Berkeley
UNIVERSITY OF CALIFORNIA
BERKELEY ROUNDTABLE ON
THE INTERNATIONAL ECONOMY

BRIE Working Paper
2018-9

Employment, Work, and Value Creation in the Era of Digital Platforms

Martin Kenney, Petri Rouvinen, and John Zysman

Acknowledgements: This research was funded in part by the Ewing Marion Kauffman Foundation. The contents of this publication are solely the responsibility of the authors.

Employment, Work, and Value Creation in the Era of Digital Platforms

Forthcoming

Martin Kenney
Distinguished Professor of Human and Community Development.
University of California, Davis

And

Research Director
Berkeley Roundtable on the International Economy

Petri Rouvinen
Research Director
ETLA - The Research Institute of the Finnish Economy
Helsinki, Finland

John Zysman
Professor (Emeritus) of Political Science
University of California, Berkeley

And

Director
Berkeley Roundtable on the International Economy

Introduction

At least since the introduction of Intel's first microprocessor in 1971, rapidly evolving digitalization has provided an ever-expanding set of tools that empower, but also nudge or even force, individuals and organizations to change their behaviors. These can in turn shift economic, political, and social outcomes. Digitalization, enabled by advances in information and communication technology (ICT) and expanding volume of digitally coded information, is both revolutionary and evolutionary at the same time. The widespread emergence of digital platforms is arguably the most important revolutionary aspect of digitalization in the past decade. Digital platforms should be understood as intermediaries reorganizing economic and social life (Barley, 2015; Kenney & Zysman, 2016; Orlikowski & Scott, 2015; Scott & Orlikowski, 2010; Srnicek, 2017; van Dijck, 2013).

Given the rapid rise and increasing dominance of digital platforms, it is timely to consider how they have and will influence work and value creation. The other chapters in this volume (save for theorizing in Chapter 2) consider how digital platforms change education and work in one of the leading countries of digitalization processes – Finland. In contrast, we consider the broader international scene for considering the implications of their increasing adoption. In contrast to other scholars that provide taxonomies of platform types (see, for example, Fumagalli, Lucarelli, Musolino, & Rocchi, 2018; Li, Nirei, & Yamana, 2018), our intent is to provide a taxonomy for the types of work and value creation that are emerging in the platform economy (Kenney & Zysman, 2016).

While our interest is work, we do not confine ourselves to just digital labor markets platforms that match the supply and demand of paid labor. This would too narrowly focus and radically understate the impact platforms are having. Such platforms are only a minor part of a story that is far broader, more complex, and more significant. First, while some of the world's most valuable corporations are platform companies, firms and, in fact, organizations in nearly every industry are not only creating websites, but also building platforms that can manage their interface with the external

market and society (Parker et al. 2016). These, along with a long tail of smaller platform firms and startups nurturing new platforms, are a considerable source of direct and arms-length employment – and thus a source of platform work, in another sense of the term. Second, some platforms establish markets for digital content. In these markets, the virtual good – as opposed to the physical manifestation of labor input that went into creating it – is traded. In other words, in these consignment markets, the authors license copies of their creations to platforms allowing it manage monetization. While consignment markets certainly existed before digital markets, platforms radically reshaped them in terms of scale and scope. In our broad focus, we thus consider three categories of work: platform firm employment, platform-mediated work, and platform-mediate content creation.

While we do not discuss the issue in length, we wish to point out that the labor impacts of platforms go beyond even our broad focus, because they are molding many other types of economic activities and reshaping industries (Kenney & Zysman, 2016; Zysman & Kenney, 2018). Since platforms often directly shape interactions in the market place, they have a considerable potential to disrupt market structures. For example, the increasing centrality of platforms for delivery of goods and services will also change the sectoral composition of economies and thus have substitution and budgetary effects. Some intermediation, such as wholesaling, may vanish as separate activities and just be provided by a platform that also provides B-to-C services.[1] If a platform gains market share, a comparable non-platform offering is likely to have lost it, though in cases where the platform such as Uber, Lyft, or Airbnb offers decreased prices thereby substituting for taxis but also increasing in the size of the market (Parrott & Reich, 2018).

Furthermore, platforms have become an important mechanism for collecting large volumes of data and for monetizing it, e.g., in the form of targeted advertising. This in turn spills over to another revolutionary aspect digitalization, artificial intelligence (not to be discussed in this chapter). Thus,

[1] For example, Amazon has replaced or drastically impacted the book distributor suppliers by disintermediating them.

also platforms' indirect structural effects are large, which in turn has consequences on work, as the fortunes of business and industries change. Indeed, even if a person is not participating on platforms, or a business is neither a platform provider nor a user/customer of at least one, all are still embedded in an environment that is increasingly organized by platforms. Platforms have considerable virtues but as they grow, they very often become de facto monopolies in their domains, which in the future could allow them to extract "rents" from the ecosystems that they have locked-in.

As has been the case with any powerful new economic organization principle, digital platforms are changing the organization of competition, work, and consumption – and thus the very fabric of modern society. And yet, the ultimate outcomes will not be determined by technology. Rather, the changes will be shaped by business strategies, consumer choices, and policy decisions in society. Further, while a number of the largest platforms have global scope, at least, some aspect of adoption and usage will be shaped by national choices and particularities.

Platforms

Digital platforms build on previous advances in ICT. Ghazawneh and Henfridsson (2015) build on Tiwana, Konsynski, and Bush (2010). The term "platform" has multiple meanings and, for our purposes, we will be relatively narrow. In an earlier era, Microsoft was the quintessential platform firm – and it still remains a formidable digital platform competitor. However, for this article, we accept Ghazawneh and Henfridsson (2015) definition of the platforms of interest as being "an extensible cloud-based software stack enabling multi-sided interaction among contractually independent parties." These "software-based external platforms consisting of the extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate." In other words, the platforms of interest are those that are online, cloud-based, and accessed through a wide variety of edge devices, smartphones, personal computers, and – in the future – other "things". Each of these platforms provides boundary resources, such as application programming interfaces (APIs) and software development kits to third

parties so they can build further applications upon them – with the goal of creating ecosystems of complementors.

. A platform always has some sort of governance structure, as well as some protocols and standards. If a digital platform is designed properly, it attracts complementors that form an *ecosystem* of platform users. Parker, Van Alstyne, and Choudary (2016) summarize "The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants." However, this does not refer to the power that the platform owner has over the ecosystem participants that make asset-specific investments in the specific platform. The ecosystem metaphor elides the fact that the successful platform owner often "taxes" the ecosystem participants for usage. Instead of an ecosystem, this arrangement can be compared to the relationship of a share-cropper to the landlord, where users in exchange for the use of the site provide a harvest of data. Further, the ecosystem metaphor also omits the possibility that the platform owner is often in a position to absorb particularly valuable functionality or resources from complementors. The platform owner often has the ability to unilaterally change not only the share of any income accruing to the various participants, such as, subsidizing one side of the platform with income from the other side, but also to change the rules of participation in the ecosystem, as has been seen on Facebook, Amazon, Google, and other platforms recently.

A platform not only controls, but actively shapes its participants' user interfaces and access to other participants. At times, this is in the best interest of most users, e.g., when the content on the platform is curated or when version control is handled sensibly, but this also gives the platform power over participants (they may try to offset this by using strategies such as multi-homing). As the platform grows and interaction with it intensifies, it accumulates large and growing volumes of information – in most current platforms, this data is owned by the platform. The EU's GDPR legislation implemented in May 2018 potentially changes this, although its practical consequences remain uncertain, as the users almost always are willing to trade their data for access and thus will wave protections.

Platforms exploit key features of digital technologies to decrease interaction frictions or even make possible interactions that previously never could have occurred. Since platforms establish multi-sided markets, they often feature both direct (same side) and indirect (opposite side) network effects; thus, the sheer number of transactions a platform performs not only improves it, but also allows decreasing costs due to scale. This implies an initial chicken-and-egg problem that the platform provider must solve – there is no incentive to join a platform that does not already have many participants. Network effects, in combination with scale and scope effects of digital technologies, often can result in winner-take-most markets that can be dominated by and controlled by one or two firms. These types of domination can depend upon the particular markets. For example, online remote work has a larger variety of platforms often separated into particular verticals. In other sectors, such as travel, initially there were large numbers of online entrants, but then markets were consolidated through acquisitions yielding high levels of concentration.

Looking at the most popular platforms internationally today suggests that, so far, we have largely seen a "Silicon Valley" version of platforms (with the exception of China, which has its own dynamics in the domestic market), in which, during their early stage, startups are structured to pursue growth at all costs, in an effort to achieve market domination.[2] Lisa Gansky, a prominent entrepreneur, summarizes the evolution of the platform economy as follows (as cited in Sundararajan, 2016): "Early companies like Uber, Lyft, Quirky, Airbnb, TaskRabbit, RelayRides, and 99 Designs garnered much visibility, but these companies were funded by venture capital, with an eye on big paydays for investors – and not necessarily for the drivers, hosts, creators, and sellers that make the companies viable." Platforms could well be cooperatives (Scholz & Schneider, 2016) or they could be run by its participants via suitable arrangements. While there have been experiments with a whole variety, thus far nearly all of the most widely adopted platforms have been introduced by for-profit companies.

[2] There are a few exceptions such as Spotify and Booking.com. For the globalization of Chinese platform firms, see Jia et al. (2018).

Platform work taxonomy

In this section, we extend the platform work taxonomy proposed by two of the authors of this chapter (Kenney & Zysman, 2018b).[3] The core strength of this taxonomy is that it distinguishes between work within and work generated by the platform companies, on the one hand, and work in the platform ecosystem, on the other. The first smaller set comprises of workers creating and maintaining the platforms. The second larger set consists of workers in the platform ecosystems, whom we further divide into those undertaking platform-mediated work and those undertaking platform-mediated content creation. We also include non-compensated user-generated content (Terranova, 2000).

A common mistake when considering work in the platform economy is to think of it only in terms of employment. Because of the nature of platform ecosystems, the vast majority of the individuals receiving income are not employed by the platform firms or, in fact, by any firm at all. For example, there are millions of individuals or small limited liability corporations in the Apple and Google app store operators; Lyft and Uber drivers; Airbnb hosts; Amazon Marketplace, eBay, Etsy, and Instagram vendors; YouTubers, Amazon book publishers, and Kickstarter and Indiegogo funded project creators. They all generate income through the use of platforms. These vast dependent ecosystems are very difficult to measure but have recently received attention from various statistical agencies and private sector research institutions (Allard & Polivka, 2018; Farrell & Greig, 2016). Finally, of course, there is the enormous and, perhaps, impossible to measure, population of workers that are building websites meant to be discovered by Google, managing their firm's social media strategy, and individuals updating their LinkedIn profiles – all of whom are creating value for digital platforms. In Table 1, we present a tentative taxonomy of these workers in a way in which the number of income generators could be empirically measured.

[3] Other platform categorizations include Fumagalli et al. (Fumagalli et al., 2018) and Forde et al. (2017).

Table 1: Labor Force Distinctions in the Platform Economy

Platform type	Employment type	Typical examples*	Compensation type	Labor conditions	Value creation process
Platform firm					
Venture labor	Full time	Google, Amazon, Facebook, Snap, Airbnb	Salary and stock options	Excellent	Creating and maintaining platform
Contractors (provide service to platform firm but not employees)	Full or part time	Dynamex, LeapForce	Salary or by job	Precarious, mostly low wage	Routinized
Platform-mediated work					
Platform-mediated marketplaces	Independent or contractors	Amazon, Craigslist, eBay, Etsy	Salary or by job	Low wage or precarious	Direct work including logistics
Platform-mediated in-person service provision	Contracted service through platform (contested)	Uber, Airbnb, Lyft, PostMates, GrubHub	Normally, but not always, set by platform	Gig, low income	Provide service, sometimes monetize asset
Platform-mediated remote service provision	One-time project contract	Upwork, Fiverrr, InnoCentives, Amazon Mechanical Turk	Agreed upon by job	Gig, low income	Project work
Platform-mediated content creation					
Consignment content creators	Not employed	YouTube, Apple App Store, Google Play, Twitch	Income from sales or share of advertising	Skewed, with few having large returns	Content creation
Non-platform organization content producers (e.g., websites)	Employed or contractors	All organizations with a web presence	Salary or by the job	Varies widely	Build websites, etc., for their firms
User-generated content	Not employed	Google, Facebook,	Use of the platform	N/A	Produce data from which

		Yelp!, Snapchat			value is extracted

Platform firms

At the center of the ecosystems are the firms operating platforms. In many domains, there is just one or a very few dominant firms. Non-existent or minimal direct competition places these firms in an excellent position to extract value from one or more sides of the platform and their profit margins can be abnormally high (as is the case with Apple, Facebook, Google, and Microsoft).

Platform Firm Employees: Venture Labor

The term "venture labor" (Neff, Nardi, Kaptelinin, & Foot, 2012) refers to the platform firm's founders and employees. They comprise only a small fraction of overall number of individuals receiving income in platform ecosystems. Particularly during boom periods, the established platform companies offer not only high compensation, but also remarkable benefits for the direct employees. A myriad of new startups – nearly all of which are backed by sizable business angel and venture capital investments – are being funded to establish platforms in a wide variety of industries. These startups are predicated upon attracting talented employees capable of working long hours in the hopes of building a successful business. If the firm is successful, at the time of its sale either to an existing firm or to the public, the founders and early employees can reap fabulous returns due to their stock holdings.

Platform Firm Contractors

Platform firms typically have enormous numbers of workers that they utilize via either short-term direct employment or temporary help firms' arms-length contracts.[4] These temporary employees and contractors can work remotely or even on site and directly with venture laborers, but nearly always

[4] For a more general discussion of the temporary help industry, see Hyman (2018). For a discussion of the complicated and contradictory perception of these contract employees, see Barley and Kunda (2004).

receive lower pay, fewer benefits, and less job security.[5] The sheer breadth of the activities that the contractors undertake is surprising. Many of them are what Lilly Irani (2015) terms "data janitors", who work both on- and off-site to perform not only coding but also search engine result monitoring, data cleaning and organization, vetting uploaded material for prohibited content, and discharging a remarkable number of tasks (Gillespie, 2018). For example, in 2012 it was reported that Google Maps employed 7,100 people, of whom 1,100 were full-time employees and 6,000 were contractors (Carlson, 2012). A recent Bloomberg news article estimated that Google has as many contractors (which it calls the "invisible workforce") as regular employees (Bergen & Eidelson, 2018). This population of employees will certainly grow.

Platform-Mediated Work

The work discussed previously is concentrated on the platform itself. Organizations and individuals performing platform-mediated work are those that are integrated directly into the platform's ecosystem or, what are often termed platform complementors. This work depends upon the platform and those doing the work are subject to the platform's rules and regulations. We identify two distinct types of platform-mediated work. First, platforms often establish marketplaces facilitating the sale of goods and services; examples of this include eBay and Etsy. While the good or service may be delivered offline, the transaction is initiated on an online platform. Second, platform-mediated labor markets allow potential customers to contract for labor, which may be provided either in-person and remotely.

Platform-Mediated Marketplaces

Platform-mediated marketplaces were one of the earliest types of internet web sites. Initially, many of them stocked their own inventory, but with a few exceptions, the most notable of these being

[5] These workers are strictly segregated from the direct employees and as a recent article shows are under far more onerous conditions (Wong 2018).

Amazon, most of these retailers failed or were acquired – often by Amazon. Not surprisingly, Amazon was the most powerful survivor of the retail conflagration that hit the entire internet sector when the dot.com bubble collapsed. Despite the collapse, over the last 15 years retail has gradually moved online, as today approximately 9 percent of all US retail purchases are through online intermediaries and has been growing approximately one percentage point a year (Census Bureau, 2018). This tendency is global with estimates that in 2018 34% of China's retail purchases have an online intermediary (most often online payment) (*Xinhua*, 2018).

There are a number of permutations of the online marketplaces. For example, Amazon is both an online retailer, on its own account, and a platform-mediated marketplace hosting other sellers, both businesses and private individuals. However, Expedia merely serves as an intermediary between travelers and their needs for accommodation and transport. One profound implication of platform-mediated marketplaces, and online sales more generally, is that on increasing fraction of sales is initiated online, which diminishes or even eliminates the role of physical sales outlets. Typically, online retailing has higher sales per employee, even when compared to highly efficient competitors such as Walmart (Wigglesworth, 2017). Online retailing is dramatically impacting the viability of physical retail outlets (Townsend, Surane, Orr, & Cannon, 2017). While employment in physical retail should be expected to increase, to some degree, that employment should be replace by employment in warehousing and logistics. Therefore, retail stores that employ college students and similarly somewhat educated individuals that can interact with the public will be replace by warehouse work has little need for college-educated workers. Because many of the retailers on platforms such as eBay, Etsy and Amazon are independent, some production and storage will shift to private homes. Small-scale providers depend on platforms for customer engagement, logistics, and several other aspects of their businesses. Moreover, warehouse work is more easily automated providing yet further opportunities for the displacement of workers. This has implication for labor in terms of types and location.

The character of work related to platform-mediated marketplaces in typically quite different from venture labor. For example, back-end fulfillment, e.g., in Amazon's warehouses and even more so at outsourced fulfillment firms, such as, Dynamex, demanding work conditions with low pay and very meager benefits are the norm.[6] Alternatively, on platforms such as Etsy or eBay, while offering sales outlets and opportunities for income generation, all of the responsibilities for fulfillment and buyer satisfaction fall upon the vendor, who is a free agent. While some vendors can build sound businesses on these sites, most earnings are precarious. These businesses are also susceptible to competition, changes in the strategies of the platform owner, fickle consumer tastes, and any misfortunes that befall the vendors themselves.

Platform-Mediated In-Person Service Provision

In-person services have been provided by both corporate and independent contractors. With the advent of digital platforms, an increasing proportion of this type of service provision has been reorganized as a digital intermediary. Work contracted through such labor platforms can be thought of as "gig" work.

The most discussed example of this type of work is, of course, Uber, which, with minimal vetting, welcomes both casual and full-time drivers. This easy entry of drivers is vitally important, because it exposes all of the drivers to competition from the driver willing to provide the service at the lowest price. In particular, part time drivers can enter the market for short periods when they need income and thus drive down wages for full-time drivers or the direct competitors, taxi cabs (Hall & Krueger, 2018). The economics of this model are quite interesting. During the highest demand periods, new drivers can flow into the market and drive down prices, but also meet the demand during periods when competitors would normally be very busy and making the most money (Dubal, 2017;

[6] For a journalistic description of the experiences of Amazon's contracted out delivery service workers, see Peterson (2018).

Hua & Ray, 2018). This distinction between those who enter the market idiosyncratically for a variety of reasons, but not full time or as a career, and those who plan to use the platform for a full-time, permanent source of income is critical (Hua & Ray, 2018). By dissolving previous barriers to entry, these platforms create (a) competition between platform and non-platform providers (regular taxies) and (b) part-time and full-time platform providers, which together have a tendency to depress earnings for all drivers.

While much of the focus has been on Uber (and Lyft and Didi in China), other platforms have attempted to organize such gig work. Another variation, of course, is Airbnb through which housing owners can rent their homes on a short-term basis. There were other less successful in-person labor platforms such as TaskRabbit, which provided workers that would bid on various chores. TaskRabbit never was able to grow successfully and was eventually sold to Ikea. Other variations on the Uber model include online bicycle messenger delivery services such as DoorDash in the US and a wide variety of such operations in China and other Asian nations. All of these applications will clearly create income for the providers. However, this type of work is also precarious and competition threatens to lower price. Even in the case of Uber, the question of how many of these firm will really be successful is uncertain, as even the highly touted Uber is losing enormous amounts of money (Conger, 2018).[7]

Platform-Mediated Remote Contracting

Using telecommunications networks and internal firm platforms to contract for remote workers has a long history (see, for example, Dossani & Kenney, 2009). The recent change is that firms and individuals are increasingly willing to contract freelance workers online. The platforms offering this type of work are remarkably diverse, as are the tasks for which buyers contract. It ranges from low-

[7] For further discussion of the ability of these new entrants to lose enormous amounts of money to tip the market, see Kenney and Zysman (2018a).

skill micro-tasks such as labelling images, for which the contractors may only be paid pennies, such as is the case of Amazon Mechanical Turk (Ross, Irani, Silberman, Zaldivar, & Tomlinson, 2018). However, the variety of tasks is remarkable and includes relative higher-skill projects, such as search engine optimization of a customer's web site via Upwork (Graham, Hjorth, & Lehdonvirta, 2017), and even in some cases, sophisticated problem solving at sites such as Innocentive, which is for sophisticated problem-solving. In the cases of Innocentive, customers pose sophisticated problems on the website as challenges with a prize for the individual or team that provides the best answer (Lewin & Zhong, 2013). Remote work provision can provide an alternative to outsourcing to a large service provider such as IBM or TCS. As importantly, department-level managers can hire labor without increasing headcounts or making long-term commitments. It also allows managers to access true temporary labor thereby meeting fluctuating demand. The limits of such offshoring are not easily measured, but there are constant efforts to find new tasks that can be discharged remotely through the mediation of a digital platform. Here again, it is hard to estimate how many individuals receive some income through one of the work platforms. However, in a 2018 Securities and Exchange Commission filing, Upwork (2018) claimed to operate the largest online global marketplace for freelance workers. For the year ended, June 30, 2018 it had a gross services volume of $1.56 billion provided 375,000 freelancers undertaking nearly 2 billion projects in over 180 countries.[8] While Upwork is the largest of these firms, there are a remarkably variety of these labor-contracting platforms distinguished by size, location, and specialization.

Platform-Mediated Content Creation

Content, in all of its manifestations, made the web valuable and Google, Facebook, LinkedIn, and earlier Yahoo! valuable companies. To better understand the value and income that comes from content creation, we separate platform-mediated content creation into three categories: first, user-generated content uploaded to platforms where the content and, in certain cases, the audience created

[8] Simple division of the number of freelancers by income suggests that the average income per freelancer was approximately, $4,160. This suggests that the average freelance must be working part-time.

for that content can be monetized; second, content generated by existing organizations that is posted on the web or existing platforms as part of the organization's strategy. This content creation process is an enormous source of employment both directly and through contracting that has thus far been largely ignored; third, the gigantic volume of uncompensated user-generated content and data that is created as people surf the internet, interact on platforms such as Facebook and Instagram, and upload their information onto LinkedIn. This enormous amount of content, when catalogued and analyzed is at the source, is the most valuable asset of many platform firms.

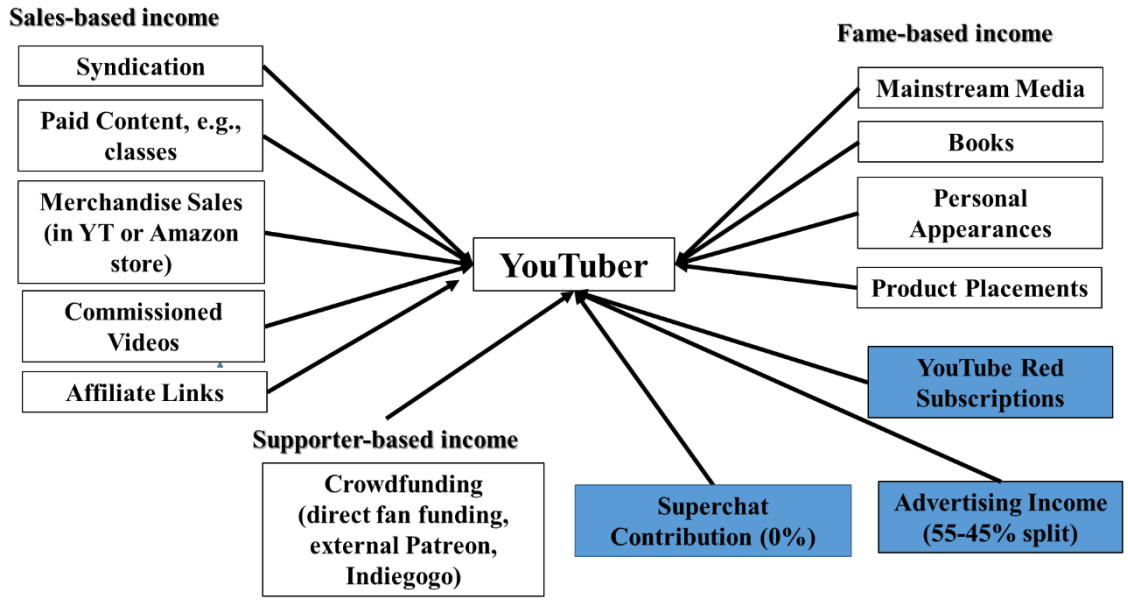
Consignment Content Producers

Platforms such as the app stores, YouTube, and Amazon Publisher Services are marketplaces for virtual goods or content. These are distinct from the afore-mentioned "gig" markets, since the providers are not delivering services through a temporary contract, rather they produce content that is then monetized through the platform. In these consignment markets, the authors in essence license a copy of their creation to the platform firm that then offers it to consumers. A platform specializing on content is worthless without a pool of creators. However, when the platform becomes dominant, much of the power shifts to the platform owner. Moreover, for complementors, income is unevenly distributed, with a few winners and a long tail that receives little, if anything (Brynjolfsson & McAfee, 2011).

This category encompasses a remarkably diverse number of activities, but all of them are predicated upon the production and provision of the content to the platform in the hope of attracting an audience or consumers. In some cases, such as, the app stores, the content is often sold for a relatively nominal fee, and the income is generated by other means such as in app purchases, this is particularly prevalent in online games. In other venues, the creators generate revenues not only through advertising, but as Figure 1 indicates, they monetize, i.e., generate income, their audiences in a wide

variety of innovative ways. The market for these products is extremely skewed, with a few huge successes and an extremely long tail of content that generates little income

Figure 1: Various Income Sources for YouTube Creators



In the consignment model, the consigner is effectively a freelance content producer. This business model can be considered from a historical perspective, as consignment has long existed in the art world. However, internet platforms have dramatically increased opportunities for such business models. Prior to the existence of the internet and independent publishing, authors wrote novels, and some of them convinced publishers to publish them. In traditional publishing world, publishers were gatekeepers who selected only a small number of would-be authors' works for publication. The remaining novels were never published and thus had no opportunity to even prove their market value. Internet-based independent publishing allows written materials that were rejected by traditional publishers or shelved without any consideration to be marketed. Effectively, these new content delivery platforms have lowered entry barriers, permitting previously excluded creators to enter, thereby enlarging the market but also possibly threatening the brick-and-mortar publishers.

Conversely, today existing publishers and successful offline authors are threatened with a loss of market share, pricing control, and, eventually, displacement. The ultimate results of these new delivery methods are unclear. For example, the London-based *Guardian* suggests that mid-ranking authors with long-standing publishers are experiencing a significant loss of income (McCrum, 2014). Alternatively, the success of the Flappy Birds game in the Apple App Store, was a game that no software publisher would have backed because it was so simple and crude.[9] What is apparent is that there are new types of content, new distribution channels, and many new content creators entering the market.

Non-Platform Organization Content Producers

Today, every firm, indeed, every organization must create a website to communicate with customers, employees, communities, and constituencies. Originally, much of this content was hosted on web servers either owned by the organization or managed by a wide variety of firms that sold hosting services. It is the search for these websites that Google indexes and monetizes for search users. Effectively, firms must be indexed by Google to be found – it is the librarian for the internet. Today, what cannot be found on the Internet effectively does not exist.

To illustrate, Nike's web site provides a plethora of online materials, including public relations, advertising, sales, and investor information. It is a virtual location constructed by paid employees (though portions of the site may allow users to post comments, photos, etc.). A search for Nike on Google may trigger an advertisement by either Nike or another firm—the appearance of this advertisement triggers a micropayment to Google. In an economic sense, Nike's work became free labor for Google, while it is a cost of doing business for Nike. Those workers building websites are creating value for their employer, but it is also creating value for Google, as the search is monetized through advertisements.

[9] At the height of its popularity, the very simple and even crude Flappy Birds game was estimated to be bringing in $50,000 per day through in-app purchases, before the game creator removed it from the Apple App Store.

The number of paid employees and contractors working on digital context of existing organizations is unknown, but – of the categories we consider here – it is easily far larger than those employed by the platforms such as Google and Facebook. Moreover, since these websites are increasingly hosted on cloud services such as Amazon Web Services, Google, Microsoft Azure, and IBM, they are being platformized in a new way. In a profound sense, this is also platform work, because they are creating the value monetized by Google.

User-Generated Content

On many of the most valuable platforms – including Facebook and Google, as well as GitHub, LinkedIn, Snapchat, Twitter, Yelp, and Instagram –users either upload content or generate content-like virtual products (such as GitHub's open source software) in the process of using the platform (Lanier, 2013; Terranova, 2000). The platform incurs the costs of providing the service. Platforms add value in this content by categorizing, storing, making it discoverable, and serving it. While end users provide the content free of charge, platforms develop strategies for monetizing it (Lambrecht et al., 2014).

The salient feature of online value creation is the enormous volume of what has been termed "free labor," i.e., the exchange of user-generated content and user information for access to a service, which is then monetized via analysis and sale of either data captured or user access to third parties, such as advertisers. Most importantly, unlike radio or television, the internet is bidirectional and provides a record of virtually all activities online (Huberty, 2015).

Many of the ways that free labor is monetized are obvious: through advertising (Google and Facebook) or selling premium access to the data and connections (LinkedIn). However, there are many more subtle ways of extracting value. For example, the CAPTCHA method of testing whether the user is a human being or a bot is actually a method of extracting free labor. In 2009, Google purchased the firm reCAPTCHA, which was offering a security service to a wide variety of websites. Initially, the service was based on recognition of characters taken from the Google Books project. In this case, users

– by recognizing and entering the characters correctly – were training Google's character recognition algorithms. This problem is now largely solved, so currently, users are asked to identify which photographs from Google Street View have street signs or other visual features in them. By answering correctly users are creating curated databases for Google's artificial intelligence that can be used for other purposes including future autonomous vehicles.

Platform companies "mine", repurpose, and monetize user-generated data, which has little value before it is recorded, curated, analyzed, and delivered via a suitable business model. These firms all depend on software algorithms, and thus these firms are currently building machine learning and artificial intelligence capabilities, which complement their data possessions and access to free labor.

Observations on the platform labor taxonomy

By developing a taxonomy of work in the platform economy we elucidate the enormous scope of value creation being enabled. Digital platforms are rapidly inserting themselves as intermediaries in a remarkable number of sectors and reshaping them and the work, value creation, and value capture in them. If Marc Andreesen was correct in his observation that "software is eating the world," we might go further and saying platforms are organizing the economic world and, by extension, the world of work. We might go even further and say that the conventional word "work", is no longer meaningful. It may be better to think about human activities in terms of value creation and compensation for this creation.

Consignment content production continues to grow rapidly, as the world's consumption patterns change to online delivery. Entire new sports categories have arisen, such as, fantasy sports that is completely undertaken on online platforms – a phenomenon that is transforming the existing patterns of monetizing traditional sports. Alongside, consider the e-sports real-time gaming platform, Twitch.tv, which broadcasts e-sports (an increasingly other types of content). What is most interesting is that an entire ecosystem of commentators has emerged alongside the players themselves (Johnson &

Woodcock, 2019). Here again, both the players and commentators are complementors in the ecosystem, but for our purposes, what is important is that they are generating income.

Consider again, Figure 1 where we see that, in addition, to the income from advertising, YouTubers develop a remarkable variety of extra-platform income generation opportunities. Further, though there are patterns, or shall one say "recipes", for income generation for each genre of YouTube videos, there are differences. For example, music or skills-oriented videos often offer premium classes for an enrollment fee. There are a wide variety of product placement strategies. In other cases, YouTube stardom can be used to develop a more traditional entertainment career such as live performances. Finally, some YouTubers have been able to develop their own clothing brands that have their own suppliers. In some cases, these platform ecosystem complementor's will post to multiple platforms including YouTube, Instagram, Twitter, and Facebook. If they have a web shop it could be on Amazon or created using Shopify.

Implicit in our taxonomy is the difficulty of measuring who is working and how that should be measured. It has long been an axiom in economics that it is difficult to measure the impact of the value created by digital technological developments on GDP (Brynjolfsson & Kahin, 2000; Crafts, 2018). Not surprisingly, measurement difficulties are similarly proliferating in the measurement of work and employment.

The first difficulty is that while the McKinsey Global Institute (Manyika et al., 2016) found that between 20 percent and 30 percent of the US population engaged in some kind of independent or gig work, much of it was not connected with an online platform. This is an important distinction; identifying independent work is one thing; establishing that the total amount of independent work has grown because of digitization is another. More recently, (Abraham, Haltiwanger, Sandusky, and Spletzer (2018) explore the problems that governments confront when trying to measure the "gig" economy. Reinforcing the McKinsey Global Institute's findings, they discover that traditional job

surveys, because of their wording, which focuses on traditional employment relationships, may not elicit information from respondents who receive income from non-traditional income-generating activities, such as someone who is a full-time YouTuber or other social media influencer, or someone with a small but profitable eBay sales operation. They illustrate this by noting that tax filings show an increase in non-traditional income, whereas household surveys do not (Abraham et al., 2018).[10] These studies might lead to the conclusion that much of the income generated from platform-related activities is supplemental, however, ample evidence indicates that in the labor markets organized by the larger platforms, many individuals are dependent upon platform-derived income (Farrell & Greig, 2016).[11] Some research has attempted to count the number of individuals operating on a platform (Eurofound, 2018). This strategy may be ineffective, as there are so many platforms and many of them are so opaque that measurement of employment and particularly income will be difficult.

The second measurement problem is that the labor statistics are not straightforward in terms of analysis. Understanding the meaning and measuring the number of jobs (opportunities for earning income) created by the platforms outside direct full-time employment is difficult. Even more difficult is assessing whether the new jobs are of higher quality or better paying than the previous jobs. How can we decide whether working on these platforms is good or bad? Nearly all of the research suggests that a significant proportion of the gig economy workforce affirmatively enjoys and seeks out such employment (Barley & Kunda, 2004; Manyika et al., 2016; Schor, 2017). And yet, for many others, there is little choice but to work through a digital platform. This dilemma is best illustrated by Lyft, rather than Uber drivers. Many Lyft drivers appear to enjoy driving for Lyft, but often they are part-timers working for extra income or even just to keep busy. For these drivers, the work appears voluntary and temporary. Similarly, there are Airbnb landlords that rent due to necessity, others for

[10] See, also Allard and Polivka (2018).

[11] Many of these service providers multi-home. The iconic case is, of course, Uber and Lyft drivers, but similarly app developers today develop their apps for both Apple and the Google Android (Cusumano, 2018).

the pleasure of meeting new persons, and yet others purely to monetize their rental properties. In each of these cases, the motivations are different and thus drawing a single conclusion is difficult. What seems certain is that an increasing percentage of the labor force derives at least some income on digital platforms. This is true even without including those people creating and curating Internet websites and the billions of people creating uncompensated content to be monetized by the platform firms.

Conclusion

The emerging platform economy is already rearranging many facets of work and even what is considered work. However, there is another perspective. In 2018, the International Labour Organization concluded that "work on these platforms resembles many long-standing work arrangements, merely with a digital tool serving as an intermediary." (Berg, Furrer, Harmon, Rani, & Silberman, 2018). Such a conclusion is true, in the same way, that the introduction of the moving assembly line did not change the fact the workers in factories were employed in producing and received payment for the labor time. However, the assembly-line allowed the reorganization of production, improved efficiency dramatically, and created entirely new work categories. While we do not argue that platforms and the digital technologies will be that transformative, we maintain that work, its organization, and arrangements are most certainly already being transformed.

The platform economy is not merely fissuring the workplace (Weil, 2014) but reorganizing the relations, locations, and activities themselves creating a new and expanding set of arrangements by which individuals can generate income. Some have argued that the digital is blurring the boundaries of the firm (Youngjin, Henfridsson, & Lyytinen, 2010), and, from the perspective of work, the permutations for task division and organizational and spatial location have increased dramatically. The tests currently used for judging whether someone undertaking a task for a firm is an employee or a contractor seem ill-suited for the task. For example, recently there has been a spate of litigation about where an Uber driver is an employee or an independent contractor (Sanders & Pattison, 2016). This issue is so vexing that some have called for a new legal category for such workers (Hagiu &

Biederman, 2015). Of course, the fixation on platform-mediated in-person service provision, ignores all the remaining categories of work we enumerated and, in this way, confirms our argument that fissuring does not capture the remarkable dispersion in forms of work that is currently underway (Kenney & Zysman, 2018b).

Yet, all (popular) platforms share one commonality -- the power of the platform owners. They are in a strategically-advantaged position to absorb resources from the ecosystems' spanned by platforms, which they partly share with the employees considered essential for the platforms' success. Platforms redefine power balances between businesses, but also the relationships between the firm and labor. The platform owner has tremendous power in relationship to members of the ecosystem; all of which are dependent upon the platform in a number of ways: *First*, the platform can change the algorithms determining its operations at will (Lessig, 1999). *Second*, in the case of most platforms the algorithms determining payment and content acceptability are private and not publicized to ecosystem complementors, thus keeping them in a constant state of uncertainty (Scolere, Pruchniewska, & Duffy, 2018). *Third*, in ecosystems such as app stores or Amazon Marketplace, the platform owner can produce a competing offering to that of an ecosystem member and favor their product on the platform. *Fourth*, the platform owner has a panopticonic view of all activities on the platform and thus can shift nearly any parameter in a way that favors its ability to extract value from the ecosystem. Each of these types of power affects not only labor and work but also markets, terms of competition, and social dynamics. The Uber driver that can be disqualified as a driver by an unknown algorithm and will then lose income immediately. There is no need for notice, the app simply stops working. A YouTuber can have their videos demonetized without receiving any explanation. Not only are they forbidden from monetizing new videos, but all of the previous videos that were providing income are also demonetized. This effectively devalues their entire portfolio, not simply an offending video. In this economic system, labor is ever more precarious, has no recourse for grievances except to the firm, but

even more remarkably often is uncertain even what the decision criteria are. It is remarkable that so little attention has been given to the power dimension.

The taxonomy of the types of labor that exist in the platform economy and showed how, in each category, the organization of work and value creation differ. It also suggests that the current fixation on only one or the other of the platforms – today most commonly, Uber and Amazon – does not provide a comprehensive perspective on labor in the platform economy. The current controversies with firms from Facebook and Amazon to Uber and Airbnb signal what profound impacts platforms are having on our economy, society, and income distribution. The ultimate configuration and disposition of work and the beneficiaries of the value created by these platforms will be political decision. Again, a lesson from history may be valuable. In 1930, few would have believed that out of the rise of mass production and the Great Depression, in the United States a New Deal would have arisen and Western Europe would be characterized by social democracy. Given the power and ability to extract such an enormous part of the social surplus by these platforms, there will be a political response. The exact character of the changes driven by the move to a platform economy are not knowable in advance. And yet, given the mounting income inequality, while not solely due the rise of these platforms, may lead to increasingly tense and disruptive social and political relations. Better understanding of the roles of different types of labor in the platform economy seems imperative for addressing the future of work. Finally, it may be that we need to shift from thinking about a world of traditional employment to thinking about a world where income and relative shares in the value created provide a better basis for thinking about the economics of the contemporary world.

REFERENCES

Abraham, K. G., Haltiwanger, J. C., Sandusky, K., & Spletzer, J. R. (2018). Measuring the Gig Economy: Current Knowledge and Open Issues. *NBER Working Papers, 24950*. doi:http://www.nber.org/papers/w24950.pdf

Allard, M. D., & Polivka, A. E. (2018). Measuring labor market activity today: are the words work and job too limiting for surveys? *Monthly Labor Review, November 2018*. doi:https://doi.org/10.21916/mlr.2018.26

Barley, S. R. (2015). Why the Internet Makes Buying a Car Less Loathsome: How Technologies Change Role Relations. *Academy of Management Discoveries, 1*(1), 5-34. doi:10.5465/amd.2013.0016

Barley, S. R., & Kunda, G. (2004). *Gurus, hired guns, and warm bodies: Itinerant experts in a knowledge economy*: Princeton and Oxford: Princeton University Press.

Berg, J., Furrer, M., Harmon, E., Rani, U., & Silberman, M. S. (2018). *Digital labour platforms and the future of work: Towards decent work in the online world*. Geneva: ILO, International Labour Office.

Bergen, M., & Eidelson, J. (2018). Inside Google's Shadow Workforce. *Bloomberg News. (July 25), https://www.bloomberg.com/news/articles/2018-07-25/inside-google-s-shadow-workforce*.

Brynjolfsson, E., & Kahin, B. (Eds.). (2000). *Understanding the digital economy: Data, tools, and research*. Cambridge and London: MIT Press.

Brynjolfsson, E., & McAfee, A. (2011). *Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Boston, MA: Digital Frontier Press (Kindle Edition 17.10.2011).

Carlson, N. (2012). Apple Has ~7,000 Fewer People Working On Maps than Google. *Business Insider (September 21), https://www.businessinsider.com/apple-has-7000-fewerpeople-working-on-maps-than-google-2012-9*.

Census Bureau. (2018). Quarterly Retail E-Commerce Sales, 3rd Quarter. *Census Bureau, https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf*.

Conger, K. (2018). Losses Persist in Uber's March Toward an I.P.O. *New York Times, 167*(58056), B5-B5.

Crafts, N. (2018). The Productivity Slowdown: Is It the 'New Normal'? *Oxford Review of Economic Policy, 34*(3), 443-460. doi:https://academic.oup.com/oxrep/issue

Cusumano, M. A. (2018). The Sharing Economy Meets Reality: Assessing the uncertainties of the business models driving the sharing economy. *Communications of the ACM, 61*(1), 26-28. doi:10.1145/3163905

Dossani, R., & Kenney, M. (2009). Service Provision for the Global Economy: The Evolving Indian Experience. *Review of Policy Research, 26*(1/2), 77-104. doi:10.1111/j.1541-1338.2008.00370.x

Dubal, V. B. (2017). The Drive to Precarity: A Political History of Work, Regulation, & Labor Advocacy in San Francisco's Taxi & Uber Economies. *Berkeley Journal of Employment & Labor Law, 38*(1), 73-135. doi:10.15779/Z38KW57H5S

Eurofound. (2018). *Employment and working conditions of selected types of platform work*. Luxembourg: Publications Office of the European Union.

Farrell, D., & Greig, F. (2016). Paychecks, Paydays, and the Online Platform Economy: Big Data on Income Volatility. *JP Morgan Chase & Co. Institute, February 2016*.

Forde, C., Stuart, M., Joyce, S., Oliver, L., Valizade, D., Alberti, G., . . . Carson, C. (2017). The Social Protection of Workers in the Platform Economy. *Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy, IP/A/EMPL/2016-11*.

Fumagalli, A., Lucarelli, S., Musolino, E., & Rocchi, G. (2018). Digital Labour in the Platform Economy: The Case of Facebook. *10*(6), 1757.

Ghazawneh, A., & Henfridsson, O. (2015). A paradigmatic analysis of digital application marketplaces. *Journal of Information Technology (Palgrave Macmillan), 30*(3), 198-208. doi:10.1057/jit.2015.16

Gillespie, T. (2018). *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media*: Yale University Press.

Graham, M., Hjorth, I., & Lehdonvirta, V. (2017). Digital labour and development: impacts of global digital labour platforms and the gig economy on worker livelihoods. *23*(2), 135-162. doi:10.1177/1024258916687250

Hagiu, A., & Biederman, R. (2015). Companies Need an Option Between Contractor and Employee. *Harvard Business Review Digital Articles*, 2-6.

Hall, J. V., & Krueger, A. B. (2018). An Analysis of the Labor Market for Uber's Driver-Partners in the United States. *ILR Review, 71*(3), 705-732. doi:10.1177/0019793917717222

Hua, J., & Ray, K. (2018). Beyond the precariat: race, gender, and labor in the taxi and Uber

economy. *Social Identities, 24*(2), 271-289.

Huberty, M. (2015). Awaiting the Second Big Data Revolution: From Digital Noise to Value Creation. *Journal of Industry, Competition & Trade, 15*(1), 35-47. doi:10.1007/s10842-014-0190-4

Hyman, L. (2018). *Temp: How American Work, American Business, and the American Dream Became Temporary*: Penguin Publishing Group.

Irani, L. (2015). Justice for 'data janitors'. *Public Culture, 15*.

Jia, K., Kenney, M. and Zysman, J. 2018. Global Competitors? Mapping the Internationalization Strategies of Chinese Digital Platform Firms. In *International Business in the Information and Digital Age, Volume 13* edited by Verbeke, A., Puck, J. and van Tulder, R.

Johnson, M. R., & Woodcock, J. (2019). 'It's like the gold rush': the lives and careers of professional video game streamers on Twitch.tv. *Information, Communication & Society, 22*(3), 336-351. doi:10.1080/1369118X.2017.1386229

Kenney, M., & Zysman, J. (2016). The Rise of the Platform Economy. *Science and Technology (National Academy), XXXII*(3), 61-69.

Kenney, M., & Zysman, J. (2018a). Unicorns, Cheshire Cats, and the New Dilemmas of Entrepreneurial Finance? *Venture Capital (An International Journal of Entrepreneurial Finance), Revise and resubmit*.

Kenney, M., & Zysman, J. (2018b). Work and Value Creation in the Platform Economy. In A. Kovalainen & S. Vallas (Eds.), *Research in the Sociology of Work* (Vol. forthcoming): Emerald Group Publishing Limited.

Lambrecht, A., Goldfarb, A., Bonatti, A., Ghose, A., Goldstein, D., Lewis, R., . . . Yao, S. (2014). How do firms make money selling digital goods online? *Marketing Letters, 25*(3), 331-341. doi:10.1007/s11002-014-9310-5

Lanier, J. (2013). *Who Owns The Future?* : Penguin Books Limited.

Lessig, L. (1999). *Code and Other Laws of Cyberspace*: Basic Books.

Lewin, A. Y., & Zhong, X. (2013). The evolving diaspora of talent: A perspective on trends and implications for sourcing science and engineering work. *Journal of International Management, 19*(1), 6-13.

Li, W. C. Y., Nirei, M., & Yamana, K. (2018). Value of Data: There's No Such Thing As A Free Lunch in the Digital Economy. *Paper presented at the Sixth IMF Statistical Forum, Washington DC, November 2018*.

Manyika, J., Lund, S., Bughin, J., Robinson, K., Mischke, J., & Mahajan, D. (2016). Independent work: Choice, necessity, and the gig economy. *McKinsey Global Institute Report, October 2016*.

McCrum, R. (2014). From bestseller to bust: is this the end of an author's life? *Observer (March 1), http://www.theguardian.com/books/2014/mar/02/bestseller-novel-to-bust-author-life*.

Neff, G., Nardi, B. A., Kaptelinin, V., & Foot, K. A. (2012). *Venture Labor: Work and the Burden of Risk in Innovative Industries*: MIT Press.

Orlikowski, W. J., & Scott, S. V. (2015). The Algorithm and The Crowd: Considering the Materiality of Service Innovation. *MIS Quarterly, 39*(1), 201-216.

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2016). *Platform Revolution: How Networked Markets Are Transforming the Economyand How to Make Them Work for You*: W. W. Norton & Company.

Parrott, J. A., & Reich, M. (2018). An Earnings Standard for New York City's App-based Drivers. *Report for the New York City Taxi and Limousine Commission, July 2018*.

Peterson, H. (2018). Missing wages, grueling shifts, and bottles of urine: The disturbing accounts of Amazon delivery drivers may reveal the true human cost of 'free' shipping. *Business Insider (September 11), https://nordic.businessinsider.com/amazon-delivery-drivers-reveal-claims-of-disturbing-work-conditions*.

Ross, J., Irani, L., Silberman, M. S., Zaldivar, A., & Tomlinson, B. (2018). Who Are the Crowdworkers? Shifting Demographics in Mechanical Turk. *Conference on Human Factors in Computing Systems - Proceedings*, 2863-2872.

Sanders, D. E., & Pattison, P. (2016). Worker characterization in a gig economy viewed through an Uber centric lens. *Southern Law Journal, 26*(2), 297-320.

Scholz, T., & Schneider, N. (2016). *Ours to Hack and to Own: The Rise of Platform Cooperativism, a New Vision for the Future of Work and a Fairer Internet*: OR Books.

Schor, J. B. (2017). Does the Sharing Economy Increase Inequality within the Eighty Percent?: Findings from a Qualitative Study of Platform Providers. *Cambridge Journal of Regions, Economy and Society, 10*(2), 263-279. doi:https://academic.oup.com/cjres/issue

Scolere, L., Pruchniewska, U., & Duffy, B. E. (2018). Constructing the Platform-Specific Self-Brand: The Labor of Social Media Promotion. *Social Media + Society, 4*(3). doi:10.1177/2056305118784768

Scott, S. V., & Orlikowski, W. J. (2010). Reconfiguring Relations of Accountability: The Consequences of Social Media for the Travel Sector. *Academy of Management Annual Meeting Proceedings, 2010*(1), 1-6. doi:10.5465/AMBPP.2010.54499679

Srnicek, N. (2017). The challenges of platform capitalism: Understanding the logic of a new business model. *Juncture, 23*(4), 254-257. doi:10.1111/newe.12023

Sundararajan, A. (2016). *The Sharing Economy: The End of Employment and the Rise of Crowd-Based Capitalism*. Cambridge and London: MIT Press.

Terranova, T. (2000). Free Labor: Producing Culture for the Digital Economy. *Social Text, 18*(2), 33-58. doi:muse.jhu.edu/article/31873

Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research, 21*(4), 675-687. doi:10.1287/isre.1100.0323

Townsend, M., Surane, J., Orr, E., & Cannon, C. (2017). America's 'Retail Apocalypse' Is Really Just Beginning. *Bloomberg (November 8). https://www.bloomberg.com/graphics/2017-retail-debt/*.

Upwork. (2018). Prospectus for an initial public stock offering. *Upwork, Inc., https://www.sec.gov/Archives/edgar/data/1627475/000119312518291879/d575528d424b4.htm#toc575528_10*.

van Dijck, J. (2013). *The Culture of Connectivity: A Critical History of Social Media*: OUP USA.

Weil, D. (2014). *The Fissured Workplace*: Harvard University Press.

Wigglesworth, R. (2017). Will the death of US retail be the next big short? *Financial Times* (July 16), https://www.ft.com/content/d34ad3a6-5fd3-11e7-91a7-502f7ee26895.

Wong, J. C. (2018). Revealed: Google's 'two-tier' workforce training document. Guardian (December 12) https://www.theguardian.com/technology/2018/dec/11/google-tvc-full-time-employees-training-document

Xinhua. (2018). China's online retail sales grow over 34 pct in Q1. *Xinhua,* http://www.xinhuanet.com/english/2018-04/22/c_137128431.htm.

Youngjin, Y., Henfridsson, O., & Lyytinen, K. (2010). The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. In (Vol. 21, pp. 724-735): INFORMS: Institute for Operations Research.

Zysman, J., & Kenney, M. (2018). The Next Phase in the Digital Revolution: Intelligent Tools, Platforms, Growth, Employment. *Communications of the ACM, 61*(2), 54-63. doi:10.1145/3173550

Short CVs of the authors

Martin **Kenney** is a Professor at the University of California, Davis, and a Senior Project Director at the Berkeley Roundtable on the International Economy (BRIE). He has published or edited six books and over 140 scholarly articles on university-industry relations, venture capital, Silicon Valley, and entrepreneurship in the U.S. and Asia. He is a receiving editor at Research Policy and edits a book series in innovation and globalization for Stanford University Press.

Petri **Rouvinen** is a research director at ETLA, The Research Institute of the Finnish Economy. He has published or edited over ten books and dozens of scholarly articles in peer-reviewed journals. He has served as an expert in the projects of the EU, OECD, UNU/WIDER, and the World Bank. He represents Finland in the global competitiveness programs of IMD and the World Economic Forum.

John **Zysman** is a professor of Political Science at the University of California, Berkeley, and co-founder of the Berkeley Roundtable on the International Economy (BRIE). He has written extensively on national policy and corporate strategy. He is the author or editor of numerous books, scholarly articles, and journal special issues. His interests also include comparative politics, Western European politics, political economy, and the impacts of computation on society.