

WORK IN THE DIGITAL AGE

***Challenges of the Fourth
Industrial Revolution***

**Edited by
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and Florian Ranft**



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ENTREPRENEURIAL FINANCE IN THE ERA OF INTELLIGENT TOOLS AND DIGITAL PLATFORMS

Implications and consequences for work

Martin Kenney and John Zysman

Venture financing, a form of entrepreneurial finance, has played a central part in the story of the digital revolution. Indeed, Silicon Valley, the global centre of the venture capital industry, draws its name from the substrate of the contemporary semiconductor, which is the computational engine for all digital products. The continuing performance improvements characteristic of Moore's law provided ever new potentialities for new generations of start ups. While improvement in processing power was the core engine for this venture-capital-financed entrepreneurship, the new firms were not only in semiconductors, but also in layers in stack above the processor itself. There were semiconductor firms of various generations including Intel and AMD, Cirrus Logic, and even later NVIDIA. There were computer firms ranging from Tandem Computers to Sun Microsystems and Silicon Graphics on to Apple and Osbourne. As there were more computers, users wanted to network them together and with this came 3Com, Cisco and many other firms; all of which used semiconductor chips. In addition to semiconductor

components, they needed disk drives, input devices, printers and many other devices – many of which were also pioneered in Silicon Valley. However, the most powerful development of all was the establishment of an independent software industry – the most successful was Microsoft, but there were many, many more, including Oracle, Adobe, Intuit and others successfully established in Silicon Valley. Eventually, these technologies were united in the internet, whose technologies were developed at CERN in Switzerland and the University of Illinois. At each stage in this development venture capitalists could be found who were willing to invest in the new firms (Kenney 2011). These entrepreneurial financiers had only one goal – to make capital gains. The vehicle for these capital gains was, quite simply, a firm whose product grew so rapidly that other investors would be willing to buy that firm, or buy equity in that firm, at massive capital gains multiples.¹

Over the last two decades, we have been gradually moving into a phase in which technology has progressed to the point at which the ongoing digital revolution is resulting in a business environment within which platforms, intelligent tools and their application to manufacturing and services is becoming ubiquitous and even transformative. The rapid development and adoption of robotics and intelligent systems with self-learning algorithms are automating not only tasks associated with blue-collar work, but also less-routine tasks that have been considered knowledge-intensive (Brynjolfsson and McAfee 2012, 2014; Ford 2015).² This digitisation process seems to be inexorably diffusing into more sectors of economic and social life. Though there is a debate about the extent and speed of the transformation, much of this work will be reorganised on digital platforms and undertaken with digital tools. These developments are a backdrop for considering the role of finance in this process.

As we enter an era in which platforms and intelligent tools become important for the entire economic system, the computation-intensive automation of services and manufacturing is upon us. Moreover, given that this phase is transforming work and, dare we say, value creation, broadly, it is important to consider whether the firms born

in this hothouse of entrepreneurship – motivated by capital gains, and driven to establish unassailable market positions – will also facilitate, let alone consider, the augmentation and promotion of the societal work force.

The ability of financial actors to fund firms introducing new disruptive digital technologies over relatively long periods of time, while experiencing large losses, is having a powerful impact on the relations and conditions of work and employment.³ Suggesting that it is important to consider the role of finance in the growth of digital platforms does not mean we must engage with the larger question of the role of finance in the US economy or to enter into the more general debate over the financialisation of the US economy, though these are an important context for our essay (Davis and Kim 2015; Lazonick 2010). We focus on the implications of the enormous sums of venture capital (and private equity) available, permitting investors to provide massive sums of capital to firms with the intent of restructuring (or, in the current vernacular, disrupting) existing businesses or value chain organisation (Christensen 2013).

FINANCE, THE TRAJECTORY OF TECH FIRMS AND CONSEQUENCES FOR WORK

Investment euphoria is not unique to the current era. Carlota Perez (2003), in *Technological Revolutions and Financial Capital*,⁴ and William Janeway (2012), in *Doing Capitalism in the Innovation Economy*, have argued that because of the infrastructures built and technologies introduced during the investment euphoria, the political economy is permanently altered (Soskice and Hall 2001; Zysman 1983). The underpinnings of the current investment euphoria are important to consider. Financial conditions and start-up tools in this era permit a novel investment strategy that has real consequences for labour and work. The first element is that the cost of building digital 'tools', including platforms, has dropped dramatically. Cloud computing provides low-cost infrastructure for 'users' while vast

libraries of open-source software are available online at repositories such as GitHub or SourceForge (Murray and Zysman 2011). Together they allow low-cost experimentation in the name of disruption, seeing what sticks and creates enough market position quickly to drive capital valuations. Sustainable market positions for these firms can be a concern for a later day.

The 'disruption' meme suggests that a new more efficient business model is being introduced to bypass the old-fashioned existing businesses. The automobile disrupted the horse-and-carriage business; digital search engines and digitisation of content displaced or altered library operations. In this narrative, disruption is positive; it compels existing businesses to adapt or vanish. For example, Amazon dramatically shrank the number of physical bookstores.

Of course, the ultimate question is: why should we care? If consumers gain and the disruptors benefit financially, who should complain? Certainly, Uber makes finding a ride in London easier for a visitor from San Francisco and vice versa. Google changes our attitude and approach to information. LinkedIn replaced the rolodex and the job board by transforming the manner by which professional connections are maintained.

This logic that progressive 'disruption' advances society comes with consequences, however. Let us note at least a few. As the newspaper business struggles, some have argued that investigative and international journalism is declining, and some argue that it has contributed to a decline in our democracy. Alternatively, others might argue that entirely new sources of information from outside the mainstream are now available allowing for new perspectives. If there is a problem, then perhaps a solution is to subsidise journalism with the result that it becomes dependent on the government, rather than private interests. Uber drivers lack protections, so perhaps we rejigger employment law.

What is particularly interesting is that the current financial euphoria is concentrated on funding platform economy firms. One of the characteristics of digital platforms is that they exhibit powerful network effects that often lead to winner-take-all outcomes

(Eisenmann, Parker and Van Alstyne 2006; Gawer and Cusumano 2008). It is the winner-take-all outcomes that allow the young firm to outpace its larger competitors and, if it is successful in the market, often establish a monopoly or near-monopoly position. For example, consider the position of Google in search, maps, YouTube and a variety of other services; Amazon in online retail; Facebook in social networks; eBay in online auctions; LinkedIn in professional networks; Yelp! or TripAdvisor in online reviews; OpenTable in restaurant reservation services; and the like.⁵

The start-up process in such winner-take-all environments assumes that the start up will initially be cash-flow negative as it grows and competes against other start ups and incumbents that are also seeking to restructure the new business space that the technology's progress has made possible. Such start ups begin by 'bleeding' money. Investors are wagering on the firm establishing a powerful market position – or what could be termed a 'proto-monopoly'. These firms are not expected to win via early, sustained operating profit but by absorbing operating losses during their growth phase financed by venture investment, with the aim of driving incumbents and other new entrants out of the market. Investors are increasingly comfortable with absorbing the exceptional losses, if convinced that it will be possible to lock in a position to generate proto-monopolistic profits and, by extension, enormous capital gains.⁶

Because many of the start ups must sustain operating losses over long periods, it is possible to question the narrowly economic, as much as the social benefit. Are the disruptions, if they are driven by extended losses, really justified as welfare generating? These firms are structured to pursue growth at all costs as they endeavour to achieve market domination. In one sense, this appears to be predatory, but it is also a natural outcome in many of these markets. For example, would the economy have been better off with 10 different incompatible personal computer or smartphone operating systems? Similarly, would the economy be better served with 10 search engines – moreover, technically in the case of search, there is learning from each search so *ceteris paribus* a search engine that attracts

more searches is likely to enter a virtuous circle of improvement that is impossible for laggards to overcome. Importantly, operating losses with the goal of market dominance may also encourage business strategies of transgressing established marketplace and social rules, because locking in a winning position is everything.

Financing losses as a way of overcoming existing systems via social disruption and long-term operating losses forms a treacherous environment for incumbents that are judged by the profits they make. To illustrate, in its last annual report in 2017, Walmart had \$486bn in sales and operating income of \$23bn, while its greatest competitor Amazon in 2016 (last annual report) had \$136bn and operating income of \$4.1bn. However, though Amazon has grown significantly in the last year it still trails Walmart in profits and especially in income. And yet Amazon had a stock market valuation of \$608bn, while Walmart had half the valuation at \$301bn. Effectively, the stock market valued Amazon twice as highly as Walmart, despite Walmart having five times as much income. This stock market valuation allows Amazon to make far less profit, thereby allowing it to undercut competitors, which are forced to generate profits to keep investors satisfied.

The point is not to dismiss the enormous value that digital technologies and platform-based business have created. Rather, it is to interrogate the enthusiasm for backing entrepreneurial start ups, losses or not, and for seeking to turbo-charge their growth to the point that they become a so-called 'unicorns' – firms whose most recent venture capital round valued the young firm at more than \$1bn (see below).

THE DECLINE IN THE COST OF TECHNOLOGICAL AND BUSINESS EXPERIMENTATION

Over the past 20 years the cost of establishing a start up or experimenting internally has decreased dramatically. As important as the cost decline, incidentally, is how the abundance of software tools

and cloud-based operations speeds the time from forming the firm to actually launching a digital service (Kushida, Murray and Zysman 2015). The reasons for this cost decline are numerous; a technical one is the secular decline in the cost of computation – a longstanding tendency encapsulated in the shorthand of Moore's law but far deeper than just the dynamics of semiconductors. It is evident that the economics of IT start ups have fundamentally changed. Previously, a start up had to purchase and build an entire IT infrastructure, which was a capital cost, and – as difficult – write original software for whatever product it was introducing. However, the emergence of merchant cloud-computing offerings allows a new firm to rent server capacity from a vendor, such as Amazon Web Services. What previously was a capital investment is now a variable cost, and capacity can be scaled up or down without any capital investment (Murray and Zysman 2011). Cost and time to market were further reduced by the availability of downloadable open-source software modules from sources such as GitHub. This open-source software eliminates the need to write code from scratch, thereby reducing cost, providing opportunities to customise, and avoiding vendor lock-in (Northbridge and Blackduck 2016). The availability of low-cost infrastructure and open-source software dramatically decreases the cost of establishing a new digital business. Thus the technical changes permit the entry of far more new firms than ever before and encourage internal experimentation in existing firms. Of course, being able to easily enter does not guarantee success – there can be many more experiments, with only a few survivors.

ABUNDANT CAPITAL AND THE TOLERATION OF OPERATION LOSSES

The ample available capital and the belief that many industries are poised for disruption because of developments in information and communications technology (ICT) – such as big data, machine learning and the internet of things (which, with smartphones, are

new classes of computers) – and the development of new business models have convinced investors that start ups offer the opportunity for great potential capital gains. This has resulted in an enormous flow of capital into private equity, of which venture capital is one type.

Not only is the sheer amount of capital available remarkable, but there has been a proliferation of start-up funding mechanisms (Arrington 2010). Let us begin with conventional venture capital firms. Before the internet bubble that began in the mid-1990s, traditional venture capital firms were the predominant funders of successful technology start ups (Kenney 2011). As the elite venture capital firms became more successful, many of them raised and managed mega-funds with \$1bn or more in assets. These firms could no longer invest in early-stage firms, where an appropriate investment is \$1mn or less simply because of the management time needed to ensure the investments were prudent.

The market gap created by the emergence of mega-funds evoked four institutional responses. First, a group of angels or ‘super-angels’ emerged easily able to invest up to a few million dollars in a firm’s early stages, particularly in Silicon Valley (Manjoo 2011). Many of these angels were successful entrepreneurs who had already started a company that generated sufficient capital gains so that they could now invest in a new generation of entrepreneurs. Second, accelerators – which vet and then accept aspiring entrepreneurs, and then provide small amounts of capital and coaching in return for a small tranche of equity – emerged. Their goal was to assist in the growth of the entrepreneurs’ idea to the point that they could ‘graduate’ and form a proto-firm, able to raise money from super-angels or venture capitalists (Radojevich-Kelley and Hoffman 2012). Third, a wide variety of digital platforms for crowdfunding have been established, ranging from Indiegogo and Kickstarter – where funds are contributed to a project, but the funders receive no equity – to other platforms, such as Angelslist – where only certified investors invest in return for equity (Belleflamme, Lambert and Schwienbacher 2014). Fourth, a proliferation of smaller, seed-stage venture capital firms

has created a functional segmentation of the venture capital industry. An ecosystem of organisations and networks now exists to provide funding for entrepreneurial experiments made possible by the technological changes, reducing the cost of starting an ICT firm.

With the reduction in the capital necessary to enter a market and the increased number of channels for securing seed capital, more firms can be established, thereby increasing the number of experiments. If these experiments experience initial success as signified by rapid adoption of robotics, measured by the number of users or extent of use and not necessarily by revenue, access to far greater pools of capital is likely because, as we note, many of these digital markets have winner-take-all characteristics. It is imperative for the start up to grow as quickly as possible to occupy the space before other start-up competitors or an established firm can introduce a competitive product.⁷ During this phase, profitability is not as important as growth that captures the market. At this stage, success demands even more capital as the start up grows as expenditures out-strip revenue growth. Angels and incubators can no longer provide the capital necessary for such growth, and thus the expanding start up must secure much larger investments from the big venture capital firms.

The entrepreneurial environment is particularly munificent today as venture capitalists have been raising huge sums for investment. Fundraising in 2014, 2015 and 2016 were the largest since 2006, with a total of \$51bn raised by 314 funds in the US and Europe (Pitchbook 2017). Effectively, there is an enormous amount of capital searching for investment opportunities.

In the current environment, firms are resisting making an initial public stock offering, remaining private for longer periods. It is possible to secure the required funding, because there has been a remarkable growth of pools of available capital through the large private equity firms, some of which such as Blackstone are listed on public markets. In 2017, the private equity capital available for investment (so-called ‘dry powder’) equalled \$739bn (Pitchbook 2017). This massive inflow into private equity and venture capital

funds creates a need for fund managers to find opportunities with the promise of significant returns. The returns to investors in earlier platform firms tells investors that they can expect to earn similar returns in future precisely because platforms have network effects and can result in winner-take-all markets, with their concomitant monopoly dynamics. In the next section, we explore the proliferation of privately held start ups whose value is over \$1bn – the so-called unicorns.

THE RISE OF THE UNICORNS

The availability and low cost of capital, the technical changes, and the belief in the possibility of disruption has resulted in a remarkably large number of start ups that are not publicly traded, but whose valuation at the last private funding was \$1bn or more. Silicon Valley venture capitalist Aileen Lee termed such firms after the rare mythical creatures ‘unicorns’ – a term that has now passed into common parlance. In 2013, Lee identified 39 US public and private firms that were founded between 2003 and 2013 that had achieved \$1bn valuations in 2013. Remarkably, the number of unicorns grew quickly (Lee 2013). Verena Schwartz (2017) by combining a number of lists found that in February 2017 there were 267 unicorns worldwide. While the number of unicorns fluctuates, as do valuations, by 2018 the sheer number of unlisted firms with such a high valuation was remarkable.⁸

The point of this discussion is not to determine whether this is a bubble, but to examine a related phenomenon: the willingness of investors to fund firms that are either losing money or not making profits at such high valuations. The assumption is that eventually the firms will generate sufficient profits in the future to compensate for the lack of profits currently. There are both public and private firms without any or only minimal profits. While Apple, Facebook, Google and Microsoft have large profit margins, Amazon only barely breaks even. Other important public platform firms – Pandora, Blue

Apron, Snapchat and others – have never made a profit and have no discernible path to profitability. More significantly, nearly all of the unicorns appear to be losing money.

The amount of private equity available, much of it raised from pension funds, also has made it possible for firms to stay private longer and lose money longer. The firm Airbnb is interesting from this perspective because it was founded in 2009 and became profitable in 2016 – a long period of unprofitability that was funded by private equity. Given its growth and crossover into profitability, it would appear to be ideally suited for an initial public offering. However, in 2017, rather than going public, it raised \$1bn capital at a \$31bn valuation. The massive influx of capital allowed it to acquire a smaller competitor and continue to grow without offering stock to the public – the traditional venture capital exit strategy – or worrying about profitability.

The large number of private unicorns is remarkable and differs in an important respect from the dot.com boom from 1997 to early 2000, as during the dot.com bubble newly funded firms rushed to make an initial public offering. In the current period, now more common unicorns can remain private for a much longer period because they are able to raise capital privately. An ability to raise capital is vitally important, because a company with continuing influxes of capital can continue to offer its product or service without being profitable. This provides a tremendous advantage against incumbents already listed on markets, firms that under normal conditions are expected to generate profits.

FINANCIAL WEAPONS IN DIGITAL MARKETS: CONSEQUENCES FOR LABOUR

We made our way through this complexity by focusing on investment and business strategies that rest on enduring operating losses. The ability to access enormous sums of capital or an elevated stock valuation provides the focal firm with a powerful tool for

undercutting its rivals, as it can lower prices or even purchase its competitors, as the platform giants such as Facebook did with Instagram, WhatsApp and a host of smaller firms. The structure of competition is important not only for investors but also for labour. How firms compete can determine how much of what kind of labour is needed, who will deploy that labour, and where.

Establishing and contributing to the growth of start ups and internal firm experimentation by investors willing to incur long-term operating losses pose many questions. Rapid growth strategies by platform economy firms have, by implication, raised questions for government regulators in a wide variety of sectors, in practice an aggressive assault on regulatory boundaries, even as the labour platforms place significant and often effective wage pressure on parts of the workforce. Current strategies seem to suggest less attention is paid to developing the talents and ability of workforces or forming structures that support workers. The implications are profound.

In the case of Uber, Google Maps, a set of pricing and dispatching algorithms, and a smartphone app, for example, have transformed citizen drivers with limited knowledge of a locale into 'contracted' transportation providers, creating a compelling service. These new Uber drivers – freed from the constraints of a taxi being a public conveyance – put downward pressure on prices for all. Unfortunately, there is no single narrative here except for the ineluctable fact that platforms and intelligent tools are shifting the grounds on which all economic activities are undertaken. By extension, this suggests the two fundamental conditions in a capitalist society – labour and competition. Beyond knowing that these two conditions and everything built on them will shift, the implications are contingent and continue to evolve.

The consequences for labour will vary dramatically depending on activity and the evolution of the technology, and this will vary across applications and market segments, and indeed among firms. What appears common to all is that loss-driven market domination strategies that can generate capital gains without attaining even mid-term market sustainability appear certain to encourage strategies that will treat labour as a commodity whose cost is to be minimised rather

than as an asset whose value can contribute to long-term competitive advantage for the firm and superior social outcomes.

NOTES

1. The US economy gradually evolved to incentivise a capital-gains-driven system and, by extension, a turn away from a long-term, earnings-based system of corporate governance. The most important of these incentives was the dramatic lowering of capital gains taxes in the late Carter and early Reagan administrations. The lobbying effort was largely driven by American Electronics Association and the prime mover in Congress was Edwin Zschau, an entrepreneur who became a congressman from the district that included Silicon Valley. For a detailed discussion, see *The Passage of the Investment Incentive Act of 1978* (Johnson 1980). There were other important initiatives such as loosening interpretations of the Employment Retirement Income Security Act, easing rules on granting stock options, and easing various rules on stock trading and listing.

2. For a detailed discussion see Arnold et al. this volume.

3. It was perhaps with the success of Yahoo! that venture capitalists came to realise that giving a service away for free would work, if one could convince advertisers that they could reach customers through the internet. For a discussion of this realisation, see 'On the 20th Anniversary – The History of Yahoo's Founding' (McCullough 2015). The discovery in 1994 by the elite venture capital firm Sequoia Capital that a free service could be successful in capturing the market generate enormous capital gains led to a rethinking of the economics of venture capital investment. The venture capitalists were convinced that even with enormous losses a service could be monetised in some way, if the market was captured.

4. Our discussion draws on studies of investment euphoria, current studies of financialisation and the separate discussions about how differences in national financial systems influence the relations between business and state structure (Perez 2003).

5. We have seen similar dynamics in earlier digital industries with Microsoft in the personal computer operating system and office productivity software, Intel in personal computer microprocessors, Cisco in computer networking, and Oracle in relational databases.

6. We suggest that current antitrust and competition policy is completely unprepared to address the types of business strategies these small entrepreneurial firms use.

7. For the incumbent firm in an industry receiving the attention of the new entrants the challenge is daunting. Each of the entrants is likely to have a somewhat different business model. Thus, the incumbent faces not a single entrant with one model, but multiple entrants with different models. If any of these models shows any promise of success, then the venture capitalists will provide further funding for its growth. It is these multiple experiments and challenges that contribute to making the current environment so treacherous for incumbents. A further difficulty is that the new entrants may not challenge the incumbent across its entire business, but rather only certain particularly valuable parts of its business model, which if successful could relegate the incumbent to the commodity portions of its business.

8. Recent research suggests that the clauses in the financing contracts dramatically lower the true valuation of the most recent investment to such an extent that nearly half of the “unicorns they studied were not, in fact, worth \$1 billion or more” (Gornall and Strebulaev 2017).

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GENDER EQUALITY PROSPECTS AND THE FOURTH INDUSTRIAL REVOLUTION

Debra Howcroft and Jill Rubery

The prospects for gender equality arising from the fourth industrial revolution depend on current differences in the position of women and men in the division of both paid and unpaid work. Women in all societies are more involved in unpaid care work than men, though the amount of unpaid care work varies between countries and social classes according to family size, social norms and the availability of substitute services. Socio-economic differences mean that the immediate impacts from the fourth industrial revolution on employment and care work are likely to have gender-specific impacts. To trace the likely patterns of these effects, this chapter begins by outlining some potential outcomes, based on the assumption that there will be no significant change in employment regulation, social protection and gender equality arrangements. We also recognise that the fourth industrial revolution has the potential to facilitate social change; with this in mind, we outline a number of recommendations.

Given men and women lead unequal lives, debates on the fourth industrial revolution present a timely opportunity to propose a rethink of both the structures of employment and the forms of work. Therefore, the main focus of this chapter is to identify positive