# The Business Revolution: Economy-Wide Impacts of Artificial Intelligence and Digital Platforms

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## I.    Introduction

Over the past three decades, the business world has undergone a major transformation.  A small set of early-moving companies have leveraged a range of innovative, digital, platform-related business models for competitive advantage. To describe this transformation, Spulber (2011, pg. 269) introduced the concept of "Business Revolution" and observes that, "The Business Revolution is changing the office, the store, and the market, just as the Industrial Revolution earlier changed the factory. Scientific and technological advances in [Information and Communication Technology] ICT have generated changes in commerce on a scale that rivals or surpasses the Industrial Revolution." Some observers focus on the rise of platforms and intangible assets as a way of organizing the economy (Adner et al., 2019; Brynjolfsson et al., 2021, Spulber, 2019). Others focus on the increased ability of prediction through artificial intelligence (AI) (Agrawal et al., 2018) or on increased innovation (Cockburn et al., 2018) and entrepreneurship (Jin et al., 2022).

In each of these of these formulations, economics has been central to fundamental changes to the organization of firms as well as firm strategies within the information technology (IT) space.

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These changes can transform areas such as finance, operations, and marketing, and other core functions of the firm. The digital business revolution has made existing routines more efficient; and it has created opportunities to rethink how firms and the economy are organized.

At the most basic level, the digital business revolution is the application of technology to organizations and markets. Though this concept is not new (Landis, 1998), this iteration of the industrial revolution is different from prior ones. Intangibles, whether data itself or intellectual property (IP) utilizing data, create a different sort of firm and set of markets. Thirty years ago nearly all of the value from firms came from tangible goods. Today this has been inverted, with much firm value emerging from intangible assets. In addition, more production is moving from inside the firm to outside of the firm where third parties create much of the value (Parker et al., 2017; Benzell & Brynjolfsson, 2019).

In this essay, we identify several themes of the digital business transformation, with a particular focus on the economy-wide impacts of artificial intelligence and digital platforms. In doing so, we highlight specific industries, beyond just the high-profile "Big Tech" firms, where the digital business revolution is having, or promises to have, significant impact. The papers in this special issue (flagged with bold font below) provide a deeper analysis of the themes and applications we touch on here.

## II. The changing economics of the digital business revolution

### A. The trajectory and general impact of AI

AI and machine learning are transforming organizational and firm behavior. Brynjolfsson et al. (2019, p. 24) note, "Machine learning represents a fundamental change from the first wave of computerization." As a consequence, the study of the economics of AI is rapidly increasing. At present, the focus is on increased prediction (Agrawal et al., 2018; Brynjolfsson & McAfee, 2014; Jones & Tonetti, 2020). With improved prediction comes the ability to make better decisions, and because of the wide range of applications for decision-making, AI-enabled prediction can reasonably be categorized as a general purpose technology (Bresnahan & Trajtenberg, 1995). Yet, prediction is only an input into decision-making. It is the new developments in decision-making that increasingly mark the next stage of the digital business revolution; these developments hold promise to increase labor productivity, operational planning related to external risk exposure, financial planning, and investments. However, not all of these changes are necessarily positive; AI may lead to increased harm across a number of dimensions (Acemoğlu, 2022).

The general impact of AI may be transformational. Work by **Bresnahan (2023)** shows that it may lead to dramatic productivity growth. He identifies particular paths of AI development that may lead to broader general use of AI. He also notes several reasons to be skeptical of quick, radical change, pointing out that at present, few firms have embraced general AI.

In related work, **Agrawal, et al. (2023)** provide a theoretical framework to address the AI task versus AI system-based approaches to digital transformation. They posit that firms should adopt

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a task-level approach in those settings where decisions are not interrelated. Firms should instead use a system-based approach when there is need for coordination of interrelated decisions.

**McElheran et al. (2023)** document significant heterogeneity in early adoption of AI-related technologies. They find that fewer than 6% of firms used any of the AI-related technologies, but most very large firms reported at least some AI use. AI adoption was also more common in startups displaying indicators of high-growth entrepreneurship. The paper also shows that the geography of AI use among startups to be quite concentrated. These patterns foreshadow the possibility of an AI divide if early patterns persist.

**Hoffreumon et al. (2023)** examine how firms adopt AI technology: by purchasing commercial readymade software, by developing or customizing solutions in-house, or both. They find that adoption of AI using readymade software as a sourcing strategy is now common, and complementarities between sourcing strategies are common across sectors. Only the IT sector exhibits substitution between sourcing strategies.

**Dogan et al., (2023)** investigate how automation impacts the configurations of decision-making within organizations. Their findings reveal that increased accessibility of automation leads to higher centralization of decision-making within firms. Additionally, the study highlights the variation in automation deployment strategies based on organizational structures: centralized firms opt to automate divisions confronting greater uncertainty, whereas decentralized firms exhibit a contrasting approach.

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**B. Specific impacts of AI and digital platforms**

In this subsection, we provide an overview of the promise and pitfalls of the digital business revolution across specific, but broad, elements of the economy.

**1. Pricing**

AI already has begun to revolutionize pricing (**Asker et al., 2023**), and it also may lead to an increased ability for dynamic pricing (Xu et al., 2019; Li et al., 2023). **Asker et al. (2023)** focus on reinforcement learning, which is gathered from the AI based on learning from actions. The paper focuses on how AI pricing algorithms impact market dynamics and specifically the cases of asynchronous and perfect synchronous learning to understand convergence in pricing.

The literature on dynamic pricing and its welfare impacts – both theoretical and experimental – has generated mixed results. Building on the literature on trust, recent work suggests that AI may increase trust through trial and error and thereby increase cooperation (Wu et al., 2023). Of course, such cooperation of course may have negative repercussions when it comes to pricing outcomes that may lead to collusion. Algorithms, even if not explicitly programmed to collude, may learn over time to do so. Price setting with algorithms increasingly has become an area of interest for economics and adjacent fields. For example, Calvano et al. (2020) study a setting where algorithms repeatedly interact, showing prices rise relative to the theoretical predictions of behavior that is non-collusive due to reward-and-punishment schemes. The idea that AI can support collusion is also found in work by Klein (2021) using firms that sell homogeneous products. In Klein's work, firms take turns in alternating prices, where Edgeworth price cycles support supranormal profits.

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Other recent research points to welfare enhancements due to dynamic pricing. Williams (2022) shows dynamic pricing may be welfare improving even if there are winners and losers. Johnson et al. (2023) address an online marketplace setting where product prices are set by third-party sellers' algorithms. They show that such circumstances can lead to more intense competition between algorithms and thereby lower prices.

**2. Healthcare**

AI promises to revolutionize healthcare as part of the digital revolution (Freedman et al., 2018). As with other sectors, the consequences of increased AI use may be positive or negative for diagnosis, treatment, and costs. Deep learning AI may lead to better health outcomes than traditional types of diagnosis for areas such as cancer detection or heart disease (Aggarwal et al., 2022). However, effective implementation of AI requires trust in medical staff as well as in patients (Wang et al., 2023). In this sense AI might be considered to augment human prediction and decision-making, rather than to replace it, in order to gain trust, at least at present. Wang et al. (2023) find that AI can boost the productivity levels for all workers. However, the results are more pronounced for healthcare workers with greater task-based experience. In contrast, the results are less pronounced for workers that have greater time-based experience.

The work by **Agarwal et al. (2023)** focuses on the use of AI for physician services. They show that AI augmentation allows for more effective use of clinical information through a reduction of record complexity, improvement of interpretability, more effective screening and identification of risker conditions. The ability to augment traditional practices with AI seems promising.

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However, this augmentation raises new questions and issues that must be addressed: trust and workflow integration. Neither of these topics are unique to the healthcare setting, and economics has made important contributions to both (e.g., Tadelis 2016; Ghose et al., 2014; Autor 2015). However, healthcare also presents some unique challenges and applications, and these are compounded by AI. As such, the benefits of AI may not be distributed evenly across the economy and organizations. Because of the policy implications of increased AI human interaction in medicine, regulation may also more expressly shape outcomes.

### 3. Content Industries

The use of digital technologies in music, television and movies, books, and video games is a growing part of digital transformation (Aguiar & Waldfogel, 2018). **Aguiar et al., (2023**) show that platforms have disrupted the traditional product discovery process. This has positive and negative effects. They explore issues that arise from platform curation and product recommendations and how platforms may impact the types of products that are produced. Overall, platforms and digitization have reduced costs of distribution in these content industries and increased differentiation. There are also positive spillover effects between online distribution and in-person events (Christiansen, 2022) or for user-generated content (Kretschmer & Peukert, 2020). However, sometimes streaming may encourage piracy (Aguiar, 2017), or perhaps displace piracy (Aguiar & Waldfogel, 2018).

Content industries historically have gone through waves of vertical integration by ownership or by contract. However, until the digital era, content distribution was limited via a small set of market participants. Digitization and platforms have fundamentally changed content related

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industries. Digital platforms allow for greater discovery of new content through curation and crowdsourcing and global distribution. In this process of greater discovery for innovation in content, platforms play a critical role. They can crowdsource information and better aggregate consumer preferences in ways that steer consumers to better products. These efforts at better crowd sourcing are not without pitfalls, asplatforms must maintain trust of users in the face of increased attempts of fake reviews (Mayzlin et al., 2014).

Platforms also serve to curate via their own recommendations. These sorts of recommendations may be positive for consumers or they may create the potential for antitrust related concern. This may take the form of online resale price maintenance or most favored nation clauses or through foreclosure via refusals to deal, tying, bundling, and/or exclusive dealing. A series of enforcement actions by governments and private parties against tech platforms is creating a body of law specific to this digital context. Efforts are also underway to create ex ante rules for large digital companies that would circumscribe behavior for such firms.

Digitization in content industries creates new opportunities for consumers but also portends significant changes for current content industries in terms of who holds economic power and who shares in the rents, assuming total surplus increases. Both existing content providers and platforms are rethinking their digital strategies in light of these transformations along with increased regulatory scrutiny.

## 4. Merger policy

Merger is a potential solution for firms that do not have the internal capabilities to provide greater scale or scope in the digital business revolution. Thus, firms may choose a buy, or a make and buy, strategy rather than a make strategy based on internal growth. There may be aspects that are distinct in the digital space (Adner et al., 2019). A growing literature addresses these questions both in the big tech and the broader economy setting.

Prado & Bauer (2022) examine nearly 400 acquisitions by big tech companies, the so-called GAFAM (Google, Amazon, Facebook, Apple, and Microsoft), between 2010 and 2020. They find that these acquisitions spurred significant increases, generally upwards of 20%, in venture capital investment to their relevant industries. Li and Agarwal (2017) provide a more specific example of a tech acquisition. They examine the effects of Facebook's acquisition of Instagram in 2011. The concerns around this transaction are obvious, as a dominant firm acquiring an emerging application could potentially eliminate competition and disincentivize entrance from potential rivals. However, their study finds effects to the contrary. First, the integration improved the consumer experience and accelerated the growth of Instagram, but perhaps more importantly, that growth actually spurred market demand overall for similar products, creating new opportunities for entrants and increasing rates of investment.

But mergers and acquisitions (M&A) also occur outside the narrow band of GAFAM firms. Many technology start-ups rely on the potential for a future acquisition to return value to their investors. The presence of firms sizable enough to complete those transactions becomes a major driver of external investment in the industry, although it is less clear whether these acquisitions

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result in new or improved products that benefit consumers or merely reinforce the dominance of the acquiring companies. However, a paper by Jin et al. (2022) finds "that technology acquisitions do not shield GAFAM from potential competition that may arise from other GAFAM members or other firms that acquire in the same categories." In a related paper, **Jin et al., (2023)** discover that the majority of tech M&A target firms are outside of an acquirer's core area of business, in complementary areas, in which such mergers may be driven by increased competition in the core areas of acquirers. Additionally, they find that M&A are significant across different economic sectors. What distinguishes tech acquirers relative to other firms is that they are average younger, more efficient regarding investment, and have a greater likelihood of undertaking more global M&A.

Outside the "big-tech" setting, Hanelt et al. (2021) explore how vertical mergers can also improve innovation through accelerated product development. Their study examined the world's largest automobile manufacturers and their digital-technology acquisitions from 2000 to 2016, and the findings suggest that these mergers had significant pro-competitive effects on the manufacturers' rates of innovation. The mechanism behind these improvements is believed to be the accrual of technological knowledge within a single organization. Such expertise is generally thought to bring with it certain network effects, where the value increases with the number of users for direct network effects and for suppliers of complementary products for indirect network effects. By bringing together separate knowledge bases, these mergers appeared to generate greater advancement than if the firms had continued to operate independently.

The most notable counterexample to welfare creation for mergers comes from the work of Cunningham et al. (2021). They study and coin the term "killer acquisitions." This is a phenomenon where an incumbent firm acquires an emerging potential competitor, with the intention of shutting the product down in order to preserve its market position. Their paper examines the pharmaceutical industry. They find that when acquired firms' projects overlap with the acquirer's existing portfolio, they are far more likely to be abandoned and never brought to market. These acquisitions appeared to account for 5.3% to 7.4% of total acquisitions in the pharmaceutical space, and notably, many of those occurred at the threshold just below antitrust scrutiny, implying that the acquiring firms may recognize the potential anti-competitive nature of such mergers and specifically seek to avoid regulatory attention.

### III.    Implications

The digital business revolution has implications for both business strategy and academic research.  On the business side, we are in the early stages of the digital business revolution. Some firms have been first movers in terms of their abilities to harness the power of data for competitive advantage (Bresnahan, 2018). These first movers tend to be concentrated in B2C industries.  However, increasingly, we are witnessing this transformation in areas that are B2B and in industries that traditionally have not been structured as platforms.  The ability of firms to become platform firms and take advantage of such opportunities is still at the early stages of academic investigation (Cusumano et al., 2019).

There is increasing interest in empirical work that studies digital platforms.  **Cheng et al. (2023)** survey and analyze more than 800 empirical platform articles across top journals in the fields of

economics, finance, information systems, management, and marketing. Such a review sheds light not merely on what each field can learn empirically but also on theory. Empirical studies may require a rethink of some of the assumptions in prior theoretical platform work. By cross-referencing across different disciplines, scholars may better identify some of the potential interdisciplinary intersections of work to better inform scholarship in their own fields.

The study of platforms leads to bigger picture questions as well. Is the digital business revolution just some specific change (narrow at the task level) or is it a broader change? The answer seems to be yes to both possibilities. Some processes within firms and industries are sped up and optimized whereas some more systemic changes are different. Method innovation may have more significant impact on welfare than specific innovation (Grilliches, 1957) and studying these changes remains fertile ground for future research. These issues are increasingly being addressed as we observe how general technologies are changing the organization of the economy and how platforms are moving to ecosystems. The study of platform dynamics aids in such an understanding (Halaburda & Yehezkel, 2019; Hui & Zhu, 2021).

There are other related questions. If data help to power this digital transformation, there are fundamental questions that need to be addressed both as a matter of scholarship and with regard to policy. First, as to policy, there are difficulties in characterizing the role of data. That is, there is not a consistent way of defining data as an asset (ownership, management, and financial rights) and how to facilitate efficient data exchange (Barry & Sokol, 2024). These issues also impact broader policy questions and return us to the discussion of the original work on the business revolution regarding intellectual property (Spulber, 2011).

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