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WIPO

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Introduction

Since the onset of the first industrial revolution, a series of technological breakthroughs have drastically changed the face of societies and economies. They have also changed how innovators generate new technologies and creators produce original works. Artificial intelligence (AI) is the latest such breakthrough. While AI is not new, its capabilities and its adoption have grown to an extent that it today can empower innovators and creators of virtually all types.

At one level, AI can be viewed as just a tool that enhances human capabilities, similar to the tools that have emerged in the past. The printing press allowed for widespread dissemination of human knowledge, encouraging innovators to build upon the ideas of others. The microscope enabled scientists to study the structure of tiny objects, such as cells and microorganisms that are too small for the human eye to see. Electricity is critical for modern research labs, whether to refrigerate DNA samples or powering large scale experiments, such as the world's largest hadron collider. In the same vein, AI can analyze large amounts of medical data to identify patterns and relationships that are not apparent to human researchers.

However, AI may also be viewed as fundamentally new and different compared to past technologies in that it diminishes – or perhaps even replaces – the human ingenuity that so far has been at the root of every innovative and creative endeavor. This prospect has already become a reality in some areas: powerful AI tools have emerged that generate images, artworks, music, or stories with minimal human input.

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Historically, the emergence of new technologies has had a profound impact on the relationships and institutions that foster innovation. Policymakers – seeking to balance incentives for innovators with sufficient access to innovations for follow-on innovators and society as a whole – have frequently adjusted the policies governing innovation ecosystems. The advent of AI has already prompted such adjustments and will continue to do so.

The protection of intellectual property (IP) rights is at the heart of the incentive structure that underlies innovative and creative activities. AI poses tricky questions to the IP system. Should an AI-generated invention qualify for patent protection? Should copyright protection apply to AI-generated novels? Should it be legal to extract images from the Internet to train an AI algorithm that produces original works? To some of these questions, answers have emerged based on the interpretation of existing laws. Other questions are currently being fought in legal courts. Some legal scholars, in turn, believe that existing IP laws – originally designed for human contributions to innovation – are not anymore fit-for-purpose and require reform.

While narrow in scope, these legal questions have important economic ramifications. History has shown that seemingly small changes to IP laws can have profound effects on evolving innovation ecosystems. For example, the US Patent Act in 1952 changed the judicially developed "flash of creative genius" requirement for patentability to a statutory "non-obviousness" requirement that turned out to be more amenable to obtaining patents from routinized large-scale research and development (R&D) efforts. Other countries subsequently enacted similar patentability standards.[1] Adjusting the IP system in the face of new technologies thus requires careful consideration. Before changing any legal framework, it makes sense to first think about what is really changing, how any change affects the incentive structure for innovation and review available evidence. Is there still a market failure where the textbooks have located it up to now, did it vanish or move to another place in the value chain of innovations and creative works?

This paper seeks to place the current debate on AI and IP into a broader economic perspective. Based on insights from the economic literature on innovation incentives, the aim of this paper is to fundamentally examine which topics are newly arising from an economic perspective when it comes to AI & IP. After some basic thoughts on the nature and

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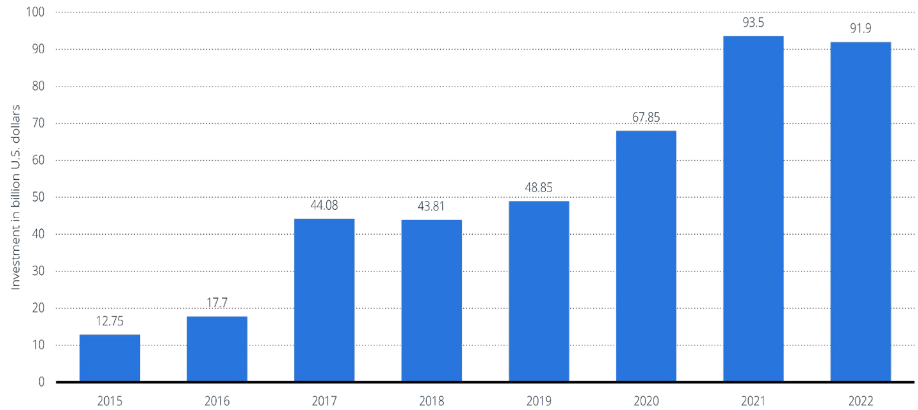
[1] See Sampat (2015). "Intellectual property rights and pharmaceuticals: the case of antibiotics." Economic Research Working Paper No. 26. (Geneva, WIPO).

the adoption of AI in the next chapter, we start in section 2 with the basic role of IP in the area of innovation and what is changing with the advent of AI. We take a similar approach in chapter 3, focusing on AI and creativity. In chapter 4 we try to shed some light on incentives for AI innovations per se, followed by some concluding remarks in chapter 6.

1. Nature and adoption of AI

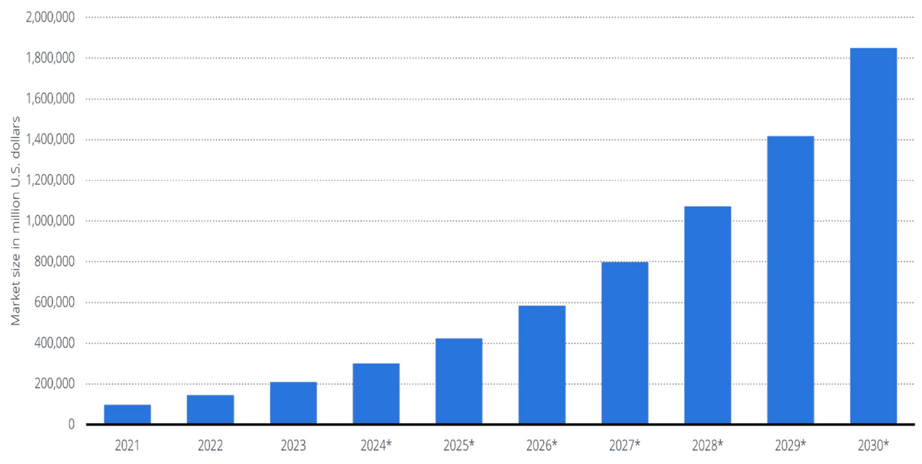
Even though AI has been part of our lives in several different forms for quite some time, be it in translation systems, face recognition techniques or robotics, it has made enormous progress in recent years. Cockburn et al. (2019) show the sharp growth in academic publications on learning systems between 1990 and 2015, from less than 100 papers in 1990 to nearly 5,000 in 2015. In the following years the new technology started to be of interest for additional commercial application. Data compiled by Statista 2023 (see Figure 1) shows an increase in global total corporate AI investment from USD 12.75 billion in 2015 to USD 91.9 billion in 2022, with high expectations of earning money from these investments in the coming years. The global artificial intelligence market size is expected to grow twentyfold between 2021 and 2030, from about USD 100 billion in 2021 to nearly USD 2,000 billion in 2030 (Statista 2023) (see Figure 2). With such prospects, it is to be expected that these investments in new technology will open up whole new horizons of innovation and creativity.

Figure 1: Global AI corporate investments worldwide 2015-2022



Source: Statista (2023).

Figure 2: Expected AI market size



Source: Statista (2023).

Despite such burgeoning prospects, the adoption and further development of AI will be constrained by a number of factors. While the scientific building blocks of AI technology are widely accessible, the skills to apply these building blocks in new applications are scarce.[2] A second obstacle is computing power: certain AI tasks require cutting-edge computing power at large scale, posing a barrier for smaller entities acquiring AI capabilities. Finally, the capabilities of AI tools depend critically on the data with which they are trained. The digitization of everyday life has, in principle, greatly widened the scope of available data. However, accessing, cleaning, standardizing and processing relevant data can encounter numerous technical, legal and financial barriers, as will be further discussed in Section 5.

The presence of these barriers also affects how companies organize their innovative activities. Do they acquire their own in-house AI capabilities or partner with specialized AI innovators? Interesting alliances have emerged, for example, between “old industries” – such as cars and pharmaceuticals – and some of the leading tech companies.[3] Access to skills, computing power and training data are key motivating factors for such alliances.

Another more recent development is the emergence of user-friendly ‘generative AI’ tools that dramatically lower the skills to use AI technology. Just as one does not need to be a mechanical engineer to drive a car, one does not need to be a computer scientist to productively use ChatGPT. There has already been a proliferation of such tools in the

[2] See Alekseeva et al. (2020).

[3] Recent announcements include, for example, new AI-focused partnership between Microsoft and Novartis as well as Google and Volkswagen.

creative industries, such as Midjourney, Speechify, Synthesia, and Amper AI; these tools utilize AI to generate new sounds, music, images, and text.

AI is said to be at the origin of the Fourth Industrial Revolution. The first three are associated with the invention of the steam engine, electricity, and eventually information and communication technology (ICT).[4] Economists refer to these inventions as “general-purpose technologies” or GPTs. A GPT is “a new method of producing and inventing that is important enough to have protracted aggregate impact” (not to be confused with “generative pre-trained transformers” – a prominent framework for generative AI, which carries the same acronym).[5] These GPTs have had a measurable impact on productivity, the labour market and other macroeconomic variables.[6] Some of them have also had a substantial impact on innovation activity itself. The idea of this concept goes back to Alfred North Whitehead, an English mathematician and philosopher. He called the concept of “the invention of the method of invention” (IMI) as “the greatest invention of the nineteenth century”.[7] Griliches (1957) gives a classic example of an IMI, using the example of hybrid maize to show that the method not only produces new products but also new ways of generating new products.[8] Crafts (2021) summarises this discussion: “IMIs raise productivity in the production of ideas, while GPTs raise productivity in the production of goods and services. However, a subset of GPTs also provide an IMI and have an important role in increasing the productivity of innovative effort.” AI is undoubtedly a GPT that also falls into the IMI category.

When it comes to the role that IP will play in the innovation process in the future, the IMI part of AI is of particular interest. There are a lot of examples that show that the use of AI systems not only helps to invent new products and services but that it also is a new method of invention. Similar arguments are true for the creativity. AI is a new method of generating creative works; it is bound to increase the productivity of the creative process and prompt new forms of creative works.

Both the input and the output of AI systems are intangible in nature. Therefore, as mentioned above, the question arises which components of AI systems require what protection under intellectual property law to set the necessary incentives for investments

[4] See Crafts (2021).

[5] See Jovanovic and Rousseau (2005).

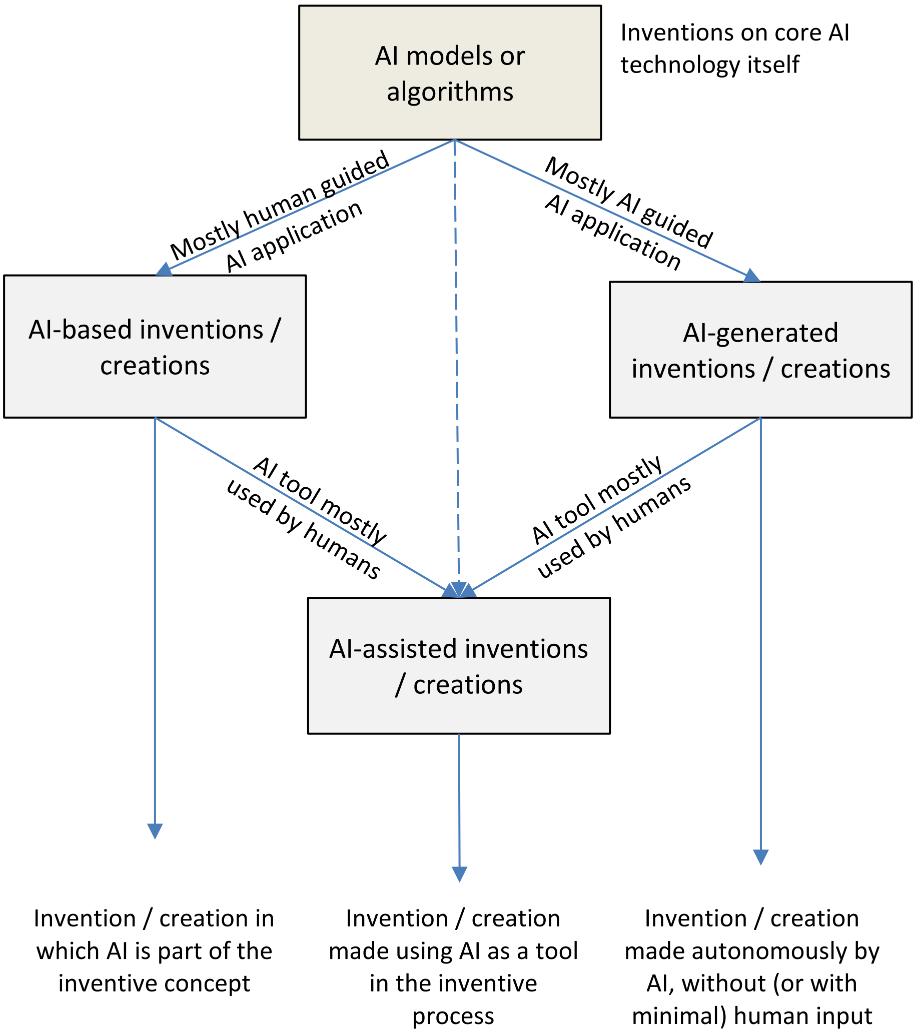
[6] See, for example, Cockburn et al (2019), Crafts (2021), Mokyr (2018).

[7] See Whitehead (1925), p. 136.

[8] See also Cockburn et al. (2019), p. 120.

and how this protection potentially differs from the ones available under the current IP system. WIPO (2023) distinguishes four definitions of AI inventions. This categorization can mostly also be applied to creative works that employ AI. AI models or algorithms are the base for all AI inventions. All downstream inventions differ in particular in the degree of input from humans and the role that AI plays as part of the output.

Figure 3: Visualisation of the different AI invention concepts.



- First, there are *AI models or algorithms*. This type of AI invention is about the basic technologies that enable AI. Well-known such technologies are, for example, machine learning or neuronal networks. They are instruments that are later used for further inventions or, in other words, a method of invention as described above. In that way, these technologies are the necessary technological input for inventions that produce the inventive output – be it of technical nature or a creative work – of the next three categories.

- Second, there are *AI-assisted inventions [or creations]*, i.e., "inventions [or creations] made using AI as a tool in the inventive [or creative] process". The final output of these inventions does not show that an AI tool was used to generate it; it could also have been achieved – usually with much greater effort – without such a tool. A classic example is the tool called AlphaFold which up to now made the prediction of the protein structure for more than 200 million proteins possible. It is used, for example, to develop new drugs.[9] An example of an AI tool from the creative field is the recognition of different object types in the autofocus system of modern cameras.

- Third, there are *AI-based inventions [or creations]*, i.e., "inventions [or creations] in which AI is part of the inventive [or creative] concept". In these inventions, AI is part of the output. This can be, for example, one of the AI-based tools mentioned above (for example, the AI based translator deepl.com) or a self-driving car whose sense of direction is based on AI. In the field of creative works, for example, artworks that react to the environment by means of AI algorithms, i.e. AI is part of the piece of art, fall into this category.

- Fourth, there are *AI-generated inventions [or creations]*, i.e., "inventions [or creations] made autonomously by AI, without human input". In this category fall inventions or creations that are the output of AI systems that only need a minor human input in order to invent or create something new. A prominent and highly debated example is the DABUS system created by Stephen Thaler producing technical inventions.[10] Another example is generative art e.g., a novel written by ChatGPT.

Much controversy still surrounds the question of AI autonomy in the fourth category of AI-generated inventions or creations.[11] Is a future of innovation and creativity without any human input really conceivable? Hilty et al. (2020), for example, are convinced that "in light of the fast-moving nature of the field this required involvement [i.e. considerable human impact] can be expected to constantly diminish". On the other side, Kim et al. (2022) describe the situation with a quote from Seneca: "Like a sword that never kills by itself but is a tool in the killer's hand, computational modelling and computers executing models do not invent by

[9] See Arnold 2023 or Chun 2023.

[10] See the homepage of the experiment: https://artificialinventor.com/. See Picht, et al. (2024) for an overview and Mitra-Kahn (2022) for an economic perspective.

[11] See e.g. Picht and Thouvenin (2023) and [insert reference to forthcoming AI inventor paper by Ulrike and colleagues].

themselves but are powerful problem-solving tools".[12] This controversy is at the heart of the legal discourse on how the IP system will cope with AI. IP laws have historically established a close link between an invention and its inventor(s) and an original work and its creator(s). This is partly because the contributions of humans have provided a legal basis to legally define the subject matter protected by IP rights and partly because IP laws have sought to establish a right for compensation of individuals contributing to inventive and creative activity, thus requiring their association to IP rights.

As we will see in the following chapters, from an economic point of view, the relevant question is less whether the invention is made by a human or a machine. It is rather how AI-generated innovations change the nature of the innovation process and how any such change affects the balance of resource and incentive needs in the innovation ecosystem.

2. AI, innovation incentives and patents

Received wisdom

To appreciate the impact of AI on the functioning of the patent system, it is helpful to recall the basic economic rationale for protecting patents. Nobel-prize winning economist Kenneth Arrow helped galvanize economic thinking on innovation incentives by arguing that the inventive process faces an intrinsic market failure (Arrow, 1962). An invention – in the form of a solution to a technical problem – possesses characteristics of a public good: many people can simultaneously use it and the original inventor may not easily prevent them from doing so. This characteristic is known as the *appropriability dilemma* of inventive activity. The patent system at its core seeks to resolve this dilemma. By affording exclusive rights to an invention, it enables innovators to reap a financial return on successfully commercialized innovations that goes to fund costly R&D undertakings. The patent system stands out in being a market-driven solution to the appropriability dilemma: decisions on which innovation opportunities to pursue are taken by individuals and companies at the technology frontier who are best informed about such opportunities.[13]

[12] Militsyna (2023) presents a five-part test to distinguish between sufficient and insufficient human participation for creative works to qualify for copyright protection.

[13] See WIPO (2011) for a more detailed analysis of how the incentives posed by the patent system compare to other policies that support innovation.

Over time, economists have nuanced this basic economic rationale with additional considerations. First, innovating firms have other means to overcome the appropriability dilemma. Survey evidence suggests that lead-time, trade secrets, as well as sales and service activities, including brand building, are often a more important mechanism for companies to generate a return to innovation than patents are (WIPO, 2011). The importance of different appropriation mechanisms differs markedly across industries, depending on the nature of technological advances and the length of R&D cycles. In a nutshell, lead-time tends to be the most important mechanisms in the electronics industry and patents the most important one in the life science industry.[14] In this regard, it is also important to note that patent protection is limited to technological inventions. Firms necessarily have to rely on other mechanisms to appropriate non-technological innovations, such as many forms of organizational or service innovations.[15]

A second important consideration is that innovative activity is typically cumulative and simultaneous in nature. One firm's innovation typically relies on insights gained from previous innovations and the commercialization of new products often relies on IP owned by many entities. The patent system has multifaceted impacts on cumulative and simultaneous innovation and the allocation of R&D investment. One important function of the patent system is to require the disclosure of patented inventions, which makes it easier for innovators to learn about existing technological knowledge and can avoid the duplication of research efforts across firms. At the same time, dense patent landscapes can also pose a challenge to innovators, especially when commercialization requires access to complementary patents, as there are high transaction costs of negotiating licenses and bargaining power among innovators is uneven (Scotchmer, 2004).

Impact of AI

How does the advent of AI change the innovation incentives posed by the patent system? As a thought experiment, suppose at the extreme that the contribution of AI entirely replaces the contribution of human inventors. Suppose also that AI-generated inventions without

[14] The cross industry differences have remained stable over time. See Levin et al. (1987) and Mezzanotti and Simcoe (2023).

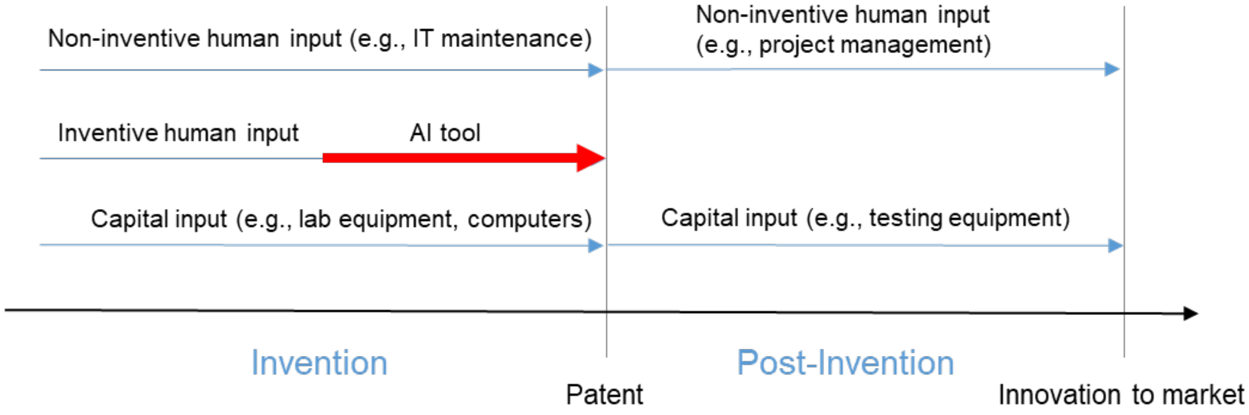
[15] The precise scope of patentability differs across jurisdictions; in some jurisdictions, for example, certain business methods can be eligible for patent protection. See Duffy (2010).

any human contribution would not qualify for patent law, as is currently the case in many countries.[16] Would innovation suffer?

The answer depends crucially on the nature of innovative activity in such a scenario. If innovation were just confined to the inventive process, with no upfront investments in R&D equipment and no post-invention product development, the answer would be 'no'. Invention would be a free public good in this case, which would not require any incentive.

In reality, however, successful innovation entails more than just human inventiveness, as illustrated in Figure 4. It relies on often costly non-inventive human as well as capital inputs. Transforming inventions into commercial products, in turn, requires extensive post-invention development. Innovation in the pharmaceutical industry, for example, requires substantial investments in clinical trials that take many years and often fail. In principle, AI may generate efficiencies beyond its core inventive contribution. For example, reduced reliance on lab testing could save certain capital expenditure. However, it would seem improbable for overall R&D costs to fall to levels that would not pose any appropriability dilemma, not least because AI systems themselves can be costly to operate. Indeed, one study on the adoption of deep learning tools in R&D activities finds the capital-intensity of R&D to increase.[17]

Figure 4: Human and capital inputs into innovation



[16] An alternative scenario would be for AI-generated inventions to be ineligible for patent protection, because they fail to meet the non-obvious requirement under patent law, in a world where AI is considered to be a person having ordinary skill in the art.

[17] See Besiroglu et al. (2023).

It is helpful to contrast the central legal and economic questions underpinning the AI-patenting nexus. As pointed out above, the primary legal question revolves around whether AI will reduce the human contribution to invention to such an extent that inventions would lose eligibility under existing laws. The primary economic question is whether AI will transform the R&D process into an activity that requires far fewer real resources, obviating the need for patent protection. Even if the answer to the first question is affirmative, it does not automatically follow that the same holds true for the second question.

How AI will affect the resource needs for innovation is ultimately an empirical question. Macro trends show to date no signs of companies reducing their R&D investments – to the contrary, R&D spending continues to be on an upward trajectory (WIPO, 2022). Furthermore, to the extent that AI increases the productivity and opportunities of R&D activities, it may well prompt greater R&D investments – provided that companies can appropriate such investments. Another uncertain factor is the regulatory scrutiny that AI research may face in the future, which could significantly raise the costs of R&D. Ultimately, the impact of AI on R&D spending may not be uniform across sectors. Shedding empirical light on the nature and magnitude of any impact is a fruitful area for future research.

In addition to this central economic question, there are other considerations that bear on the role of patents. AI may not only change the nature of R&D, it may also change business models which may affect how companies can appropriate their innovation investments. For example, AI may prompt companies to customize their products to individual customers in a way that makes it more difficult to copy technology. By contrast, AI could also facilitate the reverse-engineering of technology, which in turn would increase companies' reliance on patent protection and enforcement.[18] In the absence of patent protection, companies may seek other forms of intellectual property to appropriate their innovation investments. In the pharmaceutical and chemical industry, for example, test data protection serves to incentivize investments in trials of compounds that may not qualify for patent protection. Trade secrecy may be another IP-based appropriability mechanism that AI may favor or disfavor.

A related consideration concerns the disclosure function of the patent system, which as pointed out above can facilitate cumulative innovation. Legally, patent applicants need to describe their inventions in sufficient detail so that a person skilled in the art could carry

[18] See Bayern (2022) for a discussion of how AI is changing the potential for reverse-engineering.

them out. A first question is whether AI-based and AI-generated inventions can still meet the disclosure requirement, if they rely on so-called black-box algorithms and large-scale training data that far exceed the scale and scope of traditional patent disclosures (Ebrahim, 2020). A second question is whether reduced reliance on the patent system – either because AI-generated inventions are ineligible or because inventors prefer secrecy – may undermine learning and cumulative innovation processes.[19]

All these considerations have important economic implications. While the patent ineligibility of AI-generated inventions would act to reduce innovation incentives, much depends on the availability of alternative appropriability mechanisms, evolving business models and the nature of cumulative innovation processes. Shedding empirical light on these implications could be a valuable input for policymakers considering reforms to patent rules, or the development of any alternative remuneration system for AI-generated inventions.

3. AI, creativity and copyright

Received wisdom

Creativity is a unique phenomenon that differs in nature from invention. Creative works receive different treatment under IP laws, typically facing fewer originality requirements. Copyright protection, in particular, applies to any newly created work. It is meant to provide economic incentives to create and distribute original works in creative industries.[20] In general, like inventions, creative works are quasi-public goods: important aspects of them are hard to exclude and non-rival in consumption.[21] Hence, creators and industry intermediaries face similar market failures as inventors and innovating companies, in particular when copying is easy and happening at low cost. They may find it equally difficult to fully recover investment and appropriate returns from their initial creation and commercialization. This highlights the importance of protecting copyright and other IP rights, such as industrial design right, in promoting the production and distribution of original works. In addition, creative industries are often considered high-risk sectors in

[19] For evidence on how patent disclosure supports cumulative innovation, see Furman *et al.* (2021).

[20] See Giorcelli and Moser (2020) and Landes and Posner (1989).

[21] See Novos and Waldman (1984); Landes and Posner (1989); Towse et al. (2008).

which commercial success is difficult to predict, and creative effort and industry investment often lean towards producing content that audiences are already familiar with.[22]

Economic research shows that various players in the industry value chain appropriate returns to creative activity differently. This outcome is dependent on the bargaining power of each party involved in the value chain and depends on their contracting and revenue sharing practices.[23] Consumer demand that concentrates on the most popular creative works often results in a few superstars reaping disproportionately high rewards, as first pointed out by Rosen (1981). As technology has widened the reach of creative works, superstar effects have become even stronger. Nonetheless, upstream creative activity is often vibrant and diverse, with many ad-hoc projects, small and medium-sized enterprises, and individual creators active. Various reasons favor an oversupply of artistic labor, leading to heavy competition in these labor markets, unstable income or multiple job-holdings, and poor career prospects relative to careers outside creative sectors.[24]

Digitization and the emergence of content platforms have altered business models and the role of copyright in creative sectors. Big tech firms such as Amazon and Apple have entered the industry, with product/service bundling and exclusive data serving as a competitive advantage. They arguably operated in a favorable regulatory environment conducive to innovative service entry (reflecting, for example, 'safe-harbor' provisions laid out in the U.S. Digital Millennium Copyright Act). In some instances, incumbent stakeholders in the industry were initially slow to catch up and develop their own digital channels, partially because this required them to invest in new digital technology and license new uses of creative works from right holders.

As evidenced in the audiovisual sector, the first digital wave since the turn of the century made niche content more widely available and reduced frictions for content trade, with digital platforms now increasingly streaming locally produced content to global audiences.[25] In music and other sectors, digital sales are growing more concentrated, despite growth in the number of products in particular from independent labels and new artists.[26] Notably,

[22] See Caves (2000) and, in the case of film finance, Cuntz et al. (2023). Consumer tastes for similarity versus novelty sometimes moderate this factor (Buccafusco et al, 2017).

[23] See Towse (2006).

[24] See Benhamou (2011).

[25] See Benner and Waldfogel (2023) and Aguiar and Waldfogel (2018).

[26] See Aguiar and Waldfogel (2016); Waldfogel (2017).

digitization lowered the cost of experimentation on both sides of the market: on the demand side, digital changes lowered the cost for consumers to develop and learn about their preferences for creative and cultural goods; on the supply side, greater data availability in general has enabled creators to make new content more appealing to audiences. Moreover, online consumer tracking and large-scale experiments on distributing platforms have helped firms to better target and customize creative content to actual consumer demand.[27]

Akin to cumulative innovation processes, creative works can build upon each other over time. Copyright rules, such as the fair use doctrine in the U.S. or a closed list of copyright exemptions in the EU, define what is considered 'transformative' or other acceptable reuse of copyrighted works. These rules bear on borrowing and cumulative creativity in different creative sectors. While new reuses can cannibalize revenues from original work sales, there is evidence that advertising effects from reuse can moderate or outweigh this effect in the music industry, and, at least in theory, more reuse in general can be beneficial for right holders and increase overall welfare.[28] However, the presence of 'derivative' rights – e.g. rights granted to the original author of a book that will serve as a plot for a new movie and thus require licensing – and the lack of formalities such as registration and examination in copyright tends to increase transaction costs and encourages 'create around' or new fixation rather than licensing previous works.[29] It can also sometimes limit productive reuses and cumulative creativity as, for example, in digital sampling of music.[30] In other cases, licensing income from more productive reuse can, in principle, provide a business opportunity and additional income streams to original creators.

Some economic research has also focused on the nature of artistic creativity and creative practice as such. Previous research in the visual arts distinguishes conceptual innovators from experimental innovators.[31] The research suggests that artists differ in their practice and rely on reuse and experimentation to different degrees. It also shows that markets, at least in the visual arts, place higher value on innovation and truly new artworks. In a similar

[27] Peukert (2019). 'Algorithmic recommendation' systems fed with better consumer data and operated by many platform services, have been shown to lead to an increase in the overall concentration of content consumption, as systems drive consumers to consume what others are consuming (for example, Hosanagar et al., 2014). Other research, however, suggests that this effect also depends on the content strategy individual platforms pursue and how closely this strategy is tied to personalized recommendation (Datta et al., 2018).

[28] See Watson (2017b) and Arai and Kinukawa (2014).

[29] See Buccafusco et al. (2017).

[30] Watson (2017a).

[31] See Galenson (2007).

vein, digitization in general has been said to increase social welfare and encourage product discovery by expanding market reach and overall consumption. This is because greater supply and lower-cost experimentation in the production of new works help discover and reveal yet untapped music quality and consumer benefits, when work appeal is unpredictable before commercial release.[32]

Impact of AI

Questions similar to those around invention and patenting arise in the context of creativity and copyright. How does the advent of AI change the incentives to create posed by the copyright system? As a parallel thought experiment, suppose again at the extreme that the contribution of AI entirely replaces the contribution of human creators. Suppose also that AI-generated content without any human contribution would not be eligible for copyright protection, as is currently the case in most jurisdictions. Would creativity and the supply of new content suffer?

Historic examples show that American book publishers in the 19th century were able to maintain markets and successfully commercialize books even in the absence of copyright.[33] Even today, there are sectors where appropriation of returns relies more heavily on other economic mechanisms than copyright protection. For example, in fashion industries, even in the presence of branding and trademark protection, scholars have argued that lead-time strategy is key to preserve firms' competitive advantage and secure returns to creative investment, as new creations might not be eligible for protection under copyright laws.[34] So, in short, markets might continue to supply new AI-generated works even in the absence of copyright protection and/or if alternative appropriation mechanisms are available.[35]

Still, the impact of AI depends on the nature of creative activity in such a scenario and on the generic incentives to create that operate on the level of the individual creator. If creativity were just confined to the creative process, with no large upfront investments in

[32] See Waldfogel and Aguiar (2017).

[33] See Khan (2005) and Safner (2023).

[34] See Raustiala and Sprigman (2006) and The role of IP rights in the fashion business: a US perspective, WIPO Magazine, August 2018.

[35] In the visual arts sector, 'authenticity' more than copyright protection enables artists and intermediaries to commercialize artworks and appropriate returns from creativity. Put simple, the art market would only value the artwork created by Van Gogh himself, and it places no or little value on the exact, potentially infringing copy of the Van Gogh's work created by another artist.

content production and distribution costs, such as advertising, the answer would be again that creativity and the supply of new content should not suffer from AI adoption. However, even if digital technologies have reduced these upfront costs, they continue to be substantial for a range of creative outputs, such as the production of blockbuster films. The hypothetical lack of copyright protection for AI-generated works may thus primarily affect the direction of creative activity. Or to put it differently, if AI-generated works do not benefit from copyright protection, creators and producers of large-scale capital-intensive works may shun the adoption of AI technology.

On the one hand, this would affect the demand for creative employment: the production of creative content would continue to draw on human creators – writers, actors, photographers, musicians – rather than rely on AI substitutes. Invariably, as AI technology advances, it would increasingly pose an 'outside option' for the commissioning of new works by industry intermediaries, potentially weakening bargaining positions of human creators.[36] Unsurprisingly, questions of AI adoption have already gained prominence in labor relations in different creative industries.[37] Still, it should be noted that the overall income of creators typically comes from a variety of sources, and technological changes will not uniformly impact these sources. For example, new technology may not affect or even increase income streams from live performances as compared to music streaming sales.

On the other hand, the shunning of AI technology due to resulting works being ineligible for copyright protection could forestall new opportunities for creative expression. There are notable productivity gains to be expected from AI adoption and substantial cost declines in creation. This could stimulate experimentation and higher content supply in markets, even if it remains open to what degree AI output will be truly original and not merely a 're-hashing' of human works.

As AI 'automates' the re-use of creative works, it represents a new 'method' of creativity, lowering or even eliminating the search and experimentation costs of individual creators.[38]

[36] Something similar had happened, but under reversed signs, with the rise of large streaming platforms as alternative outlets for new music content (Waldfogel, 2012), cutting out some incumbent intermediaries and distributors in the market and improving success predictability, investment allocation and bargaining positions of some creators. Similarly, the option of self-publishing in the book industry has affected author advances in the book publishing industry (Peuckert and Reimers, 2021).

[37] See *Will a Chatbot Write the Next 'Succession'?*, New York Times May 2, 2023.

[38] See Cockburn et al. (2019), as pointed out above.

In this context, 'control' over the many future 'productive' reuses and, naturally, the sharing of 'future receivables' around AI-generated works becomes more relevant, based on the many inputs from existing works that feed into these new services (see also the discussion on training data further below). Historically, copyright rules have sought to balance incentives for generating original work and encouraging productive reuses so as to accommodate the interests of both old and new generations of creators.[39] AI is posing a new challenge in striking this balance. The most recent deal-making of Hollywood studios, production companies, actors and writers in the U.S. is a first example how new creative work uses and industry revenue sharing need to be renegotiated in light of new technology.[40]

From this 'dynamic' perspective, broad copyright protection can increase the rewards to current creators, but it can also increase the costs for future creators. The right balance depends on how different follow-on creations have to be from original works to be considered non-infringing reuse.[41] At the same time, the incentives for creators of original works are likely to be reduced, if they cannot participate in downstream revenues coming from AI-generated reuse of their work in the absence of protection. Whether or not these changes are substantial and make creators abstain from original work creation will depend on a number of economic factors, most prominently, how much markets for reusing and original works overlap and works can be considered substitutes or complements. In addition, much will depend on evolving business models for AI-generated works. For example, even if AI-generated works do not benefit from copyright protection, their creators may find other ways to appropriate returns – for example, through advertising models or live performances.

AI may also affect alternative, non-monetary incentives for the creation of new works. In particular, the attribution of a work and recognition by peer creators within communities can motivate further creativity and help reputation building in artistic careers. Such motivations have been shown to be important 'intrinsic' and 'extrinsic' drivers of creativity and labor supply decisions, beyond the purely economic incentives provided by laws and royalty income.[42] AI use could distort such incentives to create and the underlying social

[39] See, for example, Cuntz (2023).

[40] See *Studios Reveal New Proposal to Striking Writers on Data Transparency, AI and Residuals,* The Hollywood Reporter, August 22, 2023

[41] See Landes and Posner (1989) and Handke (2016).

[42] See Bille et al. (2013); Miller and Cuntz (2018).

mechanisms encouraging further creation. One possible remedy could be effective transparency regulations around AI that would disclose training data sources and make it possible to again give 'credit' and attribute original creators of input works. Intrinsic motivations may play a special role in creative practices, as easy-to-use generative AI tools such as ChatGPT, Midjourney and DALL-E 'democratize' AI use, thereby expanding creative labor markets and making them more 'inclusive'. This would promote participation by disadvantaged groups in the creative process, increasing the variety of new content available to consumers and overall welfare. At the same time, 'democratized' AI tools can challenge and, with more amateur creators entering labor markets, threaten existing income position of professional creators, leaving behind those slow to adopt new practices or with poor access to training and education. How the adoption of AI technology will ultimately play out on labor markets for creators and in the wider economy is hard to predict at this point in time.[43] Still, this is an important area for future research.

Finally, AI may have broader effects on the creative process. It may help further improve the ex-ante predictability of the success of creative works, which could allow industry stakeholders to better target investments and lower their risk exposure. For example, in the book industry, digitization already enabled more accurate information collection for predicting product appeal and the size of license payments now more accurately reflects a book's ex-post success (Peuckert and Reimers, 2021). More generally, AI tools have the potential to substantially improve the management of rights linked to protected content and thereby enhance better remuneration for creators and development of new content services (Strowel, 2022).

4. Incentives for the development of AI models and AI training data

<u>AI models</u>

From an economic perspective, developing ever more capable and powerful AI models is special in two respects. First, the GPT and IMI nature of AI suggests that the social returns to

[43] In theory, any productivity gains from the adoption of AI-enabled practices can eventually lead to lower wages and replacement of some jobs in certain sectors of the industry (Acemoglu and Restrepo, 2018). At the same time, new practices can help 'augment' and likely increase demand for labor in non-automated tasks and create new jobs, as observed in other economic research on automation and robotics (Autor, 2015). How the two countervailing effects of new AI technology adoption will ultimately play out in creative labor markets, is, however, hard to predict at this point in time. Hence, this is an important area for future economic research Brynjolfsson et al. (2023); Yilmaz et al. (2023).

new AI tools are bound to be high, as they can advance progress in a wide spectrum of fields. Second, AI models are an upstream research tool in a cumulative innovation process. One important insight from economic research on multi-stage innovation processes is that innovation incentives across innovation stages need to appropriately balanced (Scotchmer, 1991). Insufficient incentives for AI model research slow the development of tools that empower subsequent innovation; yet, powerful control over AI models may result in "hold-up" for later-stage innovators and reduce the ultimate impact of these tools.

It is difficult to assess whether such balanced innovation incentives currently exist. Key building blocks for AI models are in the public domain, in the form of scientific articles and open-source computer codes. Recent economic research has pointed to the important role of innovation commons structures around nascent technology development as a means to flourishing entrepreneurship and more efficient discovery processes for innovative and yet-unknown applications and uses of technology.[44] This might also apply to AI models at current development stages, and given its potential general purpose technology nature and expected economic impact across industries, wider access, at least temporarily, could help the discovery of future and commercially-viable applications.

Still, the adoption of more 'customized' and firm-specific uses of AI by smaller entities is likely to happen at a slower pace than the adoption by big tech firms and digital-born companies, as AI use still require heavy investment in computing power and, as further explained below, training data.[45] This might lead to further reliance on AI tools developed by larger stakeholders, in turn, potentially leading to higher industry concentration and, ultimately, less favorable bargaining positions of smaller entities and individual creators in the future.[46] That said, much depends on the business models that leading AI developers will adopt. In the field of generative AI, there is already divergence with some of the large developers favoring open-source approaches and others more closed approaches.[47] How AI models can be protected by different forms of IP is also bound to shape the development of new AI tools. In practice, mathematical methods generally cannot be protected by any form of IP; the software underlying AI models benefits from copyright protection (and, in some cases

[44] See Potts (2019); Cuntz and Peuckert (2023).

[45] That said, there is also evidence that smaller organizations might be more flexible in adapting new technologies Terziovski (2010).

[46] Arguably, competition concerns may also arise from AI's deeper 'vertical integration' with the production end of the value chains Peukert (2019).

[47] See *Meta to release commercial AI model in effort to catch rivals*, Financial Times, July 13, 2023.

also patent protection); and AI-based inventions may be eligible for patent protection. In practice, the distinction between a mathematical method, a piece of software and an invention can be ambiguous, and may ultimately be decided by courts.[48]

More generally, AI also raises substantial liability questions and highlights the need to set up and balance economic incentives around the development and use of new technology.[49] For example, unclear or ill-defined copyright infringement liability in AI development and reuse of works can increase legal uncertainty and litigation risk for AI developers, operating services and users. Still, important to note that, in principle, while liability risk may chill innovation due to higher costs, it may also incentivize the development of risk-mitigating technologies and safe product designs that reduce the likelihood of rights infringement and other types of risk associated with the use of AI.[50] Well-defined liability rules around right enforcement and/or product safety should encourage and help investment in 'preventive' measures and 'complementary' technology, without damaging incentives for further AI innovation and industry entry. New 'automated' licensing and filtering technology around AI use might be needed to enforce rights around existing content as input to AI, similar to what happened in the first wave of internet technologies.[51] Liability rules around AI will play an important part to encourage investment and sharing costs around AI and complementary technologies, and they can help keep markets for AI development and AI operating services open and contestable.[52] Setting up new rules will be challenging for various reasons and clearly requires further economic research into investment incentives and liability risk exposure. This is also because many AI systems operate (semi-)autonomously and in unpredictable ways, which makes monitoring costly to operators, and sometimes impossible.[53]

[48] For a recent review, see Khan (2024).

[49] See Buiten et al. (2023).

[50] See Galasso and Lou (2022).

[51] See Burchardi and Harle (2018) and Catalini and Gans (2017). In the past, automated licensing and filtering technologies have been costly to develop, and the implementation and adoption across new digital services was often slow to evolve, notwithstanding the likely efficiency gains they provided by automating contractual processes in the industry Peukert (2019). Therefore, general access, interoperability, and diffusion of these new supportive and 'complementary' technology needed for AI will be equally important, potentially challenging some of the incumbent stakeholders and business models currently operating in the copyright system infrastructure space such as collective management organizations (CMOs).

[52] See Bailey and Baumol (1983).

[53] See Buiten et al. (2023).

Finally, as an alternative to policy reforms, industry self-regulation and private contracts between innovative AI operators and right owners – for example, bargaining between collective management organizations and AI operating services – could provide another important mechanism to accommodate technological changes in the market. However, in the past, private contracts and negotiations in the industry often took time to develop and settle.[54]

Training data

In order to produce "new" output, AI models need a lot of input – training data. The digitization of everyday life has greatly widened the scope of data available for AI researchers and thus the scope of AI applications. Still, data is not a free good available to anyone. In some cases, data collection is a natural by-product of selling a good or providing a service and, indeed, many AI applications have relied on the footprint digital transactions leave behind. In other cases, data collection requires dedicated resources – for example, a compilation of consumer credit scores. In those latter cases, the appropriability dilemma described above applies: data has public good characteristics and data providers need a mechanism to recover the costs of data generation. IP rights – in the form of trade secrets or sui generis database rights – provide such a mechanism. However, to the extent that IP rights restrict access to data, they affect their downstream use as training data. Economic research has shown that problems of hold-up, transaction costs, and royalty stacking could undermine otherwise beneficial data licensing arrangements.[55] The fact that many modern AI tools draw on a multitude of data sources is bound to exacerbate such problems.

One important legal question in this context is whether the use of IP-protected data as training data falls outside the scope of the exclusive rights provided by IP rights. Such use may, for example, be justified under fair use rules or express exemptions provided in copyright laws. This question is at the heart of several recent lawsuits brought by copyright holders against providers of AI tools.[56] What is in society's best interest is *a priori* not obvious. On the one hand, one can argue that maintaining IP exclusivity on valuable training data would slow promising AI research. On the other hand, it could also create new

[54] For the case of music, see Schwemer (2014).

[55] See Farrell et al. (2007); Spulber (2017) and Duch-Brown et al. (2017).

[56] See, for example, *Getty Images sues AI art generator Stable Diffusion in the US for copyright infringement*, The Verge, February 6, 2023 and *Sarah Silverman is suing OpenAI and Meta for copyright infringement*, The Verge, July 9, 2023 .

incentives to generate and curate data that could stimulate socially beneficial AI research. The need for such incentives may evolve. For example, greater regulatory scrutiny of AI tools may imply that companies have to invest more in the quality and reliability of training data. By contrast, AI developers may, in the future, rely more on self-generated 'synthetic' training data, which can be generated at low cost and do not carry any liability risk.[57] In any case, finding the right balance of incentives will be a crucial challenge for IP laws going forward – reiterating the earlier point about the distribution of incentives in multistage innovation processes. In addition, as training data becomes a critical input for technological innovation, copyright rules are bound to more prominently shape innovation outcomes, blurring the classical distinction between industrial property on the one hand and copyright on the other. For example, AI trained on voice sound samples protected by copyright may empower medical devices that seek to detect throat cancer by analysing a patient's voice.

What complicates matters further is that AI developers face other barriers towards employing data in their models. Data may be encrypted or behind technological firewalls. For companies, data collections are often key competitive assets that they are unwilling to share, even if they have broader social uses. When data is publicly accessible, it is often not clear who owns it, which by itself may discourage its use. In addition, aside from IP laws, other legal restrictions may govern access to data, such as contractual terms of use as well as data privacy and security rules. The latter entail legitimate regulatory objectives and raise difficult trade-offs with innovation policy. For example, privacy considerations favour restrictive access to medical records, whereas the compilation of large-scale medical datasets could empower AI-driven health innovations benefiting society at large. Technology – in the form of data anonymization and encryption – can help to bridge privacy and innovation objectives. Even then, the transaction costs – for example, in the form of opt-in privacy rules – may still forestall the generation of large-scale training data.

Conclusion

AI technology is reshaping the nature of innovative and creative activity. Some projected implications, such as autonomously inventing machines still seem utopian. Others such as AI-generated comedy are already the subject of concrete IP disputes. Invariably, AI is changing the balance of incentives as the current IP system provides them.

[57] See *Why computer-made data is being used to train AI models*, Financial Times, July 19, 2023.

Policymakers need to follow these developments closely. In considering any policy reform, they face the challenge of not over-reacting and soberly looking at emerging evidence on the impact of AI. As in the case of past technological changes, it takes time for stakeholders to adapt, new business models to emerge, courts to interpret law and industry practices to consolidate. In addition, premature policy reforms risk unwarranted consequences and may not account for the self-regulation of markets.

At the same time, policy uncertainty could also become a barrier to innovation. For example, companies may shun using AI in their innovation and creative activities, if they fear that such use may give grounds for invalidating future IP rights. For example, AI innovators may avoid projects and new service development which carry high risks of copyright infringement liability.

There is much for economists to contribute in this debate. This review identified several areas where a better empirical understanding of the evolving ecosystem for innovation and creativity could inform policy debate. One research task is to better understand the changing nature of innovation and creativity due to AI. This not only concerns the nature of R&D and creative processes, but more broadly how AI changes business models, competition in the marketplace and bargaining relationships in supply chains. A second area of research is to understand the implications of AI for inventive and creative labor in light of the traditional incentive mechanisms embedded in IP laws. As discussed, the prospect of AI adoption has already led to frictions in labor relations in a number of creative industries, though the effects of AI are bound to be multifaceted. Finally, it is important to study the ecosystem for the further development of and access to AI models, including training data, and its implications for the downstream use by innovators and creators.

In closing, it is important to emphasize that this article focused narrowly on the role of IP in relation to AI innovation. It also considered AI innovation – as innovation in general and the discovery of new, yet-unknown applications of AI technology – as being in societies' best interest. As many commentators – and AI researchers themselves have pointed out – AI innovation raises numerous societal concerns, including the spreading of wrong information and algorithmic biases that deserve careful attention by policymakers.

References

Acemoglu, D. and Restrepo, P. (2018). Artificial intelligence, automation, and work. In The economics of artificial intelligence: An agenda, pages 197–236. University of Chicago Press.

Aguiar, L. and Waldfogel, J. (2016). Even the losers get lucky sometimes: New products and the evolution of music quality since napster. Information Economics and Policy, 34:1–15.

Aguiar, L. and Waldfogel, J. (2018). Netflix: global hegemon or facilitator of frictionless digital trade? Journal of Cultural Economics, 42:419–445.

Alekseeva, L., J. Azar, M. Gine, S. Samila and B. Taska. (2020). The demand for AI skills in the labor market. CEPR Discussion Paper DP14320.

Arai, Y. and Kinukawa, S. (2014). Copyright infringement as user innovation. Journal of Cultural Economics, 38(2):131–144.

Arnold, Carrie (2023). Inside the nascent industry of AI-designed drugs. Nature Medicine. Vol. 29, June 2023, p. 1292-1295.

Arrow, K.J. (1962). Economic Welfare and the Allocation of Resources for Invention. In R.R. Nelson (Ed.), The Rate and Direction of Inventive Activity: Economic and Social Factors. Princeton, NJ: Princeton University Press, 609-626.

Autor, D. H. (2015). Why are there still so many jobs? the history and future of workplace automation. Journal of economic perspectives, 29(3):3–30.

Bayern, S. (2022): Reverse engineering (by) artificial intelligence. In: Abbott, Ryan (2022): Research Handbook on Intellectual Property and Artificial Intelligence. Cheltenham: Edvard Elgar.

Bailey, E. E. and Baumol, W. J. (1983). Deregulation and the theory of contestable markets. Yale J. on Reg., 1:111.

Benhamou, F. (2011). Artists' labour markets. In A Handbook of Cultural Economics, Second Edition. Edward Elgar Publishing.

Benner, M. J. and Waldfogel, J. (2023). Changing the channel: Digitization and the rise of “middle tail” strategies. Strategic Management Journal, 44(1):264–287.

Besiroglu, T., N. Emery-Xu and N. Thompson. (2023). Economic Impacts of AI-augmented R&D. Papers 2212.08198, arXiv.org.

Bille, T., Fjællegaard, C. B., Frey, B. S., and Steiner, L. (2013). Happiness in the arts—international evidence on artists’ job satisfaction. Economics Letters, 121(1):15–18.

Bridle, J. (2018). New dark age: Technology and the end of the future. Verso Books.

Brynjolfsson, E., Li, D., and Raymond, L. R. (2023). Generative ai at work. Technical report, National Bureau of Economic Research.

Buccafusco, C., Bechtold, S., and Sprigman, C. J. (2017). The nature of sequential innovation. Wm. & Mary L. Rev., 59:1.

Buiten, M., De Streel, A., and Peitz, M. (2023). The law and economics of ai liability. Computer Law & Security Review, 48:105794.

Burchardi, K. and Harle, N. (2018). The blockchain will disrupt the music business and beyond. WORLD (Oakland, Calif.).

Catalini, C. and Gans, J. S. (2017). Some simple economics of the blockchain (september 21, 2017). Rotman School of Management Working Paper, (2874598):5191–16.
Caves, R. E. (2000). Creative industries: Contracts between art and commerce. Number 20. Harvard University Press.

Chun, Matthew (2023). How artificial intelligence is revolutionizing drug discovery. Bill of Health, Harvard Law School, https://blog.petrieflom.law.harvard.edu/2023/03/20/how-artificial-intelligence-is-revolutionizing-drug-discovery/

Cockburn, I. M., Henderson, R., and Stern, S. (2019). The impact of artificial intelligence on innovation: An exploratory analysis. In The economics of artificial intelligence: An agenda, pages 115–146. University of Chicago Press.

Crafts, Nicholas (2021), “Artificial intelligence as a general-purpose technology: an historical perspec-tive.” Oxford Review of Economic Policy, 37 (3), 521–536.

Cuntz, A. (2023). Grand rights and opera reuse today. *Oxford Economic Papers*, *75*(1), 206-232.

Cuntz, A., Muscarnera, A., Oguguo, P. C., and Sahli, M. (2023). IP assets and film finance - a primer on standard practices in the U.S., volume XX. WIPO.

Cuntz, A. and Peuckert, J. (2023). From hackers to start-ups: Innovation commons and local entrepreneurial activity. Research Policy, 52(2):104675.

Datta, H., Knox, G., and Bronnenberg, B. J. (2018). Changing their tune: How consumers' adoption of online streaming affects music consumption and discovery. Marketing Science, 37(1):5–21.

Duch-Brown, N., Martens, B., & Mueller-Langer, F. (2017). The economics of ownership, access and trade in digital data. *JRC Digital Economy Working Paper 2017-01*.

Duffy, John F. (2010). Why Business Method Patents? *Stanford Law Review*, 63(6): 1247-1288.

Ebrahim, Tabrez Y. (2020). Artificial Intelligence Inventions & Patent Disclosure. 125 Penn St. L. Rev. 147.

Furman, J.L., M. Nagler and M. Watzinger. (2021). Disclosure and Subsequent Innovation: Evidence from the Patent Depository Library Program. *American Economic Journal: Economic Policy*, 13(4): 239-270.

Farrell, J., Hayes, J., Shapiro, C., Sullivan, T., Ganglmair, B., Froeb, L., Werden, G., Lemley, M., Shapiro, C., and Elhauge, E. (2007). Do patent holdup and royalty stacking lead to systematically excessive royalties? supra, 74(47):603.

Galenson, D. W. (2007). And now for something completely different; the versatility of conceptual innovators. Historical Methods: A Journal of Quantitative and Interdisciplinary History, 40(1):17–27.

Gans, Joshua S., 2015. "Remix rights and negotiations over the use of copy-protected works," International Journal of Industrial Organization, Elsevier, vol. 41(C), pages 76-83.

Giorcelli, M. and Moser, P. (2020). Copyrights and creativity: Evidence from italian opera in the napoleonic age. Journal of Political Economy, 128(11):4163–4210.
Haefner, N.; Wincent, J.; Parida, V.; Gassmann, O. Artificial Intelligence and Innovation Management: A Review, Framework, and Research Agenda. Technol. Forecast. Soc. Change 2021, 162, 120392.

Griliches, Zvi (1957). Hybrid corn: An exploration in the economics of technological change. Econometrica 25(4): 501-522.

Handke, C. (2016). Intellectual property in creative industries: The economic perspective. SSRN Electronic Journal.

Hilty, R.; Hoffmann, J.; Scheuerer, S. (2020) Intellectual Property Justification for Artificial Intelligence. Max Planck Institute for Innovation and Competition Research Paper No. 20-02.

Hosanagar, K., Fleder, D., Lee, D., and Buja, A. (2014). Will the global village fracture into tribes? recommender systems and their effects on consumer fragmentation. Management Science, 60(4):805–823.

Jovanovic, Boyan; Rousseau, Peter L. (2005), General Purpose Technologies. Handbook of Economic Growth, Volume 1, Part B, 1181-1224.

Khan, B. Z. (2005). *The Democratization of Invention: patents and copyrights in American economic development, 1790-1920*. Cambridge University Press.

Khan, F.A. (2024). Intellectual Property Rights for Software, Artificial Intelligence and Computer Related Inventions: A Comparative Analysis. *Journal of Intellectual Property Rights*, 29(1).

Kim, D. (2020). "'AI-Generated Inventions': Time to get the record straight?" GRUR International, 69(5), 443-456.

Kizhner, I., Terras, M., Rumyantsev, M., Khokhlova, V., Demeshkova, E., Rudov, I., and Afanasieva, J. (2021). Digital cultural colonialism: measuring bias in aggregated digitized content held in google arts and culture. Digital Scholarship in the Humanities, 36(3):607–640.

Lambrecht, A. and Tucker, C. (2019). Algorithmic bias? an empirical study of apparent gender-based discrimination in the display of stem career ads. Management Science, 65(7):2966–2981.

Landes, W. M. and Posner, R. A. (1989). An economic analysis of copyright law. The Journal of Legal Studies, 18(2):325–363.

Levin, R., A. Klevorick, R. Nelson, S. Winter, R. Gilbert and Z. Griliches. 1987. Appropriating the Returns from Industrial Research and Development. *Brookings Papers on Economic Activity*, 1987(3): 783-831.

Mezzanotti, F. and T. Simcoe. 2023. Innovation and Appropriability: Revisiting the Role of Intellectual Property. NBER Working Paper No. 31428.

Miller, A. and Cuntz, A. (2018). Unpacking predictors of income and income satisfaction for artists. Economic Research Working Paper Series, (50).

Militsina, K. (2023). Human Creative Contribution to AI-Based Output – One Just Can('t) Get Enough. GRUR International, forthcoming.

Mitra-Kahn, Benjamin (2022): Economic Reasons to recognise AI inventors. In: Abbott, Ryan (2022): Research Handbook on Intellectual Property and Artificial Intelligence. Cheltenham: Edward Elgar, 376-390.

Mokyr Joel (2018), 'The Past and Future of Innovation: Some Lessons from Economic History', Explorations in Economic History, 69, 13-26.

Newman, D. T., Fast, N. J., and Harmon, D. J. (2020). When eliminating bias isn't fair: Algorithmic reductionism and procedural justice in human resource decisions. Organizational Behavior and Human Decision Processes, 160:149–167.

Novos, I. E. and Waldman, M. (1984). The effects of increased copyright protection: An analytic approach. Journal of political economy, 92(2):236–246.

Peukert, C. (2019). The next wave of digital technological change and the cultural industries. Journal of Cultural Economics, 43(2):189–210.

Peukert, C. and Reimers, I. (2021). Digitization, Prediction and Market Efficiency: Evidence from Book Publishing Deals. Management Science, Available at SSRN: https://ssrn.com/abstract=3110105 or http://dx.doi.org/10.2139/ssrn.3110105

Picht, Peter; Brunner Valerie, Schmid, Rena (2024). Artificial intelligence and intellectual property law: from Diagnosis to action. JIPLP (forthcoming)

Picht, Peter and Thouvenin, Florent (2023) AI&IP: Theory to Policy and Back Again Policy and Research Recommendations at the Intersection of Artificial Intelligence and Intellectual Property. International Review of Intellectual Property and Competition Law (IIC), https://doi.org/10.1007/s40319-023-01344-5.

Potts, J. (2019). Innovation commons: The origin of economic growth. Oxford University Press.

Prem, Erich (2019). Artificial Intelligence for Innovation in Austria. Technology Innovation Management Review

Raustiala, K., & Sprigman, C. (2006). The piracy and paradox: Innovation and intellectual property in fashion design. *Va. L. Rev.*, *92*, 1687.

Rosen, S. (1981). The economics of superstars. The American economic review, 71(5):845–858.

Safner, R. (2023). Honor Among Thieves: How 19th Century American Pirate Publishers Simulated Copyright Protection. *Economics of Governance*, 24(1), 119-141.

Schwemer, S. F. (2014). The licensing of online music streaming services in europe. In Handbook on the Economics of Copyright, chapter 9, pages 141–164. Edward Elgar Publishing.

Scotchmer, S. (1991). Standing on the Shoulders of Giants: Cumulative Research and the Patent Law". Journal of Economic Perspectives, 5(1), 29-41.

Scotchmer, S. (2004). Innovation and Incentives. Cambridge: MIT Press.

Spulber, D. F. (2017). Complementary monopolies and bargaining. The Journal of Law and Economics, 60(1):29–74.

Strowel, A. (2022). Study on copyright and new technologies: copyright data management and artificial intelligence. Technical report.

Terziovski, M. (2010). Innovation practice and its performance implications in small and medium enterprises (smes) in the manufacturing sector: a resource-based view. Strategic Management Journal, 31(8):892–902.

Topaz, C. M., Klingenberg, B., Turek, D., Heggeseth, B., Harris, P. E., Blackwood, J. C., Chavoya, C. O., Nelson, S., and Murphy, K. M. (2019). Diversity of artists in major us museums. PloS one, 14(3):e0212852.

Towse, R. (2006). Copyright and artists: a view from cultural economics. Journal of economic surveys, 20(4):567–585.

Towse, R., Handke, C., and Stepan, P. (2008). The economics of copyright law: a stocktake of the literature. Review of economic research on copyright issues, 5(1):1–22.

United States Copyright Office (2023): Copyright Registration Guidance: Works Containing Material Generated by Artificial Intelligence.

Varian, H. Artificial intelligence, economics, and industrial organization (No. 24839) NBER Working Paper, NBER Working Paper Series, Cambridge, MA (2018)

Waldfogel, J. (2012). And the Bands Played on: Digital Disintermediation and the Quality of New Recorded Music. *eBusiness & eCommerce eJournal*.

Waldfogel, J. (2017). How digitization has created a golden age of music, movies, books, and television. The Journal of Economic Perspectives, 31(3):195–214.

Waldfogel, J. and Aguiar, L. (2017). Quality predictability and the welfare benefits from new products: Evidence from the digitization of recorded music. Journal of Political Economy, 126.

Watson, J. (2017a). Copyright and the production of hip-hop music.

Watson, J. (2017b). What is the value of re-use? complementarities in popular music. Working Papers 17-15, NET Institute.

Watt, R. (2014). The basic economic theory of copyright. In *Handbook on the Economics of Copyright* (pp. 9-25). Edward Elgar Publishing.

Whitehead, Alfred North (1925). Science and the Modern World. Lowell Lectures. New York: The Macmillan Company.

WIPO. (2011). World Intellectual Property Report: The Changing Face of Innovation. (WIPO, Geneva).

WIPO. (2022). Global Innovation Index 2022. (WIPO, Geneva).

WIPO (2023). AI Inventions Factsheet. (WIPO, Geneva).
https://www.wipo.int/export/sites/www/about-ip/en/frontier_technologies/pdf/WIPO_AI_Inventions_factsheet.pdf

Yilmaz, E. D., Naumovska, I., and Aggarwal, V. A. (2023). Ai-driven labor substitution: Evidence from google translate and chatgpt. Available at SSRN.

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