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Intelligent Tools and Digital Platforms: Implications for Work and Employment

The rise of digital platforms leads to a number of challenges: Will the rapid introduction of intelligent tools and systems[1] provide real and rising incomes with reasonable levels of equality and growth built on sustained productivity generated by the new technology and strategies? Or will it provoke a world of increasing unemployment and inequality? Will platforms, one of the critical tools/systems shaping this phase of the digital transformation, deeply disrupt the processes of value creation and capture? Are we doomed, or can we create a new era of growth and abundance? This paper intends to provide an overview of the issues as seen from the West Coast of the United States, but with a viewpoint informed by our years of working in Europe and Asia.

The central organizing technologies for global economy and society have been undergoing a transformation over the last three decades. To illustrate the changes, as late as 2002, the five most valuable firms in the world in terms of market value were Microsoft, General Electric, Exxon, Walmart and Pfizer. In 2017 the most valuable firms were Apple, Alphabet (Google), Amazon, Microsoft and Facebook. Moreover, two Chinese platform giants, Alibaba and Tencent, had joined the global top 10. As these platform giants and other platform firms expand their footprint, an increasing number of industrial sectors, supply chains and their incumbent firms are being reorganized. With these reorganizations, workers in those sectors are being threatened with loss of employment, income and/or job transformation. Of course, new jobs and opportunities to earn an income are being created – however, the new jobs will require entirely different skills or be in different locations from the workers affected.

When considering macro-social and technical changes such as these, history can provide insight. Reflection upon the history of the previous great organizing technology, the automobile, suggests the depth of the current transformation. The 20th century industrial era was characterized as Fordist, after the founder of Ford Motor Company, and the automobile industry was the great organizing industry of its time. Automobile assembly is simultaneously a symbol of, metaphor for and organizing principle of modernity. Whether it was a Ford, GM or Volkswagen ("the peoples' car"), with all of their accompanying industries, these were the icons generating the infrastructure of a new era. The CEO of General Motors was justified in declaring that what was good for GM is good for America and vice versa. Much as Silicon Valley today is the geographic metaphor for a technological transformation and the tourist destination for those wanting to understand the cutting edge of capitalism, Detroit, as the location where the future was being created, drew Antonio Gramsci and Diego Rivera alike.

In the late 1970s and early 1980s, Silicon Valley was only beginning to be recognized, and the depth of the present transformation was hardly evident. Indeed, one French policy maker remarked that Silicon Valley would return to the sand, and the CFO of a major American financial institution told one of the authors that joining the board of an electronics firm was a waste of his time and beneath his dignity.[2] That firm was Intel.

Consider, again, the icon of the previous age, the automobile. To exaggerate only slightly, today it is a container for digital value, including semiconductors and software, which control mechanical components, engines, transmissions, brakes, suspensions, steering and now mapping systems. The electronics is the basis now of the emerging possibilities of autonomous vehicles.[3] Software, data and platforms are increasingly significant compo-

1 We are intentionally steering away from the catch phrase of artificial intelligence (AI). While AI and its cousins are tools in the broader category of intelligent tools, they carry connotations, sometimes existential fears, which can divert the debate from the immediate questions and issues.

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2 These are from private conversations with John Zysman.

3 R.N. Charette: This Car Runs on Code, IEEE Spectrum, 1 February 2009, available at https://spectrum.ieee.org/transportation/systems/this-car-runs-on-code.

nents of all manner of machines, affecting everything from GE's jet engines[4] and Pirelli's tires[5] to John Deere's newest tractors.[6] The once pervasive notion of Fordism is a powerful historical referent. But the popular effort to characterize the transformation as post-Fordism,[7] or indeed post-industrialism, simply misses the point of the power and sweep of the digital transformation and the way digital tools such as platforms are seizing hold of social and economic life.

The shifting focus and debate from autos to electronics was captured recently in California by an event meant to initiate a debate about policy for a digital era. A topic of discussion was the possibility of evolving from the now defunct "Treaty of Detroit" – a modus vivendi reached post-World War Two between the Big Three automakers and the United Auto Workers labor union about how profits would be shared between the firms and their workers – to a "Treaty of San Francisco", i.e. a set of agreements that presumably would determine the sharing of the benefits of the value created by the digital economy with the rest of society.

In this era of intelligent tools and systems,[8] one of these tools, the digital platform, is emerging as a powerful general organizing principle for the economy.[9] Platforms are a current instrument and accelerator of this ICT transformation of social existence – integrating services and manufacturing, and changing both along the way.[10] The consequences of the advance of computation, the massive adoption of digital platforms and the rise of cloud computing are diverse and deep. We focus here on two: employment and the character of market competition.

The setting

Let us remind ourselves of a bit of the history, as Silicon Valley and computation are the emblems of the story. The emergence of the digital era really begins with semiconductors. Of course, there were many forces at work during this period in the 1970s, including offshoring, which represented a decomposition and geographic redistribution of economic activity – initially in manufacturing but soon afterwards in services.[11] These other forces were facilitated by early digital communications and data technology that eased coordination of dispersed activities. Cross-national production networks and supply chains developed as a counterpoint to the vertically integrated corporation. As important, not only did many standard components and products begin to be produced in Asia, but multiple competitors entered the market, increasing price competition for many products. In many markets, that meant manufacturing products and tradeable services would quickly become commodities after initial innovation or improvement. Consequently, the principal basis of competition became price.

One strategy for escaping from this particular "commodity trap" involved the conversion of products into a service. Embedded digital electronics, computing capacity, data sources and algorithms can transform a product into a service. For example, devices such as cranes can be embedded in port management systems.[12] A company could sell tires by selling a fleet management service that would reduce the overall cost of the tires for the fleet. The list is now endless and refers to "services with everything", or more awkwardly, servitization.[13] The delineation between services and products is becoming ever more difficult to determine. For example, is the Amazon Kindle a service or a product?

The point is that the value of a product is increasingly determined by the services it can deliver or facilitate. This servitization has been accelerated by cloud computing. Cloud computing simplified the development and introduction of new digital services. Some of these services,

4 L. Winnig: GE's Big Bet on Data and Analytics, in: MIT Sloan Management Review, Vol. 57, No. 3, 2016.
5 Pirelli debuts cloud-based tire-monitoring system, Tire Business, 7 March 2017, available at http://www.tirebusiness.com/article/20170307/NEWS/170309957/pirelli-debuts-cloud-based-tire-monitoring-system.
6 Verizon's Telogis and John Deere have partnered on connected construction equipment, Business Insider, 7 November 2016, available at http://www.businessinsider.com/verizons-telogis-partners-with-john-deere-to-analyze-tractor-data-2016-11.
7 A. Amin (ed.): Post-Fordism: A Reader, Oxford 1994, Wiley-Blackwell.
8 For more information, see the Berkeley project Work in the Era of Intelligent Tools and Systems, available at http://wits.berkeley.edu.
9 M. Kenney, J. Zysman: The Rise of the Platform Economy, in: Issues in Science and Technology, Vol. 32, No. 3, 2016.
10 J. Zysman, S. Feldman, K.E. Kushida, J. Murray, N.C. Nielsen: Services with everything: The ICT-enabled digital transformation of services, in: D. Breznitz, J. Zysman (eds.): The third globalization? Can wealthy nations stay rich in the twenty-first century?, Oxford 2013, Oxford University Press, pp. 99-129.
11 M. Kenney, R. Florida (eds.): Locating Global Advantage: Industry Dynamics in the International Economy, Stanford 2004, Stanford University Press.
12 W. Laursen: The Automated Terminal, Maritime Executive, 5 December 2016, available at https://www.maritime-executive.com/magazine/the-automated-terminal.
13 The struggle, really a market battle, to be the "organizer" rather than a commodity, to be distinctive rather than a commodity, is a constant theme of this era. iPhone value, as diverse studies have shown, lies with the control of the operating system and the IP. Firms wishing to supply Apple are forced into commodity nodes in the value chain. Amazon, one might argue, is an enormous marketplace for commodities. However, Amazon is the organizer and the firm that captures all the data generated by users of its site.

when successful in attracting users, become powerful digital platforms.[14] The principles for cloud computing can be traced to the 1970s,[15] but the fundamental application of virtualization and abstraction emerged in the late 1990s, as the costs of computing and data storage continued to decrease dramatically, even as the amount of data increased exponentially. The early deployment of cloud computing was undertaken in U.S. firms, such as Amazon, Google and Salesforce, although they initially deployed these computing approaches to solve their own internal needs. It was Amazon that truly grasped the possibility that its internal data centers could also be profitably rented to external users. It created Amazon Web Services (AWS), which provides the service of renting inexpensive computing capacity and is now the fastest-growing, most profitable segment of Amazon's entire business. Paradoxically, what Amazon is offering is commodity computing at a scale never before imagined – by providing unique access and configuration, it transformed an apparent commodity into a unique service.

Scale matters for the providers of cloud services. The giant U.S. firms providing these platforms took the lead with multibillion-dollar investments in new data centers. Today, the only firms that have scale resembling that of the U.S. firms are the Chinese companies Tencent, Alibaba and Baidu.

For the users buying computing services from cloud providers, the result was that capital costs were converted into operating costs. European firms and policy makers were, in our view, slow to recognize the importance of cloud computing and, even more to the point, to envision what cloud computing could become. Regardless of what European governments desire, it seems likely that European firms will not become significant providers of cloud computing services; rather, they are more likely to remain principally cloud computing services consumers.[16]

14 K.E. Kushida, J. Murray, J. Zysman: Cloud computing: From scarcity to abundance, in: Journal of Industry, Competition and Trade, Vol. 55, No. 1, 2015, pp. 5-19.

15 M.D. Neto: A brief history of cloud computing, IBM, 18 March 2014, available at https://www.ibm.com/blogs/cloud-computing/2014/03/a-brief-history-of-cloud-computing-3/.

16 For example, one of the largest European users of the cloud, Spotify, transitioned from AWS to Google's cloud. They did not choose a European provider. The implications of this move are significant, as it reinforces the power of the Google data center and, of course, Google engineers learn even more about big data problems. More remarkably, Google's YouTube is one of Spotify's most important competitors. For more, see N. Heath: Switching clouds: What Spotify learned when it swapped AWS for Google's cloud, in: TechRepublic, 21 October 2016, available at https://www.techrepublic.com/article/switching-clouds-what-spotify-learned-when-it-swapped-aws-for-googles-cloud/.

Working and earning in the era of intelligent tools

Let us return from the technology foundations to the core issue in this essay, the consequences of the deployment of these tools for work. The core question is whether intelligent tools, including platforms, must inevitably displace work, creating an ever-expanding underclass, or – as with hopes expressed by the German government's *Industrie 4.0* project – can these tools be harnessed to augment human capacities creating a new era of equitable growth? Are the robots coming to take our jobs? The answer will depend on how the tools are deployed. Deployment will depend on whether firms and communities view workers as assets to be augmented or simple costs.

The character and breadth of the challenge, as well as the timeframe in which we must deal with the challenge, are all at issue. If broad swathes of jobs are displaced by digital automation in a short timeframe, e.g. less than ten years, this could lead to both a political as well as an economic crisis. Certainly new forms of work will be created, but the question is always in what numbers, for whom and where? The estimates vary widely from predictions of an immediate disruption and massive displacement in the coming years to a potentially challenging transition over a longer time period, i.e. a more orderly industrial transformation. In that latter case, if some additional aspects of jobs are automated over several decades, and the jobs are consequently reconfigured and transformed, then we will have a challenging but more conventional production transformation.

We really know little about what the final balance will be in terms of the displacement, creation and transformation of work. That the production and distribution of goods and services will dramatically evolve with the adoption of intelligent tools is evident. Many tasks will be automated, of course. The most dramatic estimate is that automation will displace 47% of all tasks, although this estimate was followed by an overly quick extension of the logic from the examination of tasks to conclusions that a similar percentage of jobs will be displaced.[17] As noted, however, how quickly that automation will take place is less clear, as it will be an economic and social process as much as a technical one. Along the way, new tasks and jobs will be created: data analysts, YouTubers, app developers, social media strategy consultants and Uber drivers are just the beginning. Given the current evolution of the U.S. economy, and of advanced economies more

17 C.B. Frey, M.A. Osborne: The future of employment: how susceptible are jobs to computerisation?, in: Technological Forecasting and Social Change, Vol. 114, 2017, pp. 254-280.

generally, a reasonable concern is that the new work will be at the high and low ends of the income continuum, sustaining or even accelerating the erosion of the middle.[18]

Beyond the fear of job elimination is the near certainty that virtually all work processes and jobs will be reformed and functions will be automated, while new functions in the same "job" will be added. Such transformations, the history of technology instructs, will turn on how the technologies are deployed and what they are used to accomplish. Here, two matters are crucial.

First, are workers considered assets whose understanding and knowledge are to be augmented and developed? Or are workers simply costs which need to be contained? Where firms conceive of their competitive advantages as based on skills and the effective use of those skills, these technologies may spur the development of the capacities of the workforce. That, as we understand it, is an underlying intent of *Industrie 4.0*. By contrast, in places where there is a less developed fabric of small- and middle-sized, skill-based companies with political power and consciousness of alternatives – and where manufacturing advantage has been lost or abandoned – there is likely to be a bias toward the adoption of strategies deploying robots with little concern for workers. Indeed, the Fraunhofer Institutes argue that German approaches to digitalization have been built from the vertical industry as it applies digital technologies to its process and products, while U.S. firms build software and then apply it to the particular vertical industry – a bottom-up strategy versus an over-the-top strategy.[19]

Second, and deeply related to first, is the question of "user interfaces". The ability to effectively implement new technologies depends both on how the tools are designed and on the skills of the workforce. Indeed, the stories are interrelated. Consider Microsoft Office. MS Office was certainly more than a set of interfaces; it was a program that amalgamated a number of functions. The emergence of Office ended the reign of the office automation giants such as Wang. In the process, it led to the elimination of secretarial pools of typists and clerks doing simple accounting and actuarial calculations. The tools allowed people without sophisticated computer science skills to utilize increasingly powerful computers. The modern office was transformed; roles and functions evolved. The design of user interfaces depends on the purposes to which the tools will be put, and these interfaces are a major determinant of the skills that next generations will require.

While James Bessen found that automated teller machines had little impact on overall employment at banks, there is still much more to understand about the consequences or automation for labor markets.[20] Temporary work has a long history, as day laborers were common even before the industrial revolution. More recently, the Chandlerian integrated firm that integrated nearly all functions has begun disintegrating and outsourcing functions.[21] This was best expressed in the emergence of temporary agencies and manpower contracting services – long before the emergence of online labor contracting. There is a fascination with the online gig economy, but depending upon one's definition, the reality seems to be that it is a small portion of today's labor market – perhaps 0.5% or 1% of the workforce is involved. [22]

However, if one believes, as we do, that the movement of society and the economy to a digital platform-mediated world will continue, this issue will only grow. One topic will be how labor markets will provide social welfare benefits. For example, in some European states, many such welfare rights are linked to citizenship. Where this is the case, the general movement to a more fluid labor structure may have a softer character, though even in these nations benefits are not as comprehensive for those permanently in the gig economy. Where a greater proportion of the benefits are tied to employment, as in the U.S., the changes will be far more traumatic.

The platform economy

Digital platforms are, along with machine learning and big data, defining technological features of this era of intelligent tools.[23] In fact, much of the cutting-edge work in machine learning and big data is done by the platform leaders – as they have the cash flow and the raw material for such experimentation. Platforms are, as is oft repeated, multisided transaction systems permitting innovative ways for buyers and sellers – participants in communities – to interact and transact.

18 D. Autor, A. Salomons: Does productivity growth threaten employment?, Paper prepared for the ECB Forum on Central Banking, June 2017.

19 R. Wehrspohn: Fraunhofer Industry 4.0 Strategy, Smart Living Conference, Slide Presentation, 20 October 2016, p. 12.

20 J. Bessen: Learning by Doing: The Real Connection Between Innovation, Wages, and Wealth, New Haven 2015, Yale University Press.

21 See, for example, M. Sako: Outsourcing and offshoring: implications for productivity of business services, in: Oxford Review of Economic Policy, Vol. 22, No. 4, 2006, pp. 499-512.

22 D. Farrell, F. Greig: Paychecks, Paydays, and the Online Platform Economy. Big Data on Income Volatility, JPMorganChase & Co. Institute, February 2016, available at https://www.jpmorganchase.com/corporate/institute/report-paychecks-paydays-and-the-online-platform-economy.htm.

23 M. Kenney, J. Zysman, op. cit.

Increasingly, firms are exploring ways to incorporate platforms into their basic business models. For non-platform firms, a critical issue is exploring how they will fit in a platform-organized business world. An analogy might be how firms of all types had to adjust to the changes caused by the implementation of the electrical distribution system.[24] As Thomas Hughes showed, every nation developed its own leading firms for its electrical distribution system, such as Siemens and AEG in Germany or Thomson in France.[25] However, the new defining platform firms in this era are based in China and the United States. While the technology is not the fundamental limiting factor, as was the case in the electrical industries, network externalities are extremely powerful.[26]

Digital platforms are rewiring markets and competition not only in the widely known sectors such as the hotel and transport industries, where so much attention has been centered on Airbnb and Uber, but as importantly in entertainment, retail, logistics and many others. One of the most interesting aspects of this period is the ease with which this reconfiguration of competition has occurred, even though many of the new entrants touting their platforms will not survive. In the same way, the bulk of investments in dot.com businesses failed nearly two decades ago, but the basic wave of innovation moved forward. The wide availability of early-stage and follow-on funding for profitless expansion, combined with the ready access to low-cost computing resources and the ability to create websites using easily available open-source software modules, encourages experimentation, perhaps excessive experimentation. Many new entrants and their funders believe that, if they simply invest sufficient capital rapidly enough, even while losing money in the short and medium term, they can tip the market and become dominant. Progressively higher evaluations fueled by money-losing growth can result in early investors cashing out at higher multiples while later investors fail. And yet, despite these losses, as long as there is one Amazon, Facebook, Google or Salesforce in that vintage of startups, the world of competition will have been changed and the Silicon Valley model will be fueled for exploiting the next technological wave.

Thus far the most significant and transformative platforms have emerged in consumer markets. In the industrial sectors, where supply chains link various manufacturing firms, the adoption of digital platforms has been slower, because the various firms will consider carefully whether it is in their individual interest to join the platform and share data. This resistance hobbled the enormous efforts General Electric made to introduce its Predix software to interconnect industrial firms.[27] Other firms were not convinced that data sharing from their factories and machines was in their interest.

On the topic of sharing, we note that the notion of a "sharing economy" is a profound misnomer. There are certainly instances of platforms that facilitate sharing and are conjointly maintained; Wikipedia is perhaps the best example. It is important to ask who is sharing what with whom.[28] I *share* my home with my cousin, but I *rent* to a stranger through a new form of interaction. Thus, many of the so-called sharing sites, platforms such as Airbnb, BlaBlaCar or Uber, amount to the conversion of consumer goods and idle labor time into capital goods exchanged in the market place. More recently, Uber began lending money to drivers to lease or rent cars, but due to high defaults that program is ending.[29] It is becoming increasingly accepted that these digital platforms that were once conceptualized as "sharing" are better understood as reorganizations of business sectors using algorithms with the goal of generating profit.

Shaping the future of intelligent tools and platforms

The interplay of technology possibilities and business model innovation should produce significant productivity gains.[30] How the productivity gains are distributed through the society will shape the character of that society. So the first task for policy makers is one with seemingly contradictory objectives: support innovation while protecting consumers, workers and communities. Both objectives are essential, but they will certainly often collide. With that in mind, let us highlight several potentially

24 P.A. David: The dynamo and the computer: an historical perspective on the modern productivity paradox, in: American Economic Review, Vol. 80, No. 2, 1990, pp. 355-361.

25 T.P. Hughes: Networks of Power: Electrification in Western Society, 1880-1930, Baltimore 1993, JHU Press.

26 For a general discussion, see C. Shapiro, H.R. Varian: Information Rules: A Strategic Guide to the Network Economy, Cambridge, MA 1998, Harvard Business Review Press.

27 A. Scott: GE shifts strategy, financial targets for digital business after missteps, Reuters, 28 August 2017, available at https://www.reuters.com/article/us-ge-digital-outlook-insight/ge-shifts-strategy-financial-targets-for-digital-business-after-missteps-idUSKCN1B-80CB.

28 J.B. Schor, W. Attwood-Charles: The "sharing" economy: Labor, inequality, and social connection on for-profit platforms, in: Sociology Compass, Vol. 11, No. 8, 2017.

29 This program was widely seen as essentially indenturing drivers and soon ran into difficulties as drivers could not pay back the loans. See A.J. Hawkins: Uber is phasing out its subprime car-leasing division after massive losses, The Verge, 8 August 2017, available at https://www.theverge.com/2017/8/8/16112498/uber-phase-out-xchange-car-leasing-losses.

30 For a more detailed discussion of these issues, see J. Zysman, M. Kenney: The Next Phase in the Digital Revolution: Platforms, Automation, Growth, and Employment, in: Communications of the Association of Computing Machinery, forthcoming.

vexing issues that have been raised in debates about how to promote and regulate the rising platform economy and intelligent tools.

First, are platform businesses only technology providers and thus outsiders to the economic sectors they affect? Or should they be treated as entrants into the sectors they influence and consequently regulated as such? For example, if firms such as Uber, Lyft or BlaBlaCar enter and "disrupt" a certain type of transportation, should they then be regulated as transportation firms? Of course, this also means we must determine the sector to which the disruptors belong. In such cases, it may be that the old rules must be reconceptualized, requiring new regulations.

Second, some platforms have such broad social impacts that there are calls for their regulation as utilities.[31] While the platform firms are certainly not providers of simple commodity services, they do have often economy-wide consequences by providing and even defining many marketplaces. How then do we define the rules guiding the behavior of platform firms? Can we specify their obligations to assure competitive marketplaces and the implementation of agreed-upon social regulations?

Third, and related, what constitutes market power, and how should we define and manage that market power? Importantly, the remedies are less than obvious. Assume we agree that Google has market power for search and email. If they were broken apart, would a loss of compatibility and integration ensue? Or should the separation be into numerous search engines for different countries? Would one divide Instagram and instant messaging from the Facebook social media platform? Would this be efficient? How would this intersect with Apple's increasingly walled garden? Are the rules of government policy makers well aligned with the imperatives of the structures of digital stacks and the remarkable ways in which digitalisation dissolves inter-industry and supply chain barriers?

Fourth, in a world within which software is increasingly the directive force for the operation of machines, who owns the software when it is embedded in the purchased machine and completely necessary for the machine to operate? This is applicable to both consumer products and capital goods.[32] Further, since these machines are producing increasing amounts of data, who owns that data? Consider a firm selling through Amazon Marketplace. Amazon is either a competitor or potential competitor. Amazon, the competitor, will own or at least have access to all of the partner firm's sales, which it can analyze to improve its own sales. Further, Amazon, when all is said and done, owns the customer, as it has the data and the delivery relationship.[33] If GE or Siemens owns the platform through which all of the industrial data is exchanged, then they would be in a powerful position to understand where the value is created and captured. As data and software become ever more central to the economy, the question of who owns, can rewrite and can access them will become an increasingly important economic and, therefore, political and legal issue.

Fifth, much of the funding of ICT research comes from national governments with particular implicit or explicit goals. Can this research include the aim of augmenting human capabilities and capacities? Is it possible to encourage firms to assess how the capabilities and learning of those who work for and with them are assets rather than just costs? Can programs be developed to invest in research that has the goal of encouraging the more effective use of intelligent tools so that human/computer collaborations can be productive not only to businesses but also to consumers and workers? Part of this should be geared toward supporting the development of user interfaces that allow citizens to make use of these powerful tools.

In sum, we must proceed in a way that allows citizens, in their multiple roles as workers and consumers, to participate in shaping the future, not just allowing it to happen to them. It is not a matter of robots coming, but rather one of how to direct the evolution of platforms and the development and deployment of intelligent tools and systems. It is a matter of choice. There are a variety of potential futures. The core question is which one do we want and how do we get there.

31 See D. Boyd: Facebook is a utility; utilities get regulated, Apophenia, 15 May 2010, available at http://www.zephoria.org/thoughts/archives/2010/05/15/facebook-is-a-utility-utilities-get-regulated.html; and W. Gao, Y. Yang: Chaining cyber-titans to neutrality: An updated common carrier approach to regulate Platform Service Providers, in: Computer Law & Security Review, Vol. 31, No. 3, 2015, pp. 412-421.

32 A. Ezrachi, M.E. Stucke: Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy, Cambridge, MA 2016, Harvard University Press.

33 L.M. Khan: Amazon's Antitrust Paradox, in: Yale Law Journal, Vol. 126, No. 3, 2017, pp. 710-805.