operating system and all the peripheral devices was unique to each brand. As such, an engineer trained within the DEC environment had to start from scratch to master the knowledge needed to work for the cross-town competitor, Data General. Even putting aside the legal hurdles, inter-firm mobility was technologically constrained. For a startup to launch a competitive system, it had to innovate at every level, from the core processor to all of the requisite software.

All of that changed in the 1980s. In terms of both commercial and geographic competition, there was a double irony underlying the opening up of the information-technology sector. First, when IBM responded to Apple's (closed-system) Apple II by introducing its own personal computer in 1981, it relied on third-party technologies – an Intel microprocessor and a Microsoft operating system – for critical functions for the first time in its history. And because these platform technologies were available to the world, an army of “clones” quickly emerged. The most proprietary of earlier “Big Tech” firms ended up sponsoring the first truly open computing industry.

Meanwhile, on Route 128, researchers for MIT's Project Athena were working on technical standards for rendering different proprietary systems interoperable across networks. And at the same time, engineers in AT&T's East Coast labs were creating an open, freely distributed operating system: UNIX. Together, these projects kicked open the doors for innovation. Silicon Valley was opened up by technological initiatives that emerged from the East Coast digital establishment that it would eventually vanquish.

TOIL AND TROUBLE

The digital revolution matured with the establishment of the Internet, a potentially limitless environment for communications and commerce. In the manner typical of capitalism, recognition of this new potential expressed itself in a speculative explosion that financed both the deployment of the necessary network infrastructure and a Darwinian exploration of the new economic space that had been created.

The productive bubble of the late 1990s echoed the earlier manias that funded railroad development in the nineteenth century and electrification during the 1920s. It also generated extraordinary returns to those VCs and entrepreneurs wise and quick enough *not* to believe that “this time is different.” In the end, the venture domain was flooded by a tenfold increase in risk-seeking capital, all timed to invest at the peak of the bubble.

Nicholas's analysis ends with the turn of the millennium, whereas O'Mara brings her narrative up to the present, tracking the rise of the new digital monopolists (Google in search, Facebook in social media, and Amazon in e-commerce). Once again, from the rubble of a bubble, a new economy has emerged. And once again, it has spawned a political backlash against a narrow elite.

But the reversal generated by the digital revolution is broader and deeper than the scope of O'Mara's book allows. A revolution spawned by the American state has matured to challenge that state's authority through the automation of work, the globalization of markets, and the financialization of economic life. Together, these forces have generated an increase in inequality not seen since the transformation wrought by the Second Industrial Revolution at the end of the nineteenth century. Today's populist response, albeit less coherent than the Progressive movement, is not without precedent.

The 2008 global financial crisis planted the seeds of today's populist backlash, and yet it also ushered in an unprecedented environment for financing exploratory new business models within the new digital economy. While governments around the developed world retreated into fiscal austerity, central banks became what Allianz's Mohamed A. El-Erian called “the only game in town,” pursuing aggressively loose monetary policies to support the recovery.

An unprecedented decade-long regime of ultra-low interest rates has, in turn, spawned an equally unprecedented response: startups financing experimental super-growth models by selling securities at super-high valuations to unconventional investors who lack the experience to impose the traditional constraints used by active VCs. A few of these “unicorns” (startups valued at \$1 billion or more) have the potential to establish themselves as self-sustaining businesses, paying their bills with the revenues earned from customers for the services they deliver. But many more are bound to fail, because they have no clear path from selling securities to generating positive cash flows from their operations. WeWork is the iconic example.

BRINGING HISTORY TO BEAR

Nicholas and O'Mara have each made major contributions to an immensely important subject. Their disparate but mutually reinforcing accounts of how individual entrepreneurs could cumulatively create a new economy, and of how VC enabled them to do it, are required reading for anyone who wants to know how our current tech-centered world came into being. Nicholas, in particular, has produced what may prove to be the definitive historical account of VC's emergence as a professionalized practice and asset class of strategic economic importance. He joins with O'Mara in providing rich portraits of key figures and their startups throughout the post-war period.

One other feature of both books merits mention. Each acknowledges the striking contrast between the increasing role of immigrants attracted to Silicon Valley and the limited gender diversity within the ranks of entrepreneurs and VC funds alike. While Eastern European and Asian males have found a welcome home, African-Americans remain marginalized in the demography of the Valley. And as O'Mara shows through a series of compelling profiles, highly trained and talented women were confined to the fringes of the industry by an internal culture of misogyny that did not receive public scrutiny until very recently.

A final, frustrated comment is in order. A celebration of the people behind the digital revolution behooves us to consider the status of the next necessary technological revolution: the green one. On this issue, American VC, like the American state, is missing in action, while China is playing a leading global role. It is both grotesquely ironic and historically significant that China is the one making the most not just of "appropriated" American intellectual property, but also of the American Cold War playbook of public-private partnerships at the technological frontier.