AI and the creative industries

June 2025

Growth Lab
Research at LSE

AI and the creative industries

Richard Davies, Rahat Siddique, Finn McEvoy, Hannah Cantekin, and Josh Hellings

London School of Economics, Growth Lab.

I Summary and recommendations

1. The 2020s is the decade of AI. We are living through a paradigm shift in the use of information technology in the workplace, the public sphere, and in our daily lives. Neural networks, tools first posited 70 years ago, have matured rapidly with the recent emergence of user-friendly large language models. Adoption of these tools, starting with ChatGPT, has been rapid—faster than in previous technological revolutions. China and India, together one-third of the world's population, are among the fastest adopters. Artificial intelligence is here, and it is global.

2. With this new technology come new perspectives. There is hope: AI is a new tool, promising productivity improvements. There are concerns: as with all new tools, stretching back to the threshing machine, some worry about the impact on jobs and wages. And there are questions: over competitiveness—how economies can ensure they get the best of AI—and over regulation, and over openness.

3. This report has been written by the LSE Growth Lab, supported by funding from Netflix. We survey the global evidence, including the history of previous disruptive technologies, before focusing on the creative industries. The report aims to help clarify the state of play, deepen understanding of the potential impact of generative AI, outline key benefits and risks, and offer a sensible route forward.

The economy of the 2020s: opportunities and challenges

4. The AI decade is being defined by other forces too. Three trends—stagnant productivity, lagging competitiveness, and fragmentation—loom large. Each is a risk, and each threatens economic performance over coming years. These trends form a global backdrop that is vital in assessing the impact of AI on the creative industries.

5. Productivity is the foundational problem. Entering the 2020s, the global economy was sorely in need of a technological boost. Across the world, productivity had stagnated. This matters because increased efficiency is needed to underpin sustainable growth: when inputs lead to more outputs firms can pay higher wages, invest more and return more to their shareholders. Without this growth, many economies are stuck in a low-pay, low-investment rut.

6. Given this stagnation, the emergence of a new general-purpose technology is welcome. Historically, the arrival of these types of technology have been followed by periods of higher growth, employment and raised living standards. Sometimes the effect is immediate, as with the introduction of shipping containers, a transformative technology that cut transport costs and triggered an acceleration in

global trade. In other cases, it takes more time: the potential of electricity, for example, required industrial reorganisation before it could be fully realised. A key question for the economy in general and the creative industries in particular is the speed of adoption and diffusion of AI.

7. Competitiveness is the second challenge. Europe is a particular concern, with the recent Draghi Report outlining several weaknesses and proposing a new EU industrial strategy. That strategy has three overarching aims—innovation, decarbonisation, and security. Within the first, objectives include accelerating technological innovation, improving the speed with which research is commercialised, easier access to finance, and closing skills gaps. The report also proposes concrete "building blocks": larger markets, clear strategies, financial and governance reform. As our paper shows, these competitiveness problems seen in many other countries including Canada and Japan.

8. These building blocks relate closely to AI. Finance is one example. The cost of training flagship AI models has more than doubled each year. In 2024, global data centre investment more than doubled to a record $57bn, driven by AI-related demand. Large projects, such as America's Stargate initiative, are attracting funding from players with deep financial access. By comparison to the US our analysis suggests the EU faces a $500 billion investment shortfall. Without clear access to finance, smaller companies and start-ups may be excluded from this race.

9. Another clear drag is the regulatory burden. Compliance costs are high, and rising, in many economies. In the EU regulation is seen by 60% of firms as an investment barrier. More than half of SMEs cite regulation as their greatest operating challenge. Smaller firms often bear the brunt of regulatory change. Given that creative industries firms tend to be small—90% are micro-sized companies—the regulatory drag the Draghi report warns of may disproportionately affect the sector.

10. Fragmentation is the third element in this concerning backdrop. Recent developments show that the old system of global rules has frayed. It is being replaced by bilateral deals and smaller, often market-specific blocs. The IMF's latest forecast refers to this as a "new era" – one in which global trade will be lower.

11. Stepping back, it is clear that de-globalisation is not a novel risk. Concerns over the role of the WTO have been present for many years, stemming from the inability to conclude the Doha round of trade talks that started in 2001. More recently, G20 leaders in 2018 attempted a major coordination campaign to soothe problems in one vital industry, steel. These attempts largely failed. Global economic diplomacy is at a low ebb, with the target of bigger and more open markets at risk. AI tools are being developed in this fragmented context.

12. These three trends paint a concerning picture. It is one of low productivity firms, with regulation and scarce finance weighing on their ability to compete, and fragmentation meaning they have access to smaller markets. This report examines the ability of AI to help offset these challenges, and the risks to AI, as a technology, if they continue.

AI, the economy, and the creative industry

13. Economic research looking at the overall economy suggests the impact of AI is in line with previous technology shifts: in general, AI is expected to deliver economy-wide productivity gains. The most pessimistic studies forecast single-digit gains from AI adoption over the next decade. Many are far more optimistic, predicting double-digit gains in GDP and productivity large enough to offset the malaise of the past decade. Key variables that researchers agree will determine the gains are the suite of tasks AI tools will be able to complete (broadly, how powerful the models will be) and diffusion (how widely the tools will be used across the economy). The central estimate is that AI could contribute an additional 0.7pp each year to GDP growth.

14. The principal concern is over the immediate labour-market impact: the fear being that AI will compete with workers, leading to unemployment or lower pay. This is a familiar historic concern, famously present during the industrial revolution, but also with the rise of the telephone, the internet and ATM machines. But large-scale employment or wage pressures have never been associated with technology—rather they come with shocks in either commodity, financial markets, or periods of excessive inflation. Instead, technology tends to create new roles, allowing workers to migrate between sectors: fully 60% of jobs in 2018 were in occupations that did not exist in 1940. To date, this historical pattern is playing out again: for example, in Europe, research shows that sectors with higher AI exposure have seen higher employment growth.

15. Turning to the creative industries, it is clear that firms are adopting industry-specific AI tools. For example, graphic designers are using AI features integrated into industry standard software. Adobe reports that 83% of professionals now use generative AI in their work. In film, editors are using voice models to pre-visualise scenes, helping them inform set and costume design. More than 70% of marketers use generative AI every week—with creative teams at Coca-Cola and Toys R Us producing AI-generated advertisements. Across these creative sectors, the broad technical advancements have led to tailored, sector-specific tools.

16. Our review of economic evidence and structured case studies suggest that AI is generating significant output gains in the creative industries. It has led to

improved visual effects in films, enhanced post-production processes, and more complex video games. There is, as at the economy-wide level, some concern in sub-sectors about the risk of job losses. However, two positive trends can clearly be seen. First, business dynamism, with each sub-sector of the creative industries developing its own tailored tools often built by start-ups who are creating new roles as they expand. Second, augmentation, with tools working alongside the human workforce to drive up their productivity.

17. The case of visual effects (VFX) is an example. VFX are used to create photorealistic characters and backgrounds in video production. The global VFX industry is projected to grow significantly – from $10.8bn in 2023 to $25bn in 2030. Countries such as South Korea are reaping the benefits of early adoption; as an emerging VFX leader, its content exports have grown by $4bn in four years. Over time the film industry, including VFX, has come to rely on more productivity-enhancing technology. Wages have risen, as has employment.

18. Overall, the evidence shows that the creative industries are a vital contributor to economic growth. There is also evidence that AI can have a positive effect on growth, in general, and in the creative industries specifically. Creative industry firms have long been the frontier adopters of new technology, and this is also the case with AI. Since their role, broadly defined, is to come up with new content, it is perhaps natural that they have embraced generative AI tools so rapidly. However, the extent to which AI is adopted, diffused, and used to augment labour will determine the magnitude to which these benefits are realised across the sector. Several policy conclusions follow from the evidence.

- **Regulation**. Regulation is important in many sectors, including AI. But it can also come as a cost to growth—economies need competitiveness-enhancing guidelines and rules. One risk, seen in historic case studies, is a rush to regulate technology while it is being developed. On the upside, there are economy-wide plans to cut red tape in Europe. The target set by Mario Draghi—to remove 50% of reporting regulations for SMEs—shows a recognition that many rules end up being redundant, overlapping or costly for other reasons. Exercising caution when imposing new regulation, will offset these risks to competitiveness.

- **Skills.** Technology shifts emphasise the importance of skills. Over the long run growth has been strongest when technological breakthroughs and human capital advances have come together. In recent years, however, economy-wide competitive weaknesses and growth shortfalls link directly to skills gaps. Many of these problems are particularly acute within ICT: in Europe, job vacancies are high in this sector, while the supply of STEM

graduates is relatively low. In the US, development and engineering skills are in high demand. In Korea, significant labour shortages exist in the ICT sector. Governments will need to ensure that industrial strategies that prioritise innovation are supported by educational and skills programmes.

- **Industrial strategies.** Governments worldwide are recognising the strategic importance of AI. The most proactive are helping guide private industry with the publication of clear plans for the sector. For example, in January 2025, the UK government published an AI Opportunities Action Plan, setting out proposals to grow the domestic sector. The new US Administration is planning an AI Action Plan, requesting public and industry policy proposals in early 2025. The EU recently released its strategy to become an "AI Continent". China, Japan and Korea all have such plans too, published between 2018 and 2022. These plans help firms plan, but are regionally fragmented; there is no global, coordinated effort to support the growth and adoption of AI.

- **Financing.** The explicit costs of model development present a challenge to the growth of AI in the creative industries. Our case studies clearly show how creative industry AI tools are often sub-sector specific—suggesting that start-ups and industry or national specialist firms may be more likely to develop them than deeply-funded tech giants. A shortfall in finance will hinder such firms' competitiveness, as has been the case in Europe. Like other industries, the creative industries will thus gain from steps to ensure open capital markets; provision of both bank and capital market funding; and steps to support start-ups and scale-ups.

- **Global leadership.** The divergence of global trade rules is being clearly seen in the ICT industry. Subsidy approaches have divided the world into AI camps. Trade restrictions have created new trade fault lines— particularly regarding silicon and rare earth exports. These are economy-wide debates, often linked to national security concerns which may outweigh economic policy ideals. The economic evidence, historical and modern, suggests that larger markets generally lead to faster technological diffusion and higher productivity.

19. There is much at stake. The risks facing the global economy reinforce one another. Excessive regulation, for example, reduces competitiveness but also tamps down investment, dragging on productivity. Fragmentation can result in smaller markets for all industries—including creative industries—to trade in, another drag on productivity. Piecemeal regulations, or the usage of AI regulation as a strategic barrier to trade, will function as non-tariff barriers. The creative industries are

dynamic and international sectors, offering positive spillovers to many others. To seize the gains AI can bring, firms in this sector will need clear plans for the simplification of regulation and the support of skills, access to finance for firms of all sizes, and the widest possible set of markets to trade in.

II The Global Context

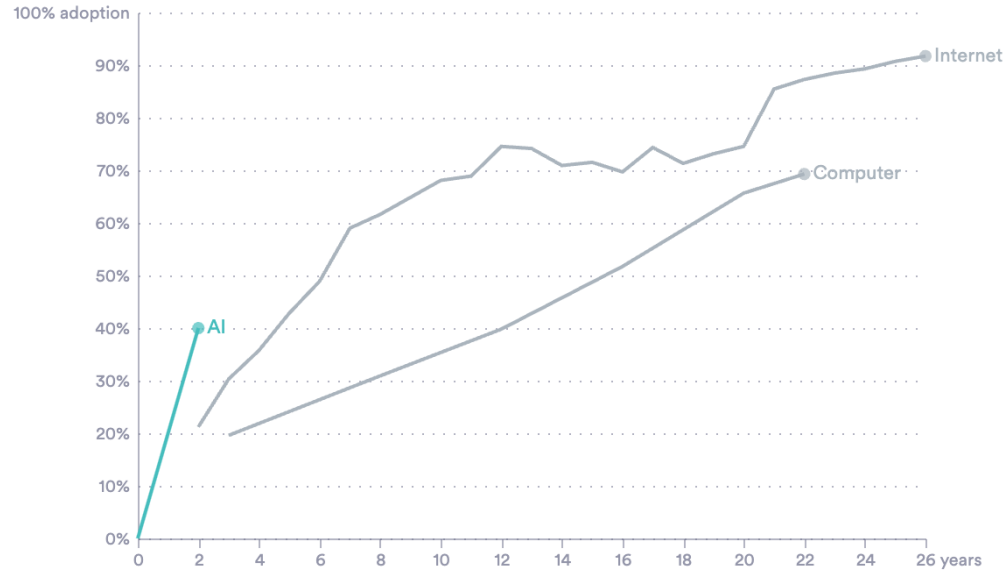
Adoption, excitement, and questions

20. Artificial intelligence is influencing economies across the world. Following the release of OpenAI's ChatGPT in November 2022, commercial, research and consumer interest in generative AI has exploded. AI tools have been adopted by individuals and firms across the economy. This includes the arts: new visual, text, and sound models have emerged with the potential to reshape the creative industries.

21. AI tools have become embedded faster than previous technologies. Almost 40% of Americans report using generative AI at work or in their personal life. Given the age of the technology, this is ten years ahead of the personal computer and faster than the internet (Figure 1). The intuitive nature and broad application of commercial AI tools has led to this unprecedented mass adoption. Whereas historical breakthrough technologies have taken decades to find widespread use, generative AI has spread far and wide in just a few years (Bick et al., 2024).

Figure 1: Adoption of AI

Proportion of US residents reporting use of technologies in either their work or personal life.



Source: Bick et al., (2024).

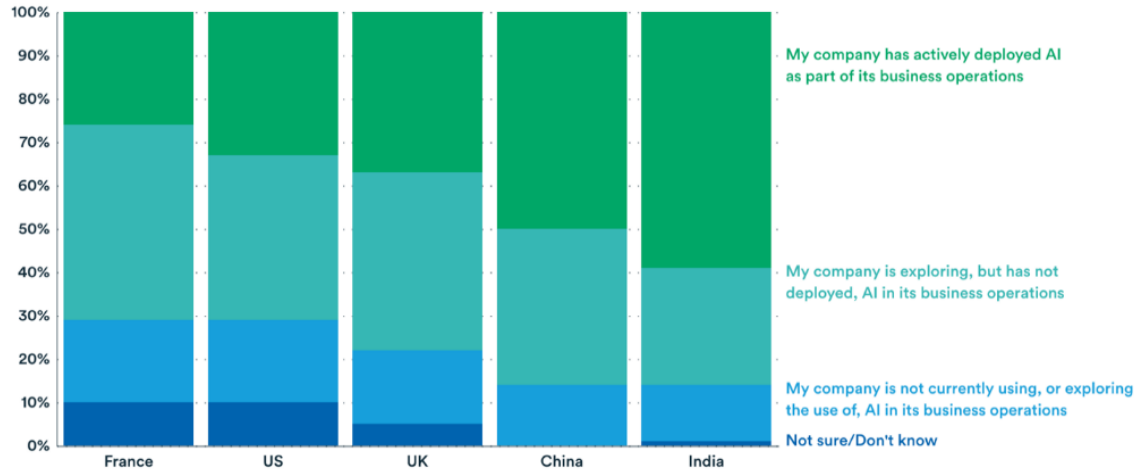
Notes: AI estimate from the Real-Time Population Survey, computer use from the Current Population Survey and Internet use from the International Telecommunication Union. Series start after 0 years, as survey introduction lags product availability.

22. Adoption has been global. Survey evidence shows broad penetration at large corporations (Morning Consult/IBM, 2023). Most IT professionals in each country

surveyed have explored or deployed AI (Figure 2). China and India have emerged as early leaders in enterprise AI adoption.

Figure 2: Enterprise AI adoption

Reported adoption of AI by IT professionals in large companies.



Source: Morning Consult/IBM (2023)

23. Public attitudes towards AI are mixed. Polling suggests that, across the world, many expect it to transform their lives (IPSOS, Americans for the Arts, 2023). In South Korea, belief in AI's transformative power is near-universal, with 79% of those polled expecting profound changes within 3-5 years. This sentiment is widespread, albeit with regional variation: majorities in Japan, Great Britain, the United States, France, and Germany report similar attitudes.

24. The polling also reveals concerns. Fear of job displacement are the key anxiety: almost a third of workers in Japan and South Korea believe AI could replace their current role (Ipsos, 2024). Many are calling for governments to support workers through this transition (ILO, 2024).

25. The creative industries look set to be a leading example of the impact of AI. Creative workers worldwide report both using AI tools to aid them in the workplace, while harbouring fears about the longer-term impact. Examples include:

- **Marketing**. 71% of marketers are using generative AI at least once a week, according to a recent survey by the American Marketing Association (2024). Professionals report improvements in quality, quantity and efficiency, but concerns over accuracy.

- **Game development**. 36% of game developers worldwide report AI use for both technical and administrative uses. Attitudes are mixed: 18% of developers see a positive impact, with 30% predicting a negative one (GDC, 2025).

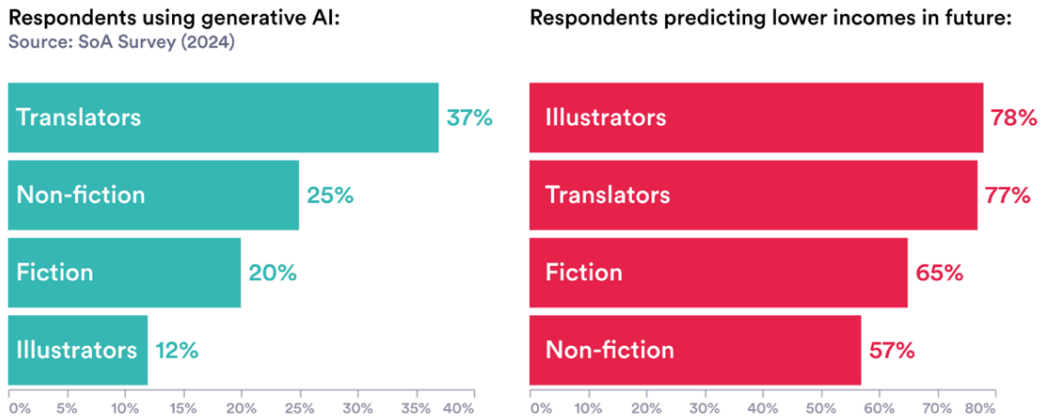
- **Film and motion design**. AI tools assist with tasks such as rotoscoping, VFX generation, and editing. Creative workers use both bespoke platforms (like Runway AI) and integrated tools within industry-standard software, such as Adobe After Effects (Adobe, 2024).

- **Animation**. In Japan, studios are experimenting with AI to support creative workers. At Nagoya-based K&K Design, animators use AI to generate in-between frames—reducing a week of work to a few hours (Nikkei, 2024).

- **Writing**. A 2024 survey by the Society of Authors found that 22% of British writers use generative AI (Figure 3; SOA, 2024). Most anticipate negative labour market impacts, specifically lower earnings

Figure 3: Creative workers' mixed feelings

Responses to a survey of British authors



Source: SOA (2024)

Notes: UK Society of Authors survey responses

Three challenging trends

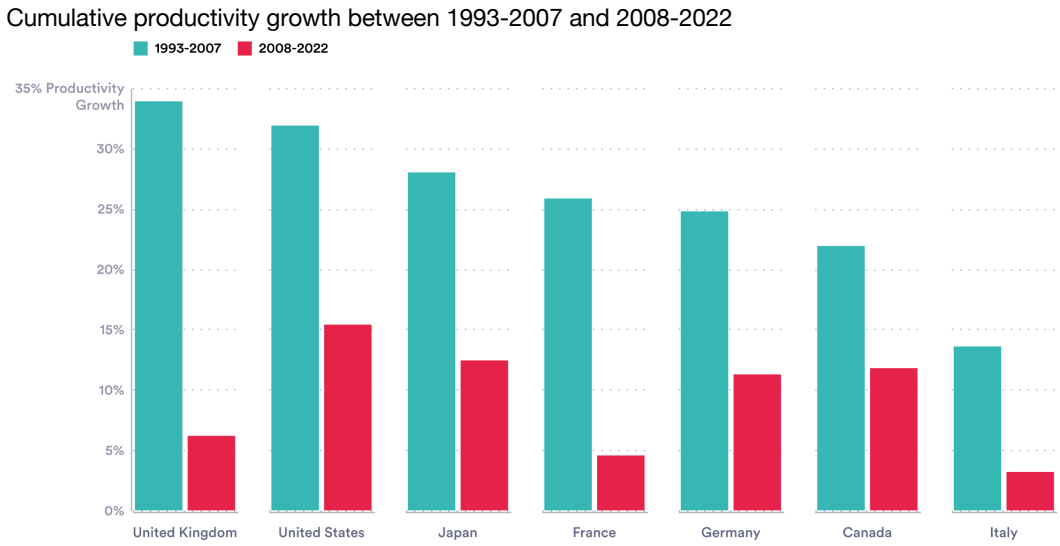
26. To assess the impact of AI, it is first necessary to consider an overview of the economic backdrop. AI is, at its core, a technological advance. Its arrival coincides with the widespread realisation that three trends—related and interlocking—have come to dominate advanced economies. In addition to a jump forward in technology, we face stagnant productivity, lagging competitiveness, and fragmentation—all trends that may hold global growth back. This section provides a brief overview of this vital context.

Productivity

27. The emergence of this new technology comes at a time of a systemic challenge—productivity. Since the Great Recession, many major economies have stagnated. Productivity growth, the driver of long-term prosperity, has slowed or stalled in every G7 country (Figure 4). Productivity has grown only one-third as rapidly in the fourteen years since the Great Recession as in fourteen years before. The UK illustrates this problem acutely, with output per worker around 20% lower than it would have been had the pre-2008 trend continued.

28. The global economy faces a "productivity paradox" – the persistent puzzle of why rapid advances in digital technologies have not yielded corresponding productivity gains (Brynjolfsson et al., 2017). If generative AI can solve this puzzle, it could transform economic trajectories across the world.

Figure 4: Stagnating productivity



Source: OECD, authors' calculations

Competitiveness

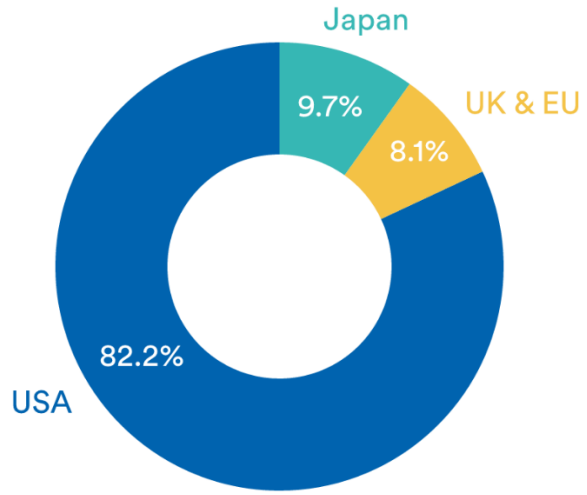
29. A second problem, closely linked to productivity, is competitiveness. Markets that compete on price and quality foster innovation and stimulate investment (European Commission, 2024). The *Draghi Report on EU Competitiveness* identified how market frictions and low investment have created ecosystems of low innovation and poor competitiveness in many European sectors (Draghi, 2024). An uncompetitive business environment is linked to a low rate of capital investment. In the decade to 2022, US companies invested more as a share of GDP than their European counterparts. This annual shortfall cumulates to an investment gap of over £500 bn. Without reform, EU businesses continue to face challenges. They struggle to develop new products and technologies in an operating environment that is slow and restrictive.

30. These problems are not limited to the EU. Within the G7 group of countries both Japan and Canada face deep challenges over competitiveness. Japan, for example, ranked 1st in a popular global competitiveness ranking published by IMD Business School in the 1980s and early 1990s. It has since fallen to 38th out of 67 countries assessed (IMD, 2024). In particular, in key sub-categories identified as critical for AI adoption, Japan has room to improve. On human capital (49th), regulatory frameworks (50th), and technological agility (56th) Japan is below average, and its ranking has declined over time. Japanese think tanks have identified a new approach to both digitalization and global trade as key elements to boost the economy (JRI, 2022).

31. In the creative industries, European and Asian firms lag those in the US. Of the 30 largest media companies, 20 are American. Even when excluding diversified giants with media operations, US companies dominate; in 2024, US firms generated 82% of the combined revenue of the top media companies (Figure 5). European media groups have ceded global market leadership, narrowing their capacity to fund the next generation of digital content and platforms.

Figure 5: Media corporations' revenue

Total revenue for the largest media corporations, by location of headquarters



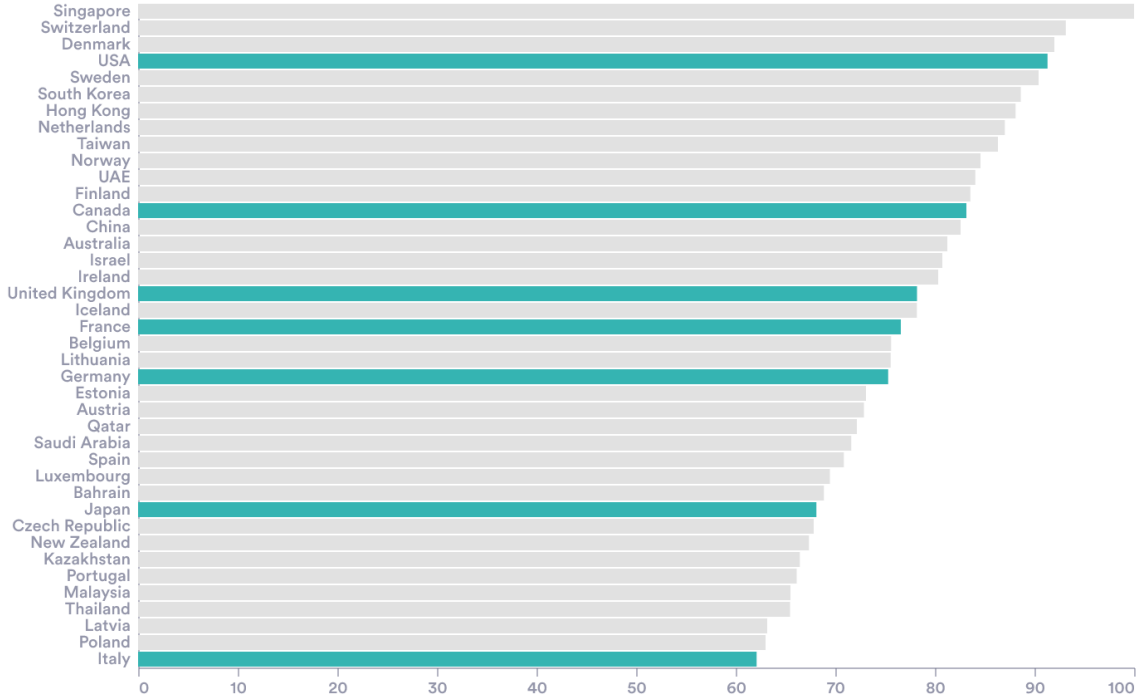
Notes: Large diversified tech corporations with media activities, in addition to other core activities, are excluded. Including these reduces the US share to 76% with Chinese companies joining the ranking.

Source: Authors' calculations with IFM (2024) data

32. A digital competitiveness gap has appeared. In IMD's 2024 Digital Competitiveness ranking, the United States is the only G7 nation in the top ten, with Canada the sole other member in the top twenty (Figure 6; IMD, 2024). Similar findings were presented in the World Economic Forum's 2020 report on ICT readiness—both Canada and Japan were outside the top 20. Meanwhile, other European nations including France and Spain are in the bottom half of this list, with Italy—a G7 member—ranked 40th.

Figure 6: Digital Competitiveness

2024 IMD digital competitiveness rankings



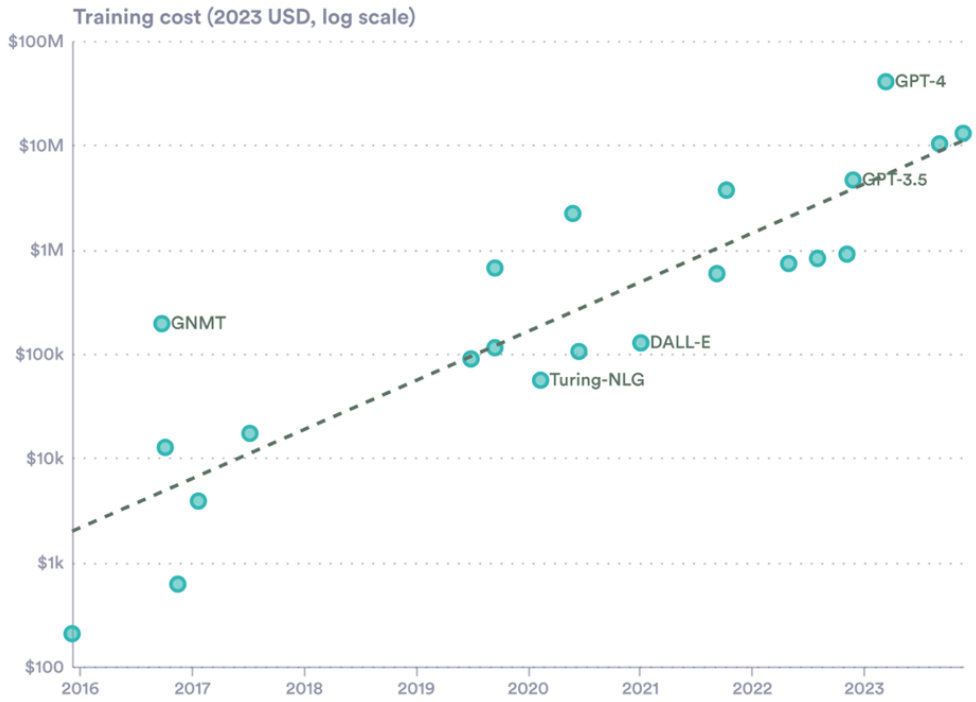
Notes: Top 40 nations shown, with G7 members shaded.

Source: IMD (2024)

33. A shortfall in access to finance been associated with lower competitiveness. This has been the case in the UK, Japan and Europe (Draghi, 2024). Sectors reliant on ICT industries, and the ICT industry itself, are particularly important in this context, because AI tools have high development costs and require large-scale up-front investment. The cost of training flagship AI models has more than doubled each year (Figure 7).

Figure 7: AI training costs

The training costs of selected AI models



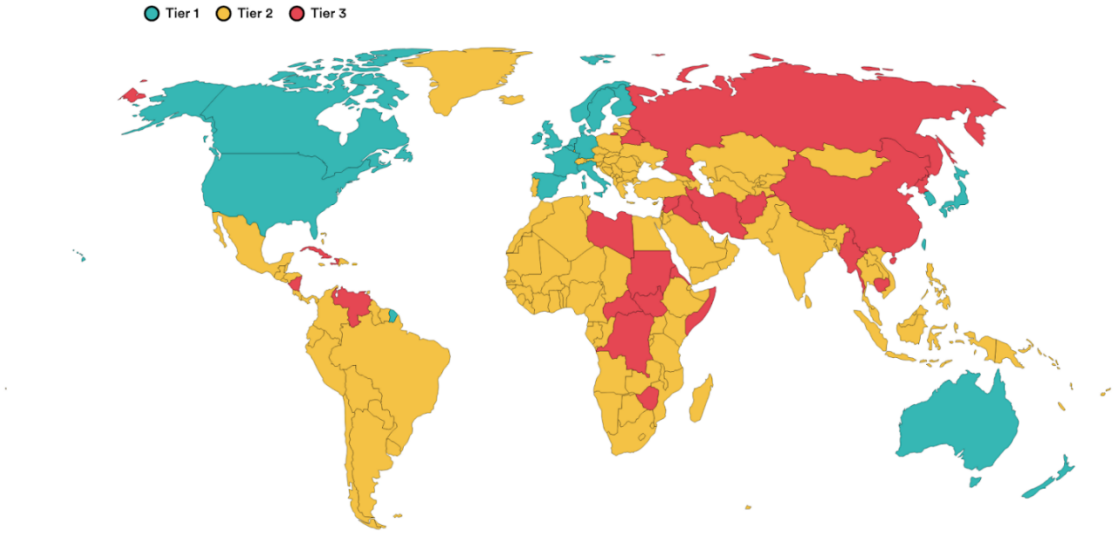
Source: EPOCH AI

Fragmentation

34. The global economy is also facing an inflection point, referred to by the IMF as a "new era" (IMF, 2025). At an economy-wide level, trade patterns are changing. Recent developments on tariffs show that the old system of global rules – in the form of the World Trade Organisation (WTO) – has frayed, and is being replaced by blocs, instead of larger global markets. This process can be seen in the ICT industries, while subsidies have divided the world into AI camps. Western and Chinese AI companies are in an intense race. The two sides: the Western, dominated by US firms, and the Chinese are illustrated by US export rules (Figure 8).

Figure 8: US Silicon export controls

Three tiers of US export controls under the US Security Bureau's Framework for Artificial Intelligence Diffusion.



Sources: Author's illustration, US Security Bureau (2025)

Notes: US chip destinations under the most Permissive (Tier1) and stringent (Tier 3) export controls.

35. Global trade challenges are likely to pose particular challenges for creative industry firms. First, fragmentation may result in smaller markets for firms to trade in. For instance, potential tariffs that could risk disrupting international collaboration and shrinking market access remain a risk. Second, the emergence of piecemeal regulations, or the usage of AI regulations as a strategic barrier to trade, will act as non-tariff barriers (NTBs). Research shows that NTBs can be harder to overcome and have an equivalent impact to tariffs (De Lyon and Dhingra, 2021).

III AI use in the creative industries

From machine learning to generative AI

36. Artificial intelligence is rapidly being adopted by the creative industries. These tools identify patterns in existing data to inform new outputs. Over time, more sophisticated approaches have evolved from simple prediction algorithms to complex machine learning and deep learning architectures. These systems learn from databases of work (code, text, images, audio, video) to draw out underlying patterns and relationships. A taxonomy of terminology is presented as an appendix.

37. Interest in AI stretches back 70 years. The term was first introduced during the Dartmouth Research Project in 1955, where it was described as "the effort to make machines behave in ways that would be considered intelligent if performed by humans" (McCarthy et al., 1955). At its core, AI refers to computational systems that can process information, identify patterns, and perform tasks that typically require human intelligence.

38. The recent leap forward came with 'generative AI', which is the focus of this report. Instead of simply recognising patterns or making predictions, generative AI models can create entirely new content—text, images, music, or video—based on learned patterns. These models, such as GPT for text or Sora for video, can generate outputs that extend beyond simple imitation.

39. This means that creative industry AI tools fundamentally differ from traditional creative software. The key difference is their ability to understand the context a creative worker is facing—i.e. understand what they are trying to do—and to generate novel content. While the previous generation of software tools could execute fast, precise, pre-programmed operations, AI systems can interpret creative intent and suggest solutions. A comparison of two tools is given in Box 1.

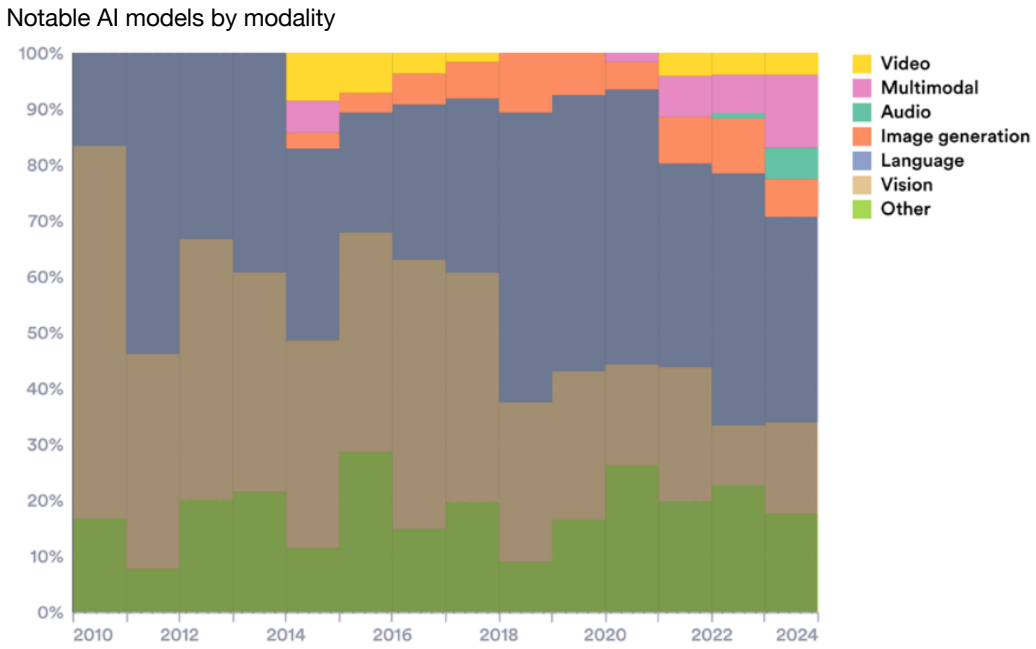
Box 1. Machine Learning vs. Generative AI – creative industry example
Older models were designed for specific tasks. They excel at well-defined problems but do not generalise beyond their training data. An example for post-production is Adobe Photoshop's 'Content-Aware Fill' feature, introduced in 2010, which can fill in missing areas of an image based on patterns in surrounding pixels. However, Content-Aware Fill is limited by its context – it analyses nearby image data to generate plausible textures but struggles when large or complex areas need filling. Adobe 'Generative Fill' tool, introduced in 2023, exemplifies the shift. It utilises deep learning models trained on vast datasets of diverse images. This allows it to synthesise entirely new image elements that match the broader visual context rather than just patching gaps. For example, where Content-Aware Fill might struggle to reconstruct a missing section of a cityscape due to a lack of similar

reference pixels, Generative Fill can infer and generate realistic buildings or sky, based on its knowledge of similar images.

40. The growing capability of creative AI came as something of a surprise. Ten years ago, many commentators were focused on, for example, applications in logistics. Since many creative roles are non-repetitive and are more subjective than other fields (for example, mathematics, or coding) they have often been considered less prone to automation (Bakhshi, et al., 2015).

41. Yet over the last decade models that specialise in writing have emerged, quickly followed by non-text models (Figure 9). In recent years, attention has shifted beyond pure language models towards multimodal, audio, and video models. In 2023, 29% of notable new AI models addressed video, audio, image, or multi-modal outputs—up from zero a decade ago. Creative generation models have demonstrated a clear capability distinct from human creation.

Figure 9: The rise of creative AI models



Source: Epoch AI (2024), Authors' calculations

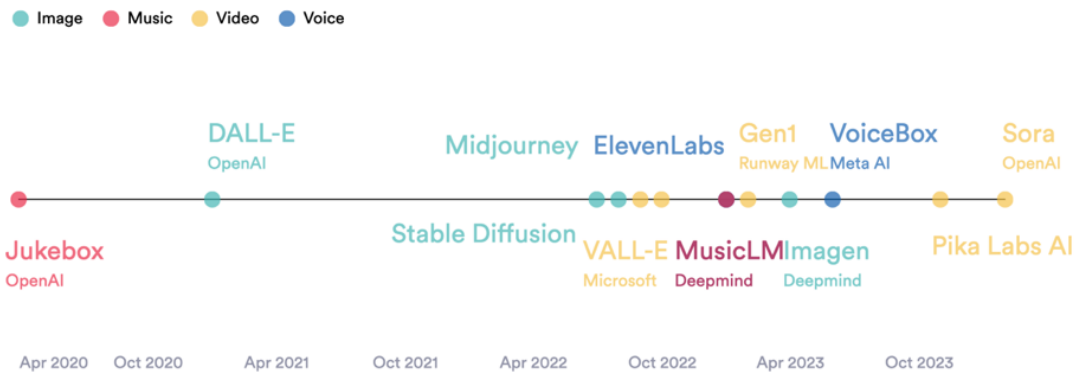
Notes: Includes models deemed "historically significant or cutting-edge" by Epoch AI .

Gen-AI – a snapshot of usage today

42. The ecosystem of institutions developing creative AI models is diverse. In the private sector, publicly-listed tech firms have been hugely active—as have start-ups (Figure 10). Academic institutions also play a role in the ecosystem: today's commercial breakthroughs rest on decades of academic research.

Figure 10: Timeline of Creative AI models

Initial releases of pioneering AI model series



Notes: Where multiple models have been released in the same series (e.g. each stable diffusion iteration), only the first release is listed.

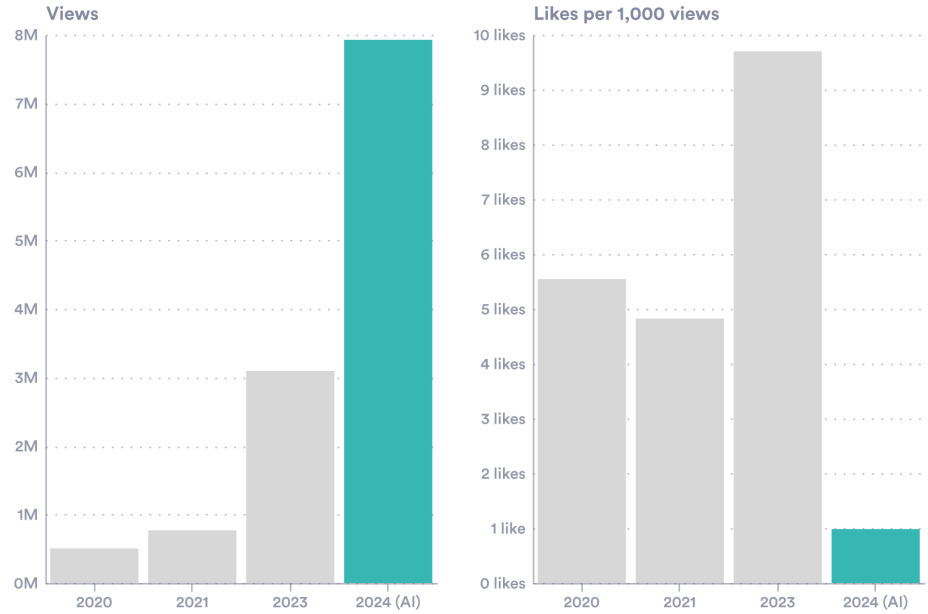
43. This new family of generative tools are already widespread. Usage extends to blockbuster films, TV shows and music videos. In 2024, *Alien: Romulus* garnered significant attention with its hybrid application of generative AI, alongside traditional tools, to create the film's monster and to feature a digital replica of deceased actor Ian Holm. Similarly, Metaphysic Studios has produced AI-enhanced music videos for major artists including Eminem, Dr. Dre, and Snoop Dogg. Other applications are more subtle. Start-ups such as Deepdub have applied voice models for AI dubbing and localisation, with adoption from major studios.

44. There have already been attempts at creating fully AI-generated content. The clearest examples have been in advertising. In 2024, Coca Cola produced its traditional *Holidays are Coming* Christmas ad using generative AI. Toys-R-Us created its AI ad with an off-the-shelf model – Sora from OpenAI. Similarly, the Spanish clothing brand Mango swapped human models for AI-generated ones in a teen fashion campaign to accelerate content production.

45. These commercial applications have elicited mixed reactions. The Toys-R-Us campaign faced criticism for its malformed toy representations and unnatural character movements. Coca-Cola's first AI-generated ad drew widespread but unusually negative attention (Figure 11).

Figure 11: Reception to Coca Cola's AI ad

Views and favourability of Coca Cola's annual holiday ads



Source: YouTube, authors' calculations

Notes: Views, and 'like'-rate for Coca Cola Christmas ads. Likes and views accurate, as of February 2024.

IV Technology and macro-economic outcomes

46. Previous sections have set out the rapid emergence of a new—generative—form of AI, and the fact that this has arrived at a time of great concern about productivity and growth. This section reviews the evidence on technology and the economy, both broadly defined. Understanding how innovations of all kinds are understood to influence economy-wide outcomes sets the background before we drill down into the specific interactions of generative AI on the creative industries.

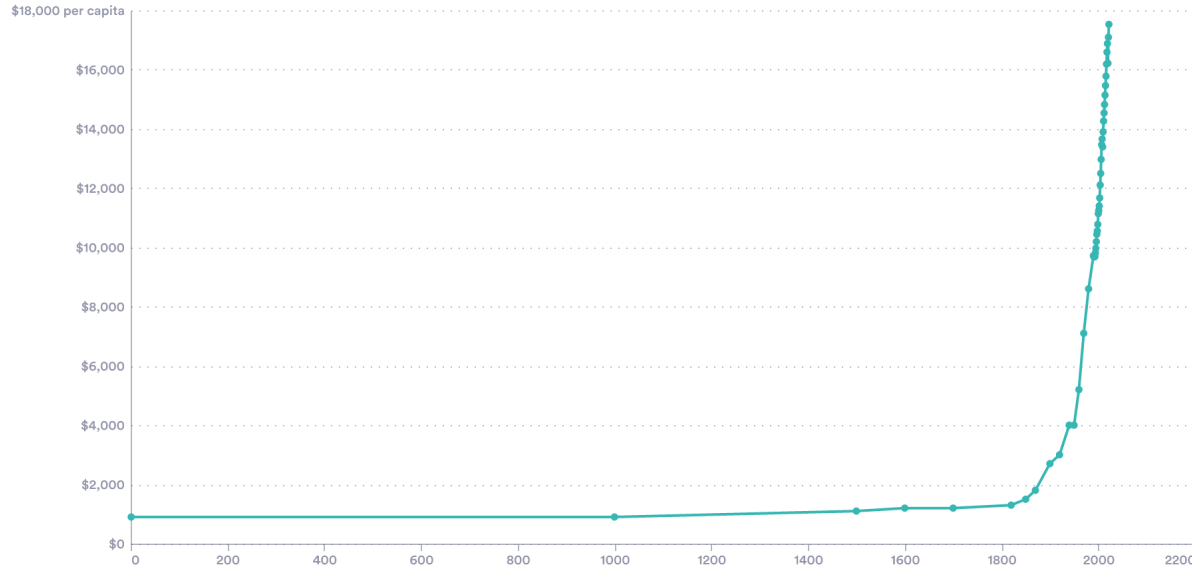
Growth and jobs – the long run

47. The study of long-run growth is a core part of economics, with some of the central findings essential in considering the impact of AI. Over the short- to medium-term gains can come from capital accumulation as economies build up, for example, their ports, factories and machines. But over time, these gains diminish, making sustainable per capita GDP increases harder to find (Solow, 1956). Technological development is the source of long-run growth (Jones, 2002; Acemoglu and Restrepo, 2003). This interacts with human capital accumulation, as new machines and new ideas compound, each breakthrough building upon previous discoveries (Lucas, 1988; Romer, 1986; Romer 1990). For long-term prosperity increases therefore, the development and diffusion of new technology and ideas are essential.

48. In the 250 years since the first industrial revolution, technological innovation has transformed the global economy. (Hobsbawm, 2000). Discoveries and inventions–crop rotation, fertilisers, the combustion engine, the steel hulled ship, transistors–have driven vast improvements in living standards and a reorganisation of society. The result is that the path of global GDP per-capita, the average production per person in a year, exhibits a “hockey stick” shape (Figure 12). Millennia of relative stagnation gave way to explosive growth as technological innovations reinforced one another.

Figure 12: Growth, the long-run view

Global GDP per capita, 2017 prices, 1-2022



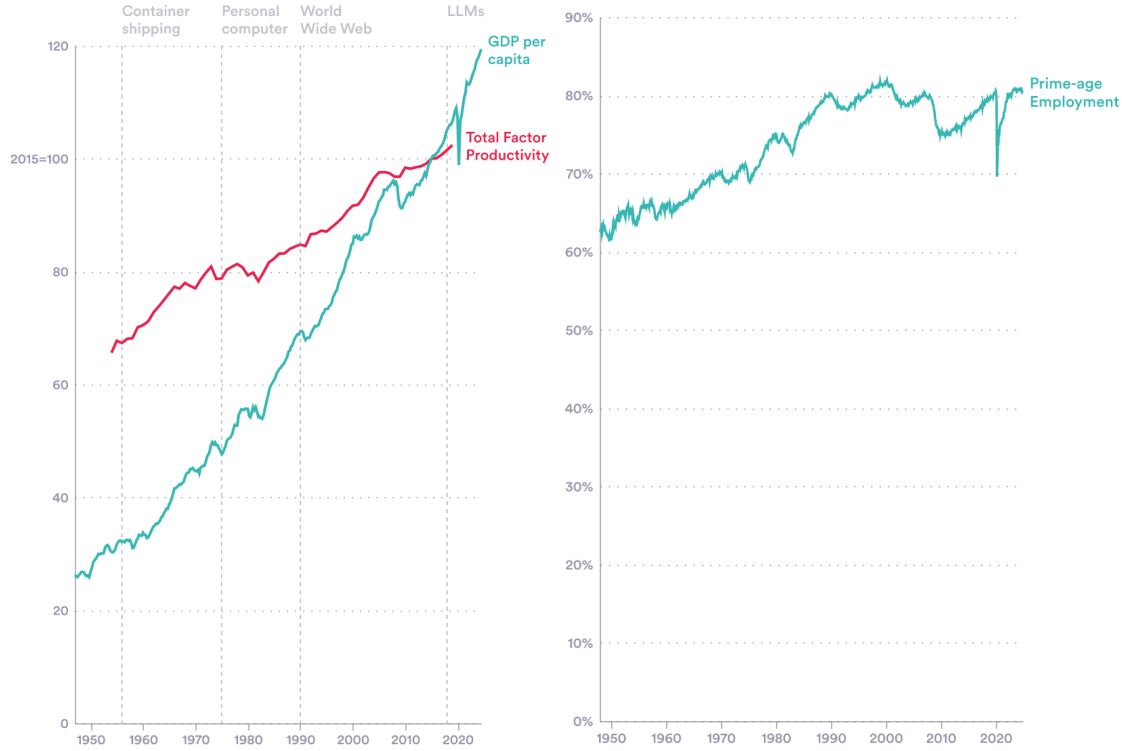
Source: Maddison Project Database, 2024

49. Economic growth is not a smooth process. It involves disruption to firms, professions, and industries. New ideas and tools shift the status quo through creative destruction, when new technologies replace old ones, and industries and jobs change (Schumpeter, 1942). Periods of higher growth are often periods of higher uncertainty too (Schubert, 2013). A core question, during these periods, is the labour market impacts—in particular the risk of unemployment, or lower wages.

50. Today, a record number of people are in work. Since the 1950s, new technologies, including container shipping, personal computers and the internet, have catalysed remarkable economic growth. In the US, output per-person has almost quadrupled. Throughout this transformation, workforce participation has increased (Figure 13). A similar pattern is seen across advanced economies. More technology is associated with more jobs, rather than fewer.

Figure 13: Innovations, growth and employment

US total factor productivity, GDP per capita, and employment

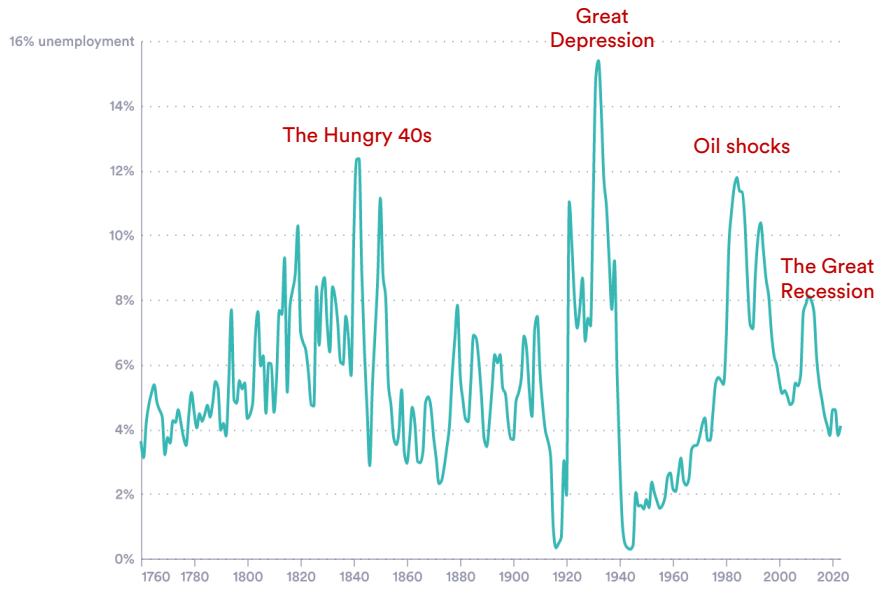


Source: Feenstra et al (2015), BLS, via FRED, authors' calculations
Notes: Major technical developments annotated

51. Spikes in unemployment, when they come, do lower living standards. Long run data for the UK shows clear peaks in unemployment: the "Hungry 1840s" (a period of widespread agricultural distress), the Great Depression, the 1970s Oil Shocks and the 2008 crash are all visible (Figure 14). In all these cases, unemployment rose with shocks to financial, resource or commodity markets. None of these periods are associated with a technological advancement. Labour markets have historically adapted to technological change while maintaining (or increasing) overall employment levels.

Figure 14: UK unemployment in the long-run

Long-run UK unemployment, with dates of key shocks

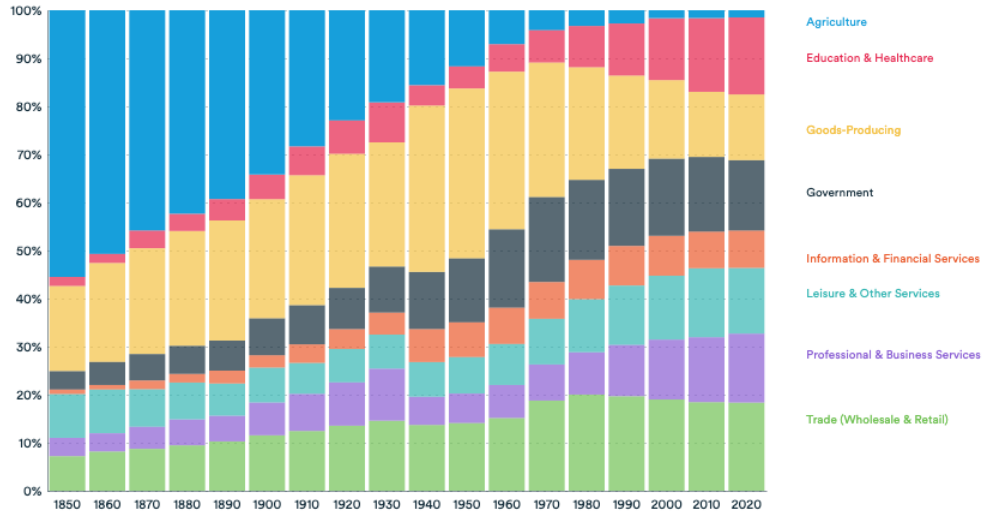


Source: ONS (2025), and Bank of England (2016)

52. Rather than change in size, labour markets have tended to change shape. In the US, for example, agricultural employment fell from over 55% in 1850 to around 1% today (Figure 15). Even in more recent decades, this transformation has continued: between 1948 and 2015, agricultural labour inputs declined by about 75% while land use decreased by 24%, yet total agricultural production more than doubled, driven by mechanisation, improved crop varieties, and advanced farming methods (Wang et al., 2018).

Figure 15: US sectoral labour shifts

US employment by sector, 1850-2020



Source: Federal Reserve Economic Data, U.S. Bureau of Labour Statistics

53. As roles in some sectors decline, others replace them. The shift away from agriculture, combined with technological progress in other sectors, created entirely new categories of work in manufacturing. Later, mechanisation meant that jobs in heavy industry were replaced by those in advanced manufacturing and services. Fully 60% of jobs in 2018 were in occupations that did not exist in 1940 (Autor, 2022).

54. The relationship between technology and employment has been a focus for economists for decades. In the 1930s, John Hicks argued that innovation is not neutral – it responds to economic incentives and in particular the relative prices of inputs (Hicks, 1932). Changes in the scarcity of labour and capital direct invention to save on the factor that has become more expensive.

55. Growth theory shows the importance of the interaction of workers with technology. Foundational papers including Harrod (1939) and Solow (1956) show that sustained growth requires labour-augmenting technical change; that is, innovations that make each worker progressively more productive. Long-run improvements in living standards require labour augmentation, where workers become more productive through advances in tools, skills and knowledge

56. Diffusion is also vital. Innovations do not spread automatically. History shows that even when a technology offers clear advantages, its uptake can be slow due to high switching costs including restrictive regulations (MacVaugh, 2010). Supportive investment is often needed to embed a new technology. The early 20th-century electrification of factories is a useful case study: early adopters replaced steam engines with electric motors, but factory layouts had been designed for a centralised (coal-fired steam) power source. Investment to restructure production lines and decentralised power distribution was vital (David, 1990). For AI to diffuse widely and deliver transformation, a similar adjustment may be needed in everything from organisational design to staff training.

57. History offers a specific cause for caution—inequality. During the Industrial Revolution in England, mechanisation and factory production yielded unprecedented productivity growth—the economy grew quickly. Yet real wages did not. This period, known as “Engels’ Pause”, saw the technology gains concentrated among business owners. The labour market adjustment came in the late 19th century, when real incomes began to rise (Allen, 2009). To manage the productivity benefits AI can bring, governments will need to be aware of this inequality risk.

58. More recently, research has tended to overestimate the disruptive effect of AI on employment and wages. Over a decade ago, it was thought that nearly half of

US jobs were at risk of automation (Frey and Osborne, 2013). Yet employment levels have increased, confounding the predictions. While automation has transformed routine tasks, it has simultaneously created demand for new skills (Autor, Levy and Murnane, 2023). Indeed, recent research shows that industries that have been more exposed to AI have seen employment demand rise faster than those where the AI exposure is lower (Albanesi et al., 2023).

59. The puzzle of why automation has not generally reduced employment can be understood through the relationship that workers have with technology. Technology may affect existing roles in two distinct ways:

- **Task substitution.** This occurs when a task can be fully automated but reflects only one part of a job. For instance, ATMs replaced routine cash-handling in the 1970s. Automation reduced routine cash-handling, but increased demand for interpersonal, service-oriented tasks ("relationship banking"). So, while technology may displace workers from specific tasks, it does not eliminate jobs altogether.
- **Augmentation and productivity.** In this case tasks that aren't substituted are instead enhanced by automation. By taking over the routine or data-heavy parts of a workflow, technology increases the quantity and/or value of the human-performed tasks. Since demand for employees generally rises with their productivity, the technology is supportive of employment.

60. New technology also creates new tasks. As technologies evolve, they generate jobs and responsibilities that did not previously exist. Acemoglu and Restrepo (2019) argue that while automation eliminates existing tasks, employment has been maintained through the continual emergence of new ones. While sceptical of AI's capacity to generate tasks at scale, they show that historical resilience in employment has depended on task creation.

61. Overall, then, the history of economic research, and of economic outcomes, provides a clear message on technology. While growth paths are not smooth in any economy, technology shocks, unlike commodity or financial shocks, are not something policymakers should seek to avoid. Rather, technology has been the source of long-run growth and improved living standards. This brings us to the latest technological wave: artificial intelligence.

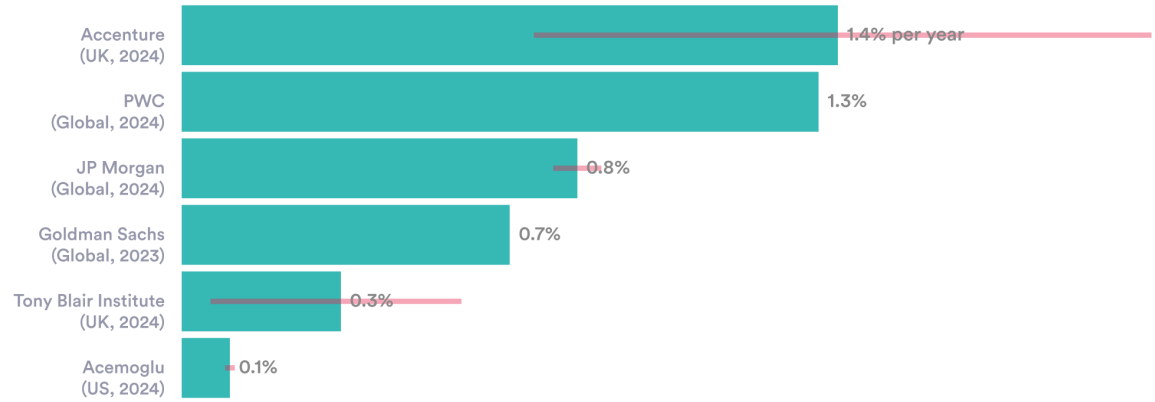
Estimates of the potential gains from AI

62. There is a growing literature on the economy-wide impact of AI. The consensus is that AI will boost both GDP and productivity. Some groups forecast large, double-digit, uplifts to GDP driven by substantial increase in labour productivity. This includes papers by Accenture, PwC and McKinsey. Gains at this scale would go some way to offsetting the growth shortfall that G7 economies have experienced over the past 15 years.

63. Others are more cautious. At the low end of the scale, Acemoglu (2024) predicts 0.1 percentage points of additional labour productivity growth per year, translating to around a 1% uplift in GDP over a decade. This variance in predictions, shown in Figures 16 (GDP) and 17 (productivity), reflects different assumptions about how AI will be adopted, how broadly it will augment work, and how quickly productivity gains will diffuse across the economy.

Figure 16: Growth estimates

Estimates of AI's contribution to annual GDP growth over the next 10 years



Sources: Acemoglu (2024), Briggs, & Kodnani (2024), JP Morgan (2024), Sharps et al. (2024), McKinsey & Company (2024). Authors' calculations.

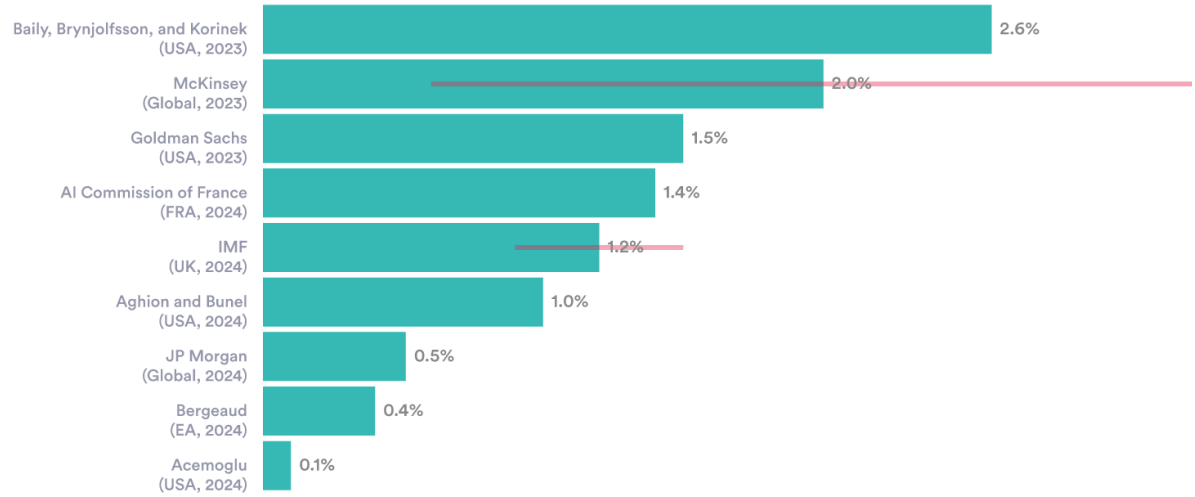
64. The optimistic case is that AI will significantly enhance workers' productivity. This, in turn, drives sustained economic growth. Some experts suggest that AI will augment a wide range of cognitive tasks—activities including document drafting, coding, design, and planning. Taken together, this work accounts for around 60% of US output (Baily et al., 2023). If AI boosts the productivity of these workers by 30%, overall productivity could rise by approximately 18%.

65. AI could also create entirely new skills and workflows. McKinsey (2024), for example, estimates that AI could expand labour demand by 21–33%, offsetting job displacement and reinforcing long-term GDP growth. This scenario translates into a

15–20% GDP uplift over ten years and annual productivity gains of 1–1.5 percentage points.

Figure 17: Productivity estimates

Estimates of AI's contribution to annual labour productivity growth over the next 10 years



Source: Authors' calculations, JP Morgan (2024), Filippucci et al.

Notes: Uses Filippucci et al's transformations from TFP to labour productivity growth.

66. The cautious case is that AI's effects will be slower to materialise and limited in scope. Three ideas tend to drive the analysis in papers with this finding. First, that the initial productivity gains have focused on the low-hanging fruit: data entry, image recognition, and basic customer service, rather than complex high-value work. Second, that AI will prioritise task substitution over augmentation—i.e. it will replace rather than enhancing human capabilities. Third, that diffusion will be slow, adoption uneven, with many sectors unable to integrate AI meaningfully. For example, Acemoglu (2024) estimates that AI will affect only 4.6% of tasks over the next decade, resulting in a productivity uplift of less than 0.5% and GDP growth of just 1% over ten years (Figures 16 and 17).

67. In summary, the evidence on AI is in line with previous generations of technology. While economists differ in their predictions the consensus is for higher productivity and higher GDP. The differences between studies are helpful too, in suggesting key trends to track in the creative industries: the types of tasks automated, the balance between automation and augmentation, and the speed of diffusion will all be important in the creative industries.

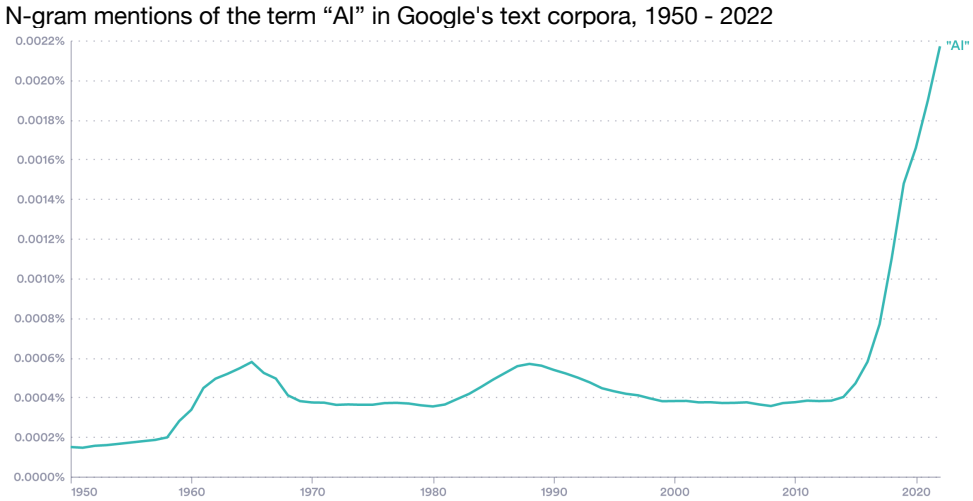
Box 3. AI cycles and winters.

The development of artificial intelligence has been marked by cycles of intense enthusiasm followed by periods of disillusionment, often referred to as AI Winters. These periods provide an interesting history but also give a flavour of the importance of policy in AI development.

The first wave of optimism came in the 1950s and 1960s, as researchers made early strides. An initial 1950s AI boom generated significant optimism but failures in machine translation projects, and Marvin Minsky and Seymour Papert's 1969 criticism of perceptrons—a simple mathematical model, inspired by human neurons—undermined confidence in AI research (Russell et al., 2022).

A winter came in the 1970s: a government review, the *Lighthill Report* (1974) concluded that "in no part of the field have the discoveries made so far produced the major impact that was then promised", leading to reduced university funding in the UK, while ARPA halted funding for AI-focused university projects like Carnegie Mellon's Speech Understanding Research program (Fouse et al., 2020).

Figure 18: AI Winters and Blooms



Source: Google Books (2025)

The first AI Winter began to reverse in the 1980s with expert systems and LISP machines which enabled more complex rule-based reasoning and specialised computing for AI. However, their commercial failure, particularly the LISP machine market collapse in 1987, triggered another AI Winter with DARPA funding again declining.

Despite these setbacks, AI rebounded. The latest surge rests on three foundations: the integration of the internet into daily life, which has led to unprecedented data abundance; advances in computing hardware and software, which have dramatically increased available computational power; and algorithmic breakthroughs in deep learning, especially neural networks, and the transformer architecture. The intense interest can be picked up in Google Ngram data (Figure 18, above).

V Generative AI and the creative economy

The creative economy – economic impact

69. The global creative economy is worth $2tn (IFC, 2025). The creative industries contribute £124bn to the UK economy, representing 5.2% of the nation's Gross Value Added (DCMS, 2024). In the US, arts and culture account for over $1tn of the economy and contribute more as a share of GDP than agriculture and transport (BEA, 2025). In South Korea, the industry contributes to 3.7% of GDP (KOSTAT, 2025). Globally, creative and cultural activities make a huge contribution to a nation's economy.

70. The industry is also a significant employer. Worldwide, 50mn people work in the creative economy (IFC, 2025). In the United Kingdom, the creative industries employ approximately 2.4mn people, accounting for 7% of all filled jobs in the country (Figure 19). Creative employment exceeds that of the manufacturing, construction, or financial services sectors (DCMS, 2024). In the US, the sector employs 5.2mn people, more than the combined employment of the federal government and agriculture sectors (BEA, 2025).

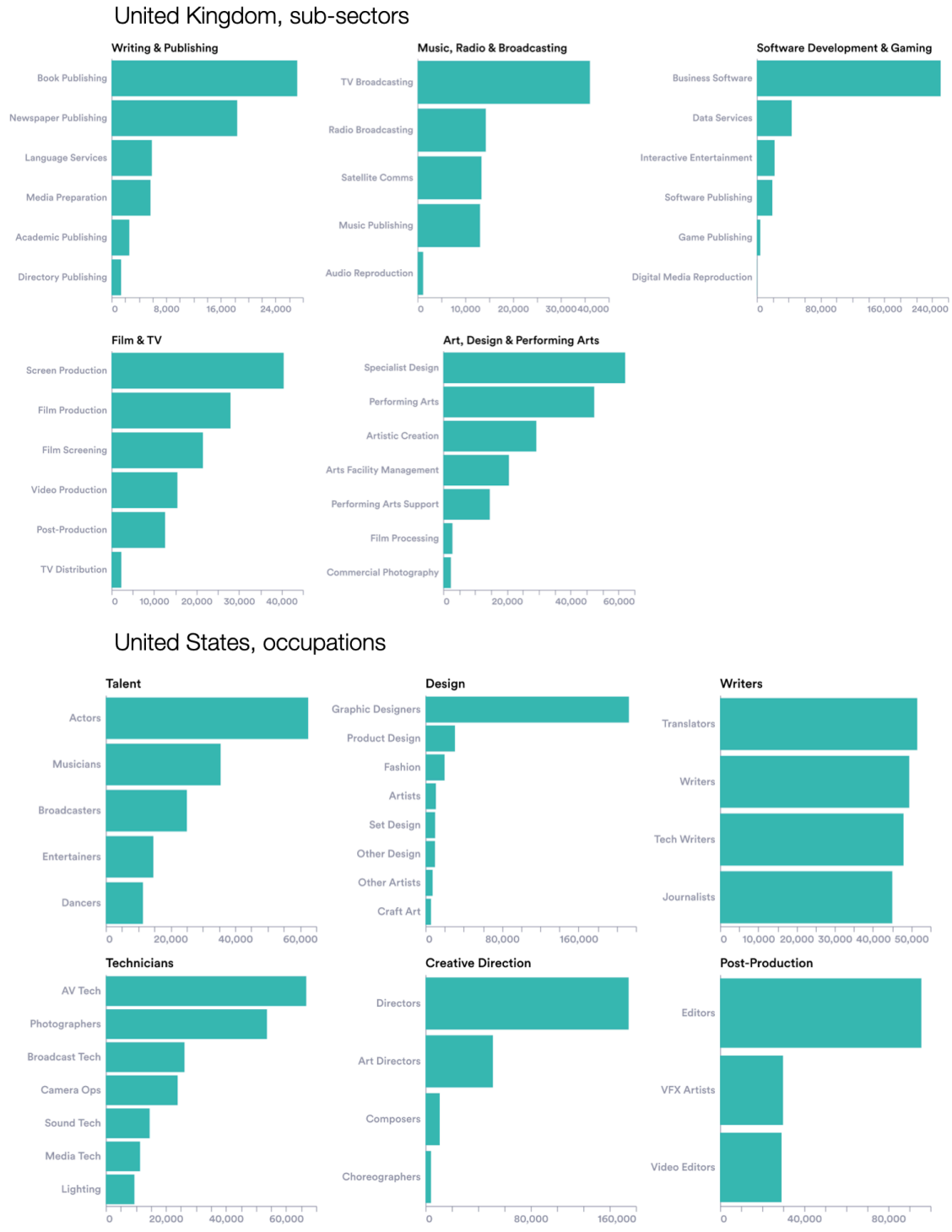
Figure 19: Employment in selected industries

US and UK creative industry employment (2024), compared to selected other industries

Source: DCMS and ONS (UK, 2024), and BEA ACPSA (US, 2025).
Notes: Creative industry definitions in the US and UK are bespoke and different. Workers employed in the creative industries will also be counted under standard SIC and NAICS divisions.

Figure 20: Creative industry employment

US and UK creative industry employment, by sub-sector and occupation



Source: ONS (2024), BEA (2025), author's calculations
Notes: 2023 figures. Sub-sector and occupation titles are shortened for legibility. Chart axes are scaled independently.

71. The creative industries are a broad and varied sector. Within the umbrella designation are fields ranging from software development to newspaper publishing and the performing arts (ONS, 2024). Each of these areas encompasses a wide variety of roles. In the United States, for example, graphic designers form the largest professional group with over 210,000 workers (BLS, 2024). Jobs and skills span the entire production process, from design and writing to talent roles (actors, musicians and broadcasters) and post-production (Figure 20).

72. Creative output and employment are shaped by culture and comparative advantage. In different parts of the world, distinct creative sub-sectors emerge.

- **Anime**. Japan's animation sector forms a key part of a visual arts industry that employs over 80,000 people (Agency for Cultural Affairs, 2024).

- **Scandinavian design**. Global firms, such as IKEA (Sweden) project a Nordic style worldwide. Denmark hosts 138,000 cultural jobs (Eurostat, 2024).

- **K-Pop**. South Korea's music sector, including the K-Pop and other genres, supports almost 70,000 jobs (KOCCA, 2023).

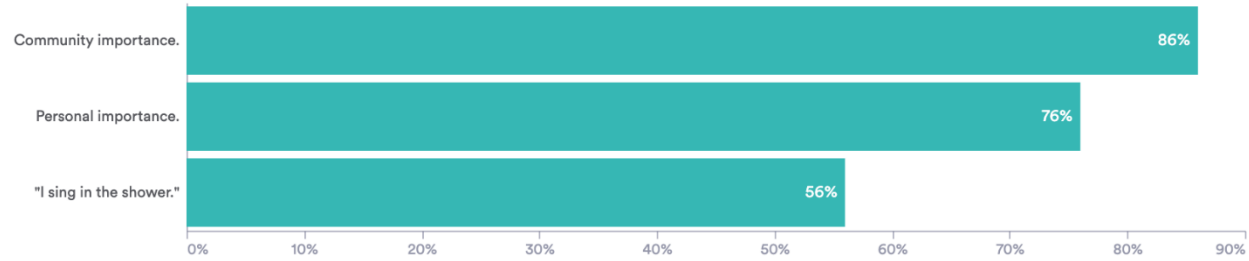
- **Nollywood**. Nigeria's film industry employs over 1 million people and ranks as the second largest by volume, contributing 2% to GDP (Omanufeme, 2016).

73. Direct measures of output and employment are likely to underestimate the contributions of the creative economy. In the US, it is estimated that the creative industry supports another 3.5mn jobs indirectly (authors' calculations; BEA, 2025). In addition to these spillover or knock-on effects, the industry plays an important role as an innovator. Research suggests firms that integrate art and science skills in their workforce are more productive and are more likely to commercialise radical innovations (Nesta, 2016).

74. The creative economy also has positive impacts on the public sphere, and social capital. These wider social and cultural gains include effects on health, wellbeing and community cohesion. An estimated 86% of Americans state that art and culture are important for their community and quality of life (Figure 21; Ipsos, 2023). Research suggests that individuals with opportunities to express creativity report a reduction of anxiety, developing a sense of purpose and improved mood (What Works Centre for Wellbeing, 2024).

Figure 21: Culture and wellbeing

US polling responses



Source: Ipsos polling of 3026 US adults, 2023

Notes: Respondents agreeing with "Arts and culture improve my community's quality of life and liveability", "Arts and culture are personally important to me" and "I sing in the shower".

75. For many countries, the creative industries are a powerful cultural export. Trade in creative services, such as video games, music and film, has found huge appeal with global audiences. South Korean entertainment, such as K-Pop, has supported the nation's cultural diplomacy. BTS, a famous K-Pop group, have spoken at the United Nations General Assembly several times and were referred to by the British monarch during the Korean state visit (Syed, 2023). A thriving creative industry can have positive benefits domestically and on the world stage.

The creative industry and technology – case studies

76. AI represents the latest transformative technology in the creative industries, which have historically been frontier adopters of technology. In this section we look back at the impact of past technologies before looking at current examples of the use of AI. The case studies, old and new, reveal useful lessons about how AI may impact the creative industries.

- **Music: synthesisers**. Initially maligned by artists and unions, these tools led to new roles, and genres of music.
- **Film: VFX**. The introduction of CGI dramatically changed filmmaking. It unlocked new visual possibilities and distributed production globally.
- **Japan: Anime**. A labour-intensive sector prone to production inefficiencies, the use of AI is showing early signs of improving working processes.
- **Gaming**. The games industry has long been at the frontiers of computing. AI is bringing both complementary and substitution effects on skills.

Case 1: Music – synthesisers

77. Synthesisers make sounds using electronic waveforms and can mimic—i.e., artificially generate the sound of—many instruments. They therefore provide an interesting historic case study to contextualise generative AI.

78. The first synthesisers, such as the Moog Modular (1964), offered novel tones and sonic possibilities. However, their potential to displace musicians concerned many in the industry. Unions and industry stakeholders quickly lobbied to slow their spread:

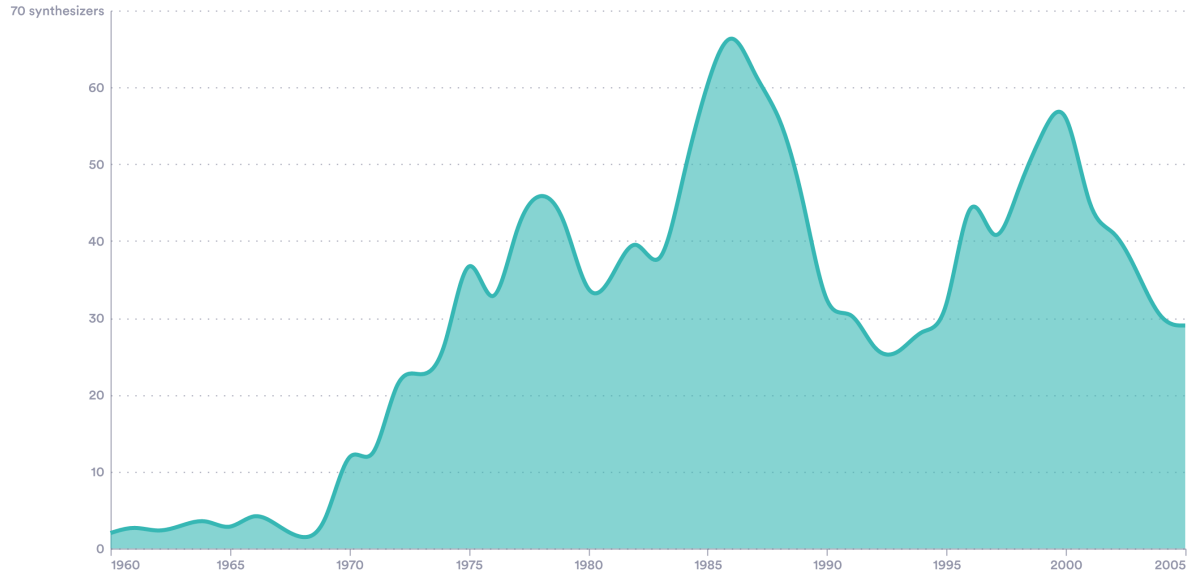
- **American Federation of Musicians (AFM).** In 1969, the AFM negotiated a contract that banned the use of synthesisers in commercials, aiming to protect musicians from displacement (Pinch, 2004).
- **UK Musicians' Union (MU).** In May 1982, following controversy over Barry Manilow's use of synthesiser strings, the Central London branch of the MU passed a motion calling for an outright ban on synthesisers. Although this did not become official union policy, it attracted significant attention and the union banned synth-players until 1997 (MU, 2016).
- **Industry pressure.** Pioneering synth acts, such as Beaver & Krause report strong union pressure. The AFM allegedly threatened to 'shut [them] down' if they used synths that sounded like real instruments (Pinch, 2004).

79. Reception by musicians themselves was mixed. Some artists embraced the new possibilities offered by synthesisers, while others saw them as artificial or even threatening. The best-known rejection came from the band Queen, who labelled their 1970s album sleeves with the declaration "No Synthesisers!". Conversely, other artists were enthusiastic adopters; for example, New Order's "Blue Monday" (1983) marked a dramatic shift toward a fully synthesised sound. By the mid-1980s, most scepticism had faded. Queen's 1980 single "Play the Game" used synthesisers.

80. The technology diffused widely as availability improved and prices dropped (Figure 22). The release of new synthesisers steadily increased as resistance abated. Landmark instruments like the Minimoog (1970) and later the Yamaha DX7 (1983) which sold over 200,000 units, further aided adoption (Lavengood, 2022). By the late 1980s, the number of commercially released synthesiser models peaked. Synthesisers had become ubiquitous.

Figure 22: Synthesiser development

New models released each year, 1960-2005



Source: Iftah Gabbai (2024), authors' calculations

81. There are no detailed studies that directly focus on the impact of artificial sounds on output and employment in the music industry. However, between 1970 and 2000 the music industry grew strongly, with sales rising from under $5 billion to over $40 billion (Leyshon et al., 2005). Data that cover both music and cinema for the US show growing employment during this period (BEA, see chart in next section). There is little to suggest a damaging link between the technology and labour market in this period. The main economic criticism at the time did not relate to technology, but to the reduction in competition through corporate mergers: the C4 concentration ratio (the sales of the top 4 firms in the industry) rising from 50% to over 80% during this period (Bakker, 2012).

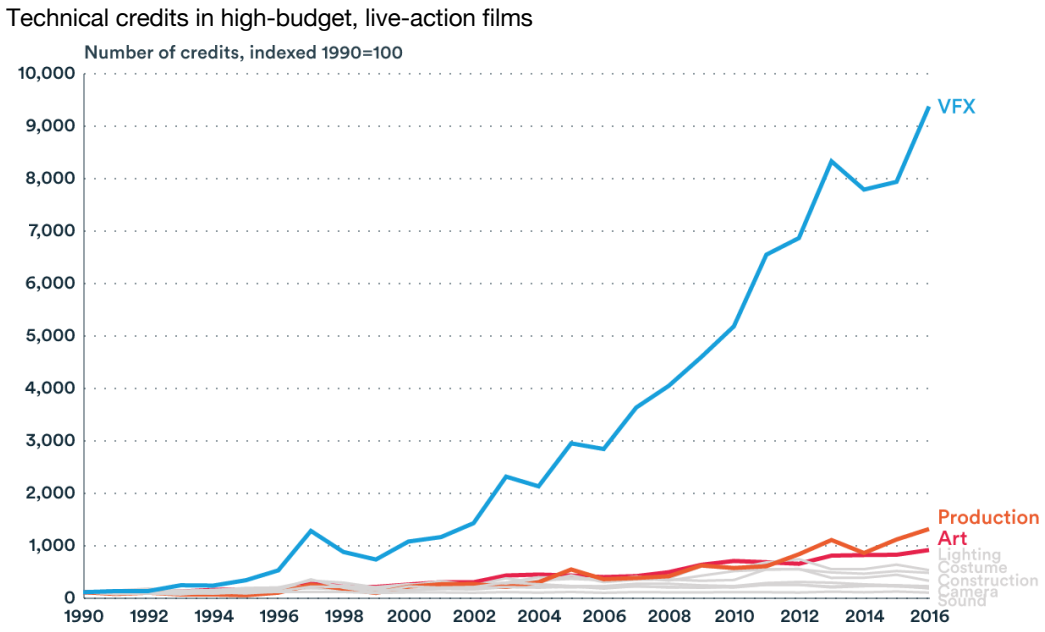
82. Today, synthesisers, once regarded as futuristic and alien, are so deeply embedded in music production as to be unremarkable. Indeed, the raw, unmistakable sounds of early synthesisers are now associated with a retro aesthetic. What was controversial is now a thing of the past.

Case 2: The film industry and VFX

83. Visual effects (VFX) in cinema or television are a broad category, referring to any steps which create images or sequences that are not live-action shots. As with synthesisers, they create content that is, in this sense, "artificial". Relying on continually evolving technology, they provide another useful study when considering AI.

84. VFX has existed since the earliest days of cinema. But the introduction of digital VFX in the early 1990s was a technological leap. Films such as *Terminator 2: Judgement Day* (1991) and *Jurassic Park* (1993) introduced global audiences to photorealistic characters and environments that would have been impossible with physical, hand-made, effects alone. While Computer Generated Imagery (CGI) required significant initial investment, it ultimately reduced production costs compared to building elaborate physical effects like miniature models, matte paintings, and animatronics.

Figure 23: The rise of visual effects



Source: Authors' calculations, Gowanlock (2020), IMDB
Notes: Credits in 15 highest budget live actions films of each year.

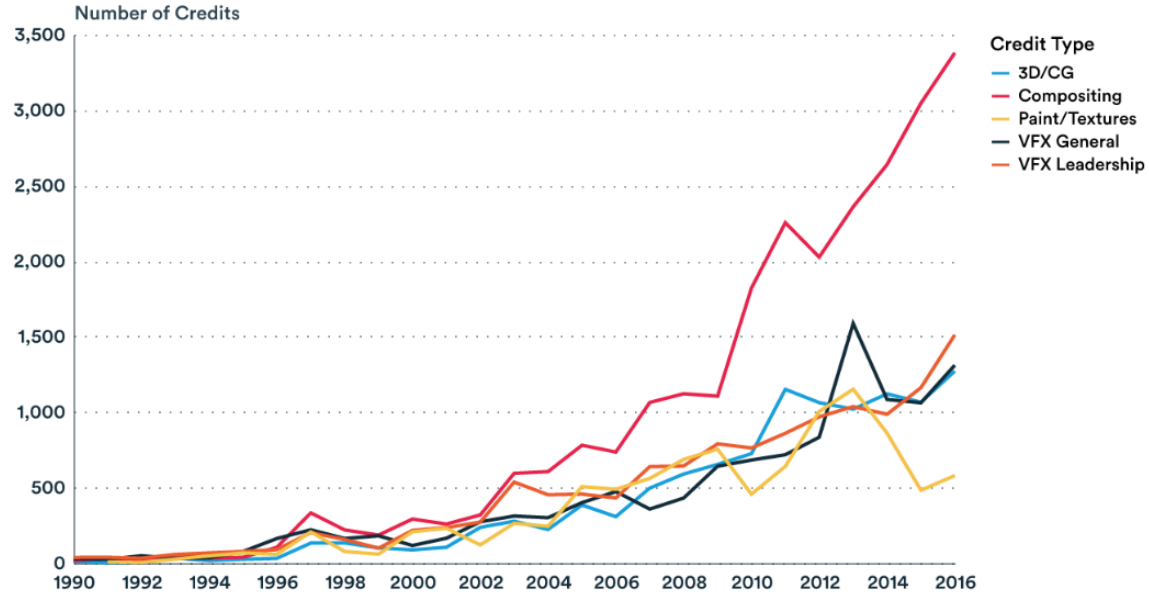
85. While VFX impressed many, they also received pushback from some corners of the film industry. The VFX prompted fears of displacement among traditional model makers, animators and matte painters. Phil Tippett, a veteran effects supervisor initially hired to manually animate Jurassic Park's dinosaurs quipped, "I've just become extinct" upon seeing the first CGI tests – a line Steven Spielberg incorporated into the film (Don, 1993). Some industry bodies also viewed digital

tools with suspicion. *Tron* director Joseph Kosinski claimed that the CGI-heavy film was “disqualified” from the visual-effects Oscar because the Academy considered its computer “cheating” (Lopez, 2010).

86. But the new technology created new skills and jobs. CGI-based VFX were embraced in blockbuster productions, rapidly increasing the number of VFX artist jobs. CGI adoption drove significant employment growth in VFX (Figure 23). Technical credits in the 15 highest-budget films each year from 1990 to 2010 show dramatic increases across all VFX categories. Compositing, the process of combining multiple visual elements into single images, became the most common VFX role (Figure 24). This employment boom transformed VFX into an important film industry sub-sector.

Figure 24: VFX credits by category, 1990-2016

Credits in the 15 highest budget live-action films each year in the animation, art, camera, costume, sound, special effects, and visual effects categories.

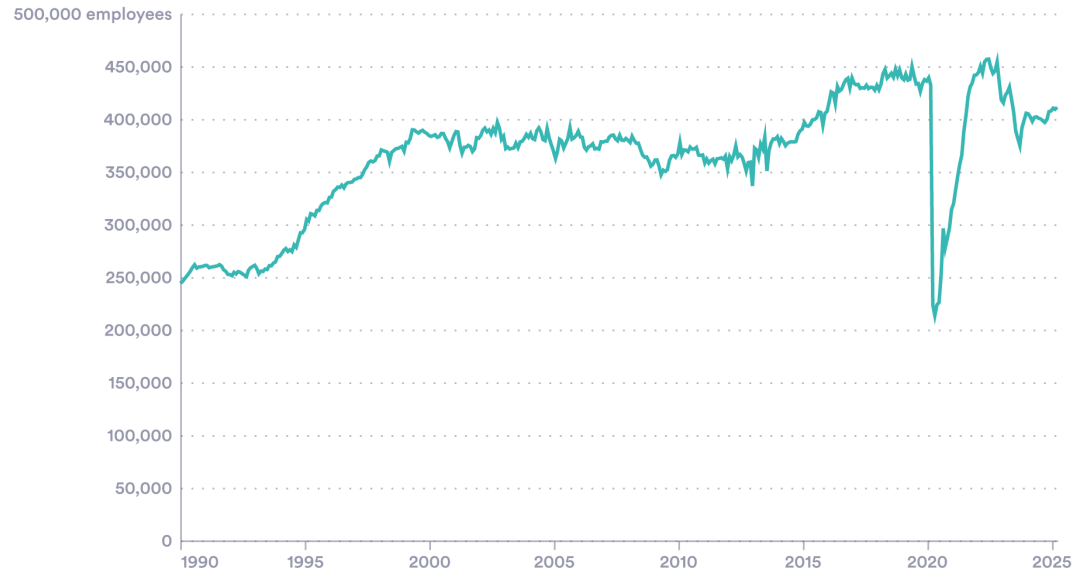


Source: Gowanlock (2020) using IMDB data.

87. VFX offers lessons in diffusion, one of the key metrics our academic review, above, suggests will determine the impact of AI. As digital VFX technology matured, its cost dropped rapidly. Elements that are now ubiquitous were initially restricted to high-budget films. For example, New Line Cinema’s The Lord of the Rings trilogy (2001–2003), which pioneered motion capture technology for the character Gollum, was then the most expensive back-to-back film production in history (BFI, 2012). Just six years later, *District 9* (2009) achieved similar CGI quality at a fraction of the cost. In less than a decade, high-quality VFX had diffused from Hollywood blockbusters to smaller lower-budget productions.

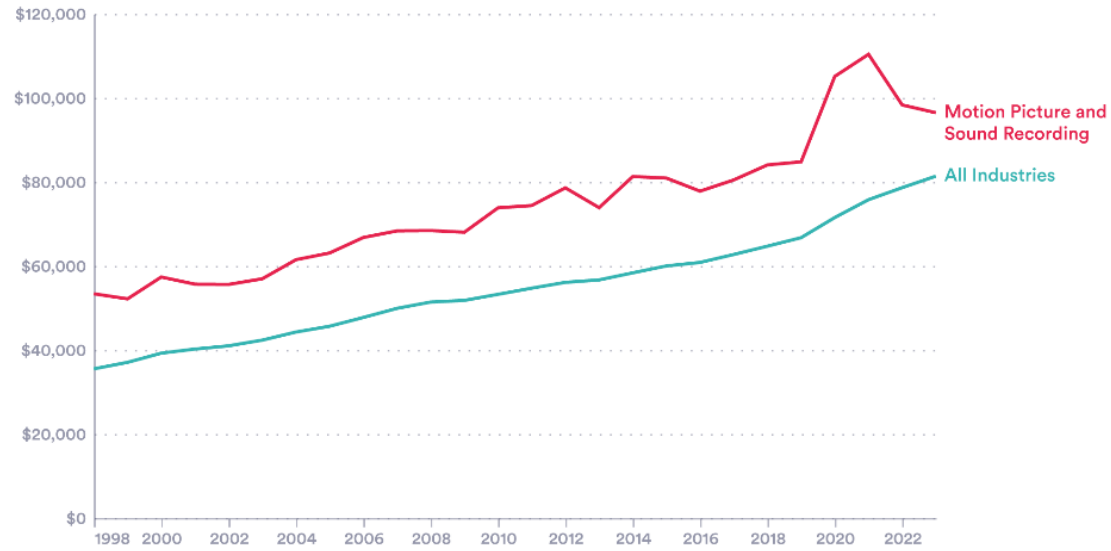
88. The available evidence shows no drag on employment. There are no long-run data series specifically on VFX employment. However, the US Bureau of Economic Analysis tracks jobs in cinema and sound recording. Headline employment rose strongly through the 1990s and was broadly stable through the 2000s before another strong rise in the 2010s (Figure 24). Wages also grew at comparable rates to the US economy (Figure 26). Given that this is a period of widespread technology adoption in these sectors, a negative link between technology and employment seems unlikely.

Figure 25: Employment: Motion Picture and Sound Recording



Source: BEA via FRED (2025)

Figure 26: Wages: Motion Picture and Sound Recording



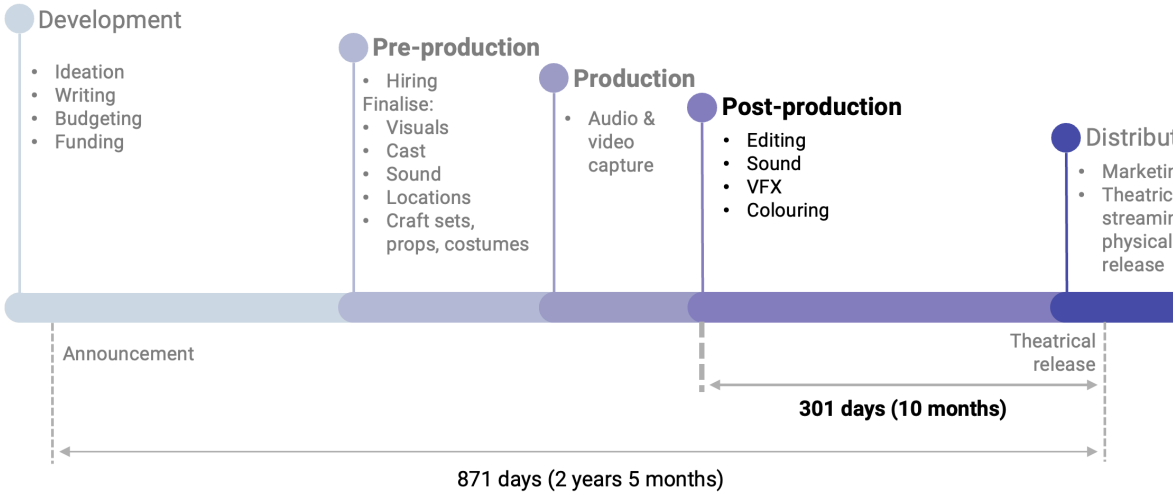
Source: BEA via FRED (2025)

89. More recently, VFX have begun to rely on AI technology. This started with deep learning models for rotoscoping, stabilisation, and other elementary tasks but now includes more sophisticated generative AI. Studios are strategically investing in new AI-driven VFX technologies such as de-aging actors, as countries vie for industry leadership. France is home to several growing VFX studios embracing AI specialisation, such as MacGuff Studios, which has deployed its 'Face Engine' tool on multiple major TV series, winning a César special award in the process. AI capabilities are also propelling South Korea to become a VFX leader, with content exports growing by $4bn in four years (see Box 4).

90. AI can save time and costs across all stages of the VFX process. The typical film spends over 10 months in post-production (Figure 27). AI-powered tools in post-production assist with compositing and quality control, helping identify and fix technical issues that would traditionally require multiple review cycles. Increased post-production productivity could shorten film release timelines. Murodillayev (2024) estimates that the use of AI in VFX results in a 10-15% reduction in films' production times.

Figure 27: The importance of post-production

A stylised film production process



Source: Follows (2018), authors' illustration

91. At the same time as embracing AI, the global VFX industry is projected to grow significantly – from $10.8bn in 2023 to $25bn in 2030 (Research & Markets, 2023). AI has streamlined many VFX processes, enabling more complex and realistic visuals which were previously too resource intensive. These technological advances mean more ambitious projects can be undertaken with tighter timelines and budgets (Research & Markets, 2023). The story so far is one of augmentation, rather than replacement: AI may reduce the number of VFX hours required for a given effect, but demand for VFX technicians is growing as increasingly ambitious projects are being undertaken.

Box 4. AI in Korean VFX

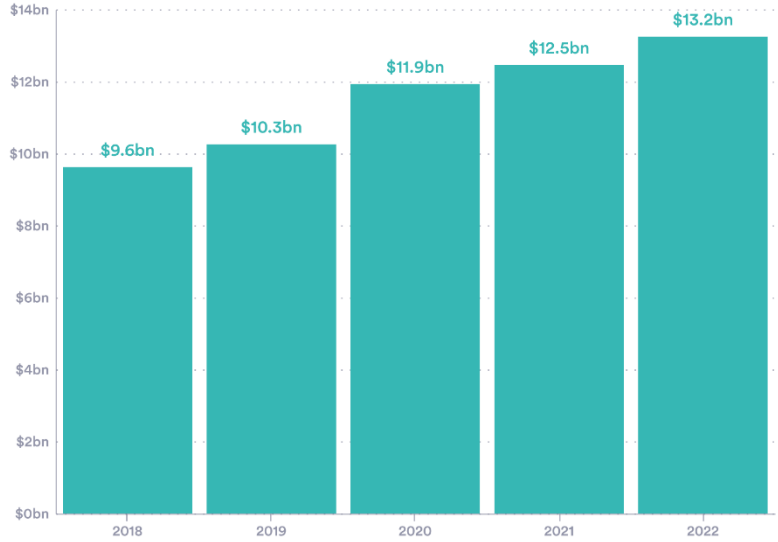
Over the last decade, South Korea's film industry has become a leading cultural force. Films such as Parasite (2019) and Minari (2020) have found international acclaim with a new audience. In addition to a booming film industry, Korean VFX companies are using AI to offer cutting-edge visual effects to international clients in the post-production process.

In 2010, only 10% of Korea's VFX work was for overseas projects, but by 2017, that number had surged to 56% (KOCCA, 2024). This increase was largely driven by demand from China but also included work on American blockbusters such as *Spider-Man: No Way Home* (2021) and *The Batman* (2022).

The success of the industry has created an export opportunity. Korean content exports—spanning film, books, animation, games, and other digital content—have seen significant growth, increasing 37% from $9.6bn to $13.2bn in just four years (Figure 28).

Figure 28: South Korean creative exports

Annual exports of South Korea's 'content industry', 2018-2022



Source: Korea Creative Content Agency, KOCCA (2023), author's calculations

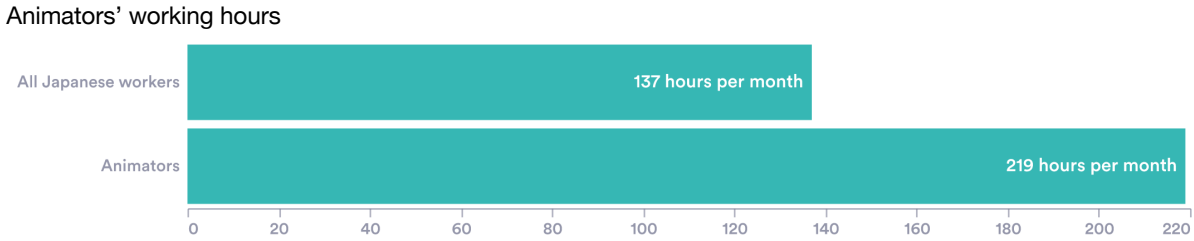
AI is playing an increasing role in the Korean VFX industry. For example, Seoul-based Gulliver Studio has employed de-aging technology for Big Bet, a Disney+ drama, incorporating AI to alter an actor's appearance and voice over time. In addition to established VFX houses, Korean start-ups are also leading AI-driven innovation in the industry. Beeble AI, for instance, has developed an AI-powered virtual production platform that allows filmmakers to create high-quality visual effects without expensive equipment. As South Korea's VFX industry expands, AI enables both artistic innovation and commercial growth

Case 3: Anime

92. Anime, a style of animation, is a dominant and growing Japanese cultural export. Emerging in Japan in the 1960s, the industry has since become global, with an international fanbase. Overseas consumption of anime grew to $11bn in 2023, and investment from international platforms including Netflix and Crunchyroll has accelerated its global reach (Masuda et al., 2023). Studio Ghibli's *The Boy and the Heron* won the 2024 Academy Award for Best Animated Feature. It is also a sector adopting generative AI.

93. Working conditions are notoriously demanding in the anime industry, with long hours and low pay. According to the Nippon Animation Film Culture Association, almost 40% of workers make less than 200,000 yen ($1300) a month (NAFCA, 2024). The average animator's workload is close to 220 hours a month, 80 hours more than the average Japanese worker (Figure 29). There are an estimated 6,000 anime artists working in Japan, yet this workforce is forecast to shrink, not grow, to 5,600 by 2030 (Mochizuki and Yokoyama, 2025). This economic pressure has led to industry-wide concerns about sustainability and talent retention.

Figure 29: Accelerating Japanese Animation



Source: NAFCA (2024), OECD (2024), authors' calculations

94. Production inefficiencies compound these challenges. Much of workers' time is spent on routine and menial tasks rather than core creative activities. The production of anime requires a huge number of digitally rendered frames, motion interpolation, and lighting adjustments. Traditional anime production demands approximately 3,000 to 4,000 drawings for a single 20-minute episode (Watanabe, 2015; Zhao, 2021). Even with digital tools, animators must create numerous character drawings for different poses, expressions, and movements.

95. AI is being used as a solution to these problems. AI tools have allowed animators to automate repetitive tasks and focus on more creative ones. An early adopter has been Nagoya-based animation studio K&K Design. Animators typically spend significant time filling the "in-between frames," the transitional moments

between dialogue or action. Animators at K&K report using AI tools to reduce this workload from a week manually to four or five hours (Nagao, 2024; NHK 2024). This dramatic time saving allows studios to meet tight production schedules while maintaining quality.

96. Japan has an aging and declining population and a workforce shortfall. At an economy-wide level, the challenge is to encourage more over-65s to work. One example from anime shows how AI could help here. The veteran Manga artist Yoshimi Kurata, who now teaches junior animators, has turned to AI tools to extend his creativity into old age. According to an NHK World report (2024), Kurata, now 70, has partnered with South Korean firm Alpha Lab AI and a local production studio to explore AI-augmented creation. In this case, models are trained from an individual creator's output to generate personal and consistent artwork.

97. In both these cases, the human element remains central. Empowering creatives with AI tools, rather than automating their jobs, enhances rather than replaces workers' creativity. At K&K, frame generation is employed by animators, who then refine the output. This approach means human expression is centred, not sidelined. Artists maintain control over the final product, using AI-generated frames as a foundation for further artistic refinement. For Kurata, the AI learns from his decades of work to generate art that is in his distinctive style. These are examples of augmentation, rather than replacement.

Case 4: Video Games

98. Gaming is a dominant global entertainment sector. Though it receives less mainstream attention than either, it generates more revenue than film and music combined ($184bn in 2024; Dentsu, 2024). It is also a technically advanced field that has been at the forefront of developments in information technology. With the rapid growth of AI capability, gaming has positioned itself as an early adopter and an innovation driver in AI, with its immersive and interactive experiences providing fertile ground for AI integration.

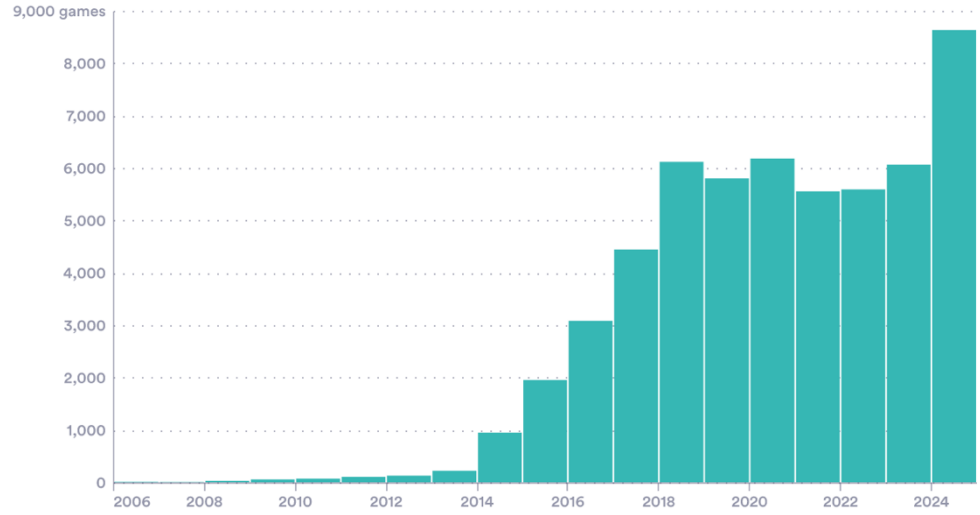
99. AI technology and game development share an intertwined evolution. For decades, consumer demand for increasingly realistic graphics drove hardware development—in particular graphics cards, a type of processing chip. These chips, which allow parallel processing to render game environments, proved ideal for the trillions of matrix operations needed to train modern AI models. Nvidia, today, a leader in AI hardware with a market value exceeding $2tn, built its foundation as a gaming graphics card manufacturer.

100. The sector remains at the frontier of AI. Games, with complex but structured interactions and embedded scoring mechanisms, representations prove an ideal testing benchmark and source for model feedback. Before the GPT series, OpenAI saw early research success with OpenAI Five, a team of neural networks that defeated world champions in the complex strategy game Dota 2 (OpenAI, 2018).

101. Gaming is a case study in diffusion. Several technologies have supported this, with accessible game engines (e.g. Unity) and open-source libraries and tools ensuring that technical barriers have fallen. Digital distribution platforms fundamentally altered the industry's structure. Physical production requirements and retail gatekeepers were removed and a wave of 'indie' titles from solo and small developers followed. On the now dominant Steam platform, just 12 indie games were released in 2006. Today, that figure exceeds 8,600 annually (Figure 30; SteamDB, 2025). A foundational technology (faster home internet) catalysed a market-specific technology (digital distribution) that then transformed the industry.

Figure 30: Online ‘indie’ game releases

Number of games released on Steam by year, 2006-2024



Sources: SteamDB (2025)

102. The gaming industry has integrated AI rapidly. The CVL Economics (2023) survey of creative industry managers reveals nearly 90% of gaming companies have adopted or are in the process of adopting generative AI programs. The integration is expected across numerous production processes, with executives anticipating AI will contribute to more than half of game development within five to ten years. Survey respondents expect AI to play substantial roles in 3D modelling (55%), concept art generation (40%), sound design (37%), animation and motion capture (28%), and lighting and texturing (27%).

103. Employment numbers are volatile in the gaming industry. During the pandemic, as lockdowns led to more people gaming at home, the industry boomed. Demand rose and employment followed. The global gaming market grew by 26% between 2019 and 2021. In the US, employment rose 12% - by 28,000 – over the same period. The industry has since cooled: in 2023-4, over 25,000 workers were made redundant (Ball, 2025).

104. Given this fragility, some workers are concerned about AI. The 2024 Game Developers Conference (GDC) Survey showed a sharp decline in optimism about generative AI: in 2023, 21% of developers viewed its impact positively and 18% negatively; by 2024, only 13% were positive, while 30% reported a negative impact (GDC, 2025). Industry professionals report anxiety about job security, with concept artists, illustrators and 2D artists appearing most vulnerable as AI image generation approaches human-quality; such workers have been disproportionately affected as the industry downsizes (Merchant, 2024).

105. Start-ups are key in these developments. A wave of new companies has embraced generative AI tools to lower barriers to entry and offer faster, cheaper game development. Since the 2021 acceleration of generative AI, several have emerged.

- **Visual elements**. Start-ups, including Scenario, a visual AI platform that allows studios to train models with their own visual property, and Latent Technology, which enables real-time AI character animation, are helping developers automate lengthy visual workflows.

- **Characters and storytelling**. Companies such as Inworld AI, which has tested intelligent non-player characters with memory and personality, and Charisma.ai, which powers branching dialogue, offer the potential for more dynamic, interactive narratives.

- **Creative ideation**. Platforms such as Ludo.ai are streamlining game concept creation. Concept art, brainstorming and elementary game design are accelerated with AI-assisted tools.

106. Tailored AI-powered tools from start-ups are finding commercial applications. For instance, Ubisoft partnered with Scenario AI to create characters for *Captain Laserhawk: the* G.A.M.E (Scenario, 2025). The studio used the tool to create thousands of unique characters, at a scale infeasible through manual creation. For production workflows, Microsoft has formed a partnership with Inworld AI to develop tools for dialogue, story, and quest creation (Warren, 2023). Together, these start-ups exemplify the diffusion of AI capabilities from research labs to commercial applications, with benefits spreading to both large studios and independent developers.

107. Both the task substitution and augmentation effects set out above are seen in game development. Ubisoft's work with Scenario AI, mentioned above, shows the dual impact; AI created the characters, work traditionally done by concept artists. Yet it shifted rather than eliminated human contributions, with developers focusing on artistic direction and quality control. Meanwhile, AI is leading to the creation of new roles. Electronic Arts, among the largest game publishers, has established dedicated AI research teams, with researchers exploring the application of AI to game development processes.

Case studies: lessons

108. Several themes emerge from the case studies.

- **Value of tasks.** Across the creative industries, AI tools have been adopted in tasks ranging from low-value repetitive processes to high-value creative inputs. In anime, for example, AI has predominantly been used in lower value tasks. New design companies have started to automate the generation of in-between frames to speed up production, while key-frame creation is left fully to artists.

  In other fields, AI tools complete valuable tasks. In VFX, the first implementations were in lengthy but specific tasks, such as rotoscoping. Generative systems have transformed the sector, including high-value CGI production. In gaming, adoption spans the industry's activities. Executives anticipate integration across 3D modelling (55%), concept art (40%), and sound design (37%; CVL Economics, 2023). With such a wide range of applications, there is little evidence that in the creative industries AI tools only target "low hanging fruit", one of the ideas that the more sceptical forecasts of AI impact rely on.

- **Diffusion.** Technology adoption follows distinct patterns across the creative industries. Cutting-edge innovations often diffuse from high-budget to lower-budget contexts. Advanced CGI that emerged in blockbusters during the 1990s rapidly filtered down to smaller productions within a decade. Similarly, synthesisers evolved from expensive bespoke instruments to mass-market tools. What begins as exclusive soon becomes standard.

  Start-ups are vital, since diffusion can occur in all directions, not just from the largest firms. AI is spreading both top-down and bottom-up. Tech giants have invested billions into foundation models and AI hardware. Yet applications in the creative industries often show the reverse trajectory. In VFX and gaming, firms like Runway and Scenario have pioneered generative AI tools subsequently adopted by established studios through strategic partnerships. New players, with fresh ideas and outlooks, have demonstrated new approaches to creative processes.

- **Regulation.** In many cases regulators slow down or hamper the use of new technology. Hasty intervention can misfire when technologies mature in ways

no one anticipates. In their first years, synthesisers faced strong union and artist resistance. But the instruments unlocked new sounds and genres.

Restrictive regulations can redirect investment to more favourable jurisdictions. Today creative efforts are truly global. The global nature of creative production means post-production can easily move between hubs like Los Angeles, Mumbai and Seoul. South Korea has built a world-class VFX sector by taking on more foreign work and seen its content exports boosted by $4bn.

- **Replacement, augmentation and job creation.** Job displacement concerns accompany most new technologies. The most pressing case we found appears to be the gaming industry. However, Ubisoft's work with Scenario AI demonstrates how roles adapt rather than disappear.

  There are clear examples of augmentation and job creation. In the case of anime, AI is being used to extend the workforce by augmenting the skills of elderly artists and save the time of younger ones—a textbook case of augmentation to provide more and better work, rather than replacing it. As technological breakthroughs such as VFX have shown, AI can introduce new roles and skills, even as it shifts the contribution made by the human workforce.

109. The evidence presented in this report demonstrates that AI is becoming embedded in creative industries worldwide. Like previous technological advances, it is creating both opportunities and challenges. It is a transformative technology, but further adoption and impact are not guaranteed; historical patterns show technology diffusion is often indirect, prolonged and uneven. Policymakers therefore face a critical balancing act. They must create conditions that maximise productivity benefits whilst helping workers navigate transitions effectively. With proper planning, strategic investment, targeted skills development and proportionate regulation, AI can boost the creative industries helping them, in turn, contribute to a growing economy.

Glossary

Machine Learning (ML). A branch of AI where algorithms learn patterns from data rather than fixed rules, improving performance through experience. Models trained on past examples can then predict, classify or create new outputs.

Artificial Intelligence (AI). Umbrella term for systems that mimic human cognitive functions. They learn from data (adaptability) and act with some independence (autonomy) to solve tasks.

Generative AI. Subset of AI that creates new content—text, images, audio, code or video—rather than just analysing data. Deep models learn the patterns of huge datasets and, from a prompt, synthesise plausible originals.

Deep Learning. Advanced machine learning that trains very large, multi-layer ("deep") neural networks to extract increasingly abstract features from data. Deep architectures enable learning hierarchical representations without manual feature engineering.

Foundation (Base) Model. Large AI systems pre-trained on vast, varied data, giving it broad, general knowledge. These models capture broad knowledge and patterns that can be refined for specific applications.

Multimodal Model. AI that natively links several data types—text, images, audio, video—inside one network. It can describe a picture, draw an image from a caption or sync speech with animation using shared "sense-making".

Transformers. Neural networks that process entire sequences simultaneously, using attention mechanisms to weigh relationships between elements regardless of distance, enabling powerful language understanding.

Self-attention. Mechanism allowing models to weigh relationships between all sequence elements by computing relevance scores, helping capture context regardless of positional distance.

Neural Networks (Artificial). Brain-inspired webs of simple computing units ("neurons") organised in layers. They process data through weighted connections, learn patterns via repeated exposure, and excel at tasks requiring pattern recognition.

Large Language Models (LLMs). Neural networks trained on vast amounts of text data to predict and generate human language. These models learn statistical patterns in language, enabling text generation, translation, summarisation, and conversational abilities.

Generative Adversarial Networks (GANs). AI systems using two competing networks: a generator creating synthetic data and a discriminator identifying fakes. This competition drives the generator to produce increasingly realistic outputs mimicking training data.

Diffusion. Generative models that gradually transform random noise into structured data by learning to reverse a process that adds noise. They create high-quality images by iteratively denoising random patterns.

References

Acemoglu, D. (2024). *The simple macroeconomics of AI*. Massachusetts Institute of Technology. https://economics.mit.edu/sites/default/files/2024-04/The%20Simple%20Macroeconomics%20of%20AI.pdf

Acemoglu, D., & Restrepo, P. (2003). *Labor and capital augmenting technical change*.

Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labor. *Journal of Economic Perspectives, 33*(2), 3–30.

Adobe Communications Team. (2024, February 2). Creative pros are leveraging generative AI to do more and better work. https://blog.adobe.com/en/publish/2024/02/02/creative-pros-generative-ai-usage

Agency for Cultural Affairs, Japan [ACA]. (2024, July). *Cultural Administration Research Survey: A quantitative evaluation—The economic and social effects of culture FY 2023* (p. 46). https://www.bunka.go.jp/tokei_hakusho_shuppan/tokeichosa/bunka_gyosei/pdf/94092701_01.pdf

Albanesi, S., Dias da Silva, A., Jimeno, J. F., Lamo, A., & Wabitsch, A. (2023). New technologies and jobs in Europe (ECB Working Paper No. 2831). European Central Bank.

Allen, R. C. (2009). Engels' pause: Technical change, capital accumulation, and inequality in the British Industrial Revolution. *Explorations in Economic History, 46*(4), 418–435. https://doi.org/10.1016/j.eeh.2009.04.004

Americans for the Arts [AFTA]. (2023). *Public opinion poll*. Retrieved April 30, 2025, from https://www.americansforthearts.org/by-program/reports-and-data/research-studies-publications/public-opinion-poll

Autor, D. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives, 29*(3), 3–30.

Autor, D. (2022). The labor market impacts of technological change: From unbridled enthusiasm to qualified optimism to vast uncertainty (NBER Working Paper No. 30074). National Bureau of Economic Research. https://doi.org/10.3386/w30074

Autor, D.H., Levy, F., & Murnane, R.J. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics, 118*(4), 1279–1333. https://doi.org/10.1162/003355303322552801

Baily, M. N., Brynjolfsson, E., & Korinek, A. (2023, May 5). Machines of mind: How generative AI will power the coming productivity boom. Brookings

Institution. https://www.brookings.edu/articles/machines-of-mind-how-generative-ai-will-power-the-coming-productivity-boom/

Bakhshi, H., Frey, C.B., & Osborne, M. (2015). *Creativity vs. robots: The creative economy and the future of employment*. Nesta. https://media.nesta.org.uk/documents/creativity_vs.*robots_wv.pdf*

Bakker, M. *(2012). Adopting the rights-based model: Music multinationals and local music industries since 1945. Popular Music History, 6(3).*

Ball, M. *(2025). The state of video gaming in 2025. January 14. https://static1.squarespace.com/static/5d8e9007bc3d0e18a4c49673/t/6818d7268f25c47322b6ca06/1746458432650/Gaming2025_vMay.5.2025-COMPRESSED.pdf*

Bank of England. (2016) [BOE]. *A millennium of macroeconomic data for the UK* (Version 3.1, updated to 2016) [Data set]. Retrieved May 7, 2025, from https://www.bankofengland.co.uk/-/media/boe/files/statistics/research-datasets/a-millennium-of-macroeconomic-data-for-the-uk.xlsx

Bernhofen, D., El-Sahli, Z., & Kneller, R. *(2016). Estimating the effects of the container revolution on world trade. Journal of International Economics, 98, 36–50. https://EconPapers.repec.org/RePEc:eee:inecon:v:98:y:2016:i:c:p:36-50*

Bhattacharjee, A., et al. *(2024, June). Productivity. NIESR General Election Briefing. https://niesr.ac.uk/wp-content/uploads/2024/06/NIESR-GE-Briefing-2024-Productivity.pdf*

Bick, A., Blandin, A., & Deming, D. (2024, September). *The Rapid Adoption of Generative AI*. Federal Reserve Bank of St.Louis. https://www.stlouisfed.org/on-the-economy/2024/sep/rapid-adoption-generative-ai

Bolt, J., & van Zanden, J. L. *(2024). Maddison-style estimates of the evolution of the world economy: A new 2023 update. Journal of Economic Surveys, 1–41.*

Briggs, J., & Kodnani, D. *(2024). Generative AI could raise global GDP by 7 percent. Goldman Sachs. https://www.goldmansachs.com/insights/articles/generative-ai-could-raise-global-gdp-by-7-percent*

British Film Institute [BFI]. *(2012). The Lord of the Rings: The Fellowship of the Ring. Accessed via Internet Archive October 24: https://web.archive.org/web/20121024023157/http://ftvdb.bfi.org.uk/sift/title/597740*

Brookings Institution. *(2024, April 12). Hollywood writers went on strike to protect their livelihoods from generative AI. Their remarkable victory matters for all workers. https://www.brookings.edu/articles/hollywood-writers-went-on-strike-to-protect-their-livelihoods-from-generative-ai-their-remarkable-victory-matters-for-all-workers/*

Brynjolfsson, E., Rock, D., & Syverson, C. *(2017). Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics (NBER Working Paper No. 24001). National Bureau of Economic Research. https://doi.org/10.3386/w24001*

Bureau of Economic Analysis [BEA]. *(2025). Arts and cultural production satellite account. https://www.bea.gov/data/special-topics/arts-and-culture*

Bureau of Labor Statistics [BLS]. *(2025, March 11). AI impacts in BLS employment projections. The Economics Daily. https://www.bls.gov/opub/ted/2025/ai-impacts-in-bls-employment-projections.htm*

Cashion, F., & O'Brien, J. *(2024, December 12). Generative AI takes off with marketers. American Marketing Association. https://www.ama.org/marketing-news/generative-ai-takes-off-with-marketers/*

CVL Economics. (2023). Assessing Generative AI's Impact on the Entertainment Industries*. https://www.cvleconomics.com/case-study/assessing-generative-ais-impact-on-the-entertainment-industries/*

David, P. A. *(1989). Computer and Dynamo: The modern productivity paradox in a not-too-distant mirror (TWERPS 339). University of Warwick, Dept. of Economics.*

David, P. A. *(1990). The dynamo and the computer: An historical perspective on the modern productivity paradox. American Economic Review, 80(2), 355–361.*

De Lyon, J. & Dhingra, S. (2021). The impacts of Covid-19 and Brexit on the UK economy: Early evidence in 2021 (CEP COVID-19 Analysis No. 021). Centre for Economic Performance, LSE.

Dentsu. *(2024). 2024 State of gaming. https://www.dentsu.com/uk/en/our-latest-thinking/state-of-gaming*

Department for Culture, Media and Sport [DCMS]. *(2024, February 15). DCMS sectors economic estimates: Gross value added 2022 (provisional). https://www.gov.uk/government/statistics/dcms-and-digital-sector-gva-2022-provisional/dcms-sectors-economic-estimates-gross-value-added-2022-provisional*

Department for Science, Innovation and Technology [DSIT]. *(2025). AI opportunities action plan.*

Draghi, M. *(2024). The Draghi report on EU competitiveness. European Commission. https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en*

Epoch AI. *(2024). Data on notable AI models. https://epoch.ai/data/notable-ai-models*

European Commission [EC]. *(2024). Protecting competition in a changing world: Staff report 2024. https://competition-policy.ec.europa.eu/system/files/2024-*

06/KD0924494enn_Protecting_competition_in_a_changing_world_staff_report_2024.pdf

Eurostat. *(2024). Culture statistics – cultural employment. Retrieved May 2024, from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics-*_cultural_employment

Federal Reserve Bank of St. Louis. (n.d.). CES5051200001: Employment, Motion Picture and Sound Recording [Data set]. FRED. Retrieved 7th May 2025, from https://fred.stlouisfed.org/series/CES5051200001

Federal Reserve Bank of St. Louis. (n.d.). CES5051200001: Employment, Motion Picture and Sound Recording [Data set]. FRED. Retrieved 7th May 2025, from https://fred.stlouisfed.org/series/CES5051200001

Feenstra, R.C., Inklaar, R., & Timmer, M.P. (2015). The next generation of the Penn World Table [Working paper]. Groningen Growth and Development Centre. Retrieved from https://www.rug.nl/ggdc/docs/the_next_generation_of_the_penn_world_table.pdf

Feenstra, R.C., Inklaar, R., & Timmer, M.P. (2015). The next generation of the Penn World Table. *American Economic Review, 105*(10), 3150–3185.

Fouse, S., Cross, S., & Lapin, Z. J. (2020). DARPA's impact on artificial intelligence. *AI Magazine, 41*(2), 3–8. https://ojs.aaai.org/aimagazine/index.php/aimagazine/article/view/5294?utm_source=chatgpt.com

Frey, C.B., & Osborne, M. (2017). The future of employment: How susceptible are jobs to computerisation?

Future Unscripted: Assessing Generative AI's Impact on the Entertainment Industries. (2024, January). CVL Economics. https://www.cvleconomics.com/case-study/assessing-generative-ais-impact-on-the-entertainment-industries/

Game Developers Conference [GDC]. (2025). GDC State of the Game Industry 2025. https://gdconf.com/news/gdc-2025-state-game-industry-devs-weigh-layoffs-ai-and-more

Goodfellow, I. J., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2014). Generative adversarial networks (arXiv:1406.2661). *arXiv*. https://arxiv.org/abs/1406.2661

Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2014). Generative adversarial networks. *Communications of the ACM, 63*(11), 139–144. https://doi.org/10.1145/3422622

Google Books Ngram Viewer. (n.d.). Ngram of "AI," 1800–2022 [Data visualization]. Retrieved 7th May 2025, from https://books.google.com/ngrams/graph?content=AI&year_start=1800&year_end=2022&corpus=en&smoothing=3

Government Commercial Function [GCF]. (2023). *Intellectual property rights: Guidance note.*

Gowanlock, J. (2020) Changes in the production departments of IMDb's top 250 movies. *Medium*. https://medium.com/@jordangowanlock/changes-in-the-production-departments-of-imdbs-top-250-movies-45b6344d23db

Griffiths, D. (2023, November 23). "'No synthesizers'? No way! How Queen backtracked on a boast, embraced synths and went stratospheric." *MusicRadar*. www.musicradar.com/news/queen-no-synths-real-story

Hicks, J.R. (1932). *The Theory of Wages*. Macmillan.

Hobsbawm, E.J. (2000). The Industrial Revolution and its impact. In P. Mandler (Ed.), *The Cambridge History of Britain, Volume 3: The Industrial Revolution, 1714–1850* (pp. 1–45). Cambridge University Press.

IMD World Competitiveness Center [IMD]. (2024, June). *World Competitiveness Ranking*. https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/

International Finance Corporation. (2025). Creative Industries. Retrieved from https://www.ifc.org/en/what-we-do/sector-expertise/creative-industries

International Labour Organization [ILO]. (2024). *Mind the AI Divide: Shaping a global perspective on the future of work*. https://www.ilo.org/sites/default/files/2024-08/Mind%20the%20AI%20Divide_v12%20%281%29.pdf

International Monetary Fund. (2025, April 22). *World Economic Outlook: A Critical Juncture amid Policy Shifts*. International Monetary Fund. https://doi.org/10.5089/9798400289583.081

Ipsos. (2024). *The Ipsos AI Monitor 2024*. https://www.ipsos.com/sites/default/files/ct/news/documents/2024-06/Ipsos-AI-Monitor-2024-final-APAC.pdf

J.P. Morgan. (2024). How AI can boost productivity and jump-start growth. https://privatebank.jpmorgan.com/eur/en/insights/markets-and-investing/ideas-and-insights/how-ai-can-boost-productivity-and-jump-start-growth

J.P.Morgan Private Bank. (2024). How AI can boost productivity and jump-start growth. Retrieved from https://privatebank.jpmorgan.com/eur/en/insights/markets-and-investing/ideas-and-insights/how-ai-can-boost-productivity-and-jump-start-growth

Jones, C.I. (2002). *Introduction to economic growth*. W. W. Norton & Company.

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*. https://doi.org/10.1016/j.bushor.2018.08.008

Karras, T., Aila, T., Laine, S., & Lehtinen, J. (2017). Progressive growing of GANs for improved quality, stability, and variation. https://arxiv.org/abs/1710.10196

Kindem, G.A. (1979). Hollywood's conversion to color: The technological, economic and aesthetic factors. *Journal of the University Film Association, 31*(2), 29–36. http://www.jstor.org/stable/20687473

Korea Creative Content Agency [KOCCA]. (2024). *2023 Content Industry White Paper Annual Report* (Gov't Pub. No. 11-137000-000234-10). Ministry of Culture, Sports and Tourism. https://www.kocca.kr/kocca/bbs/view/B0000146/2006991.do

Korea Statistical Information Service [KOSTAT]. (2025). GDP at 2020 constant prices.

Lavengood, M.L. (2022, May 12). The Yamaha DX7 in synthesizer history. https://meganlavengood.com/2022/05/12/the-yamaha-dx7-in-synthesizer-history/

Lopez, J. (2010, July 24). Comic-Con Q&A: Tron director Joseph Kosinski. *Vanity Fair*. https://www.vanityfair.com/hollywood/2010/07/comic-con-qa-tron-director-joseph-kosinski

Lucas, R.E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3–42.

MacVaugh, J., & Schiavone, F. (2010). Limits to the diffusion of innovation: A literature review and integrative model. *European Journal of Innovation Management, 13*(2), 197–221. https://doi.org/10.1108/14601061011040258

Maddison Project Database. (2024). *Maddison Project Database (2020)*. Groningen Growth and Development Centre, University of Groningen. Retrieved from https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020?lang=en

Makita, T. (2022, July). Restoring Japan's economic competitiveness: Regeneration and adaptation to globalization and digitalization is essential. The Japan Research Institute. https://www.jri.co.jp/en/MediaLibrary/file/english/periodical/jrirj/2022/10/makita.pdf

Masuda, H., Sudo, T., Koudate, T., Matsumoto, A., Rikukawa, K., Ishida, T., Kameyama, Y., Mori, Y., Hasegawa, M., & Ashikawa, M. (2024). *Anime Industry Report 2023 Summary*. Association of Japanese Animations. https://aja.gr.jp/download/2023_anime_ind_rpt_summary_en

McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (1955). A proposal for the Dartmouth Summer Research Project on Artificial Intelligence. http://www-formal.stanford.edu/jmc/history/dartmouth/dartmouth.html

McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C.E. (1955). A proposal for the Dartmouth Summer Research Project on Artificial Intelligence Dartmouth College. http://jmc.stanford.edu/articles/dartmouth/dartmouth.pdf

McKinsey & Company. (2024, June). The economic potential of generative AI: The next productivity frontier. https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/the%20economic-potential-of-generative-ai-the-next-productivity-frontier/the-economic-potential-of-generative-ai-the-next-productivity-frontier.pdf

Medium. (2021, September 20). New technology has always been scary. https://medium.com/pronouncedkyle/new-technology-is-always-scary-8bf977a13773

Merchant, B. (2024). AI is already taking jobs in the video game industry. *WIRED*. July 23 https://www.wired.com/story/ai-is-already-taking-jobs-in-the-video-game-industry/

Miller, E.J., Steward, B.A., Witkower, Z., Sutherland, C. A. M., Krumhuber, E.G., & Dawel, A. (2023). AI Hyperrealism: Why AI faces are perceived as more real than human ones. *Psychological Science, 34*(12), 1390–1403. https://doi.org/10.1177/09567976231207095

Mochizuki, T., & Yokoyama, M. (2025, February 13). Japan's anime industry grapples with exploitation of animators and actors. *Bloomberg*. https://www.bloomberg.com/news/features/2025-02-13/japan-s-anime-industry-grapples-with-exploitation-of-animators-and-actors

Morning Consult & IBM. (2023, November 8–23). IBM Global AI Adoption Index – Enterprise Report.

NAFCA. (2024). *Dai 1-kai Anime Gyōkai no Hatarakikata ni Kansuru Ankēto Kekkarepōto [The 1st questionnaire on working styles in the anime industry result report]*. https://nafca.jp/survey02/

Nagao, R. (2024, August 19). Japan's anime industry looks to AI to solve labor crunch. *Nikkei Asia*. https://asia.nikkei.com/Business/Media-Entertainment/Japan-s-anime-industry-looks-to-AI-to-solve-labor-crunch

Nesta. (2016). The fusion effect: The economic returns to combining arts and science skills.

NHK World-Japan. (2024). AI brings smooth moves to manga & anime. https://www3.nhk.or.jp/nhkworld/en/news/videos/20241209155445347/index.html

Nikkei. (2024, July 30). Japanese animation, drawing crisp with the division of labor with AI, to correct long working hours. https://www.nikkei.com/article/DGXZQOUA309VP0Q4A730C2000000/

OECD. (2024). *OECD Compendium of Productivity Indicators 2024*. OECD Publishing. https://doi.org/10.1787/b96cd88a-en

Office for National Statistics [ONS]. (2024, November 4). Employees in Great Britain by industry: 2023.

https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/employeesintheukbyindustry/2023

Office for National Statistics [ONS]. (2025). *MGSX: Unemployment rate (aged 16 and over, seasonally adjusted): %* [Labour market statistics time series (LMS)]. Retrieved May 4, 2025, from https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment/timeseries/mgsx/lms

Omanufeme, S. (2016). Runaway success. *Finance & Development, 53*(2), 30. International Monetary Fund. https://www.imf.org/external/pubs/ft/fandd/2016/06/pdf/fd0616.pdf

OpenAI. (2018, June). *OpenAI Five*. https://openai.com/index/openai-five/

Organisation for Economic Co-operation and Development. [OECD] (2024). GDP per hour worked (Indicator). Retrieved 6th May 2025, from https://www.oecd.org/en/data/indicators/gdp-per-hour-worked.html

Pinch, T., & Trocco, F. (2004). *Analog Days: The Invention and Impact of the Moog Synthesizer*. Harvard University Press.

Pinch, T. (2022). *The day the loony musician's union tried to kill the synthesizer*. Inkl. September 14

PwC. (2024). Sizing the prize: What's the real value of AI for your business and how can you capitalise? https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

Radford, A., Metz, L., & Chintala, S. (2015). Unsupervised representation learning with deep convolutional generative adversarial networks. https://arxiv.org/abs/1511.06434

Recording Industry Association of America [RIAA]. (2024). U.S. Music Revenue Database. https://www.riaa.com/u-s-sales-database/

Romer, P.M. (1986). Increasing returns and long-run growth. *Journal of Political Economy, 94*(5), 1002–1037.

Romer, P.M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5), 71–102. https://www.jstor.org/stable/2937632

Roser, M. (2023). Artificial intelligence has advanced despite having few resources dedicated to its development – now investments have increased substantially. *Our World in Data*. https://ourworldindata.org/ai-investments

Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Russell, S., & Norvig, P. (2022). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Saavedra, R., & Seaward, S. (2025, March 7). Data center marketplace. Colliers. https://www.colliers.com/en/research/nrep-usdc-data-center-marketplace-2025

Scenario (2025) How Scenario helped Ubisoft build the Niji Warriors for Captain Laserhawk: The G.A.M.E. https://www.scenario.com/post/how-ubisoft-expanded-the-world-of-captain-laserhawk-with-scenario

Schubert, C. (2013). How to evaluate creative destruction: Reconstructing Schumpeter's approach. *Cambridge Journal of Economics, 37*(2), 227–250. https://doi.org/10.1093/cje/bes055

Schumpeter, J.A. (1942). *Capitalism, socialism and democracy*. Harper & Row.

Scott, C.E. (2001). The radio inventor/entrepreneurs. *B>Quest*. https://www.westga.edu/~bquest/2001/radio.htm

Sharps, A., et al. (2024). Tony Blair Institute. Retrieved from https://assets.ctfassets.net/75ila1cntaeh/5yiS3TBdF96J4Kt0tFmj3k/c4b260667ed70fc791020268cfed443b/1mABBNuF6Anp7zTv1ZeIxe–155801112024

Sharps, S., Smith, T., Browne, J., Large, O., Subramanya, R., Tay, P., Ellina, D., Atkinson, I., Lythgow, J., & Muralidharan, R. (2024, November). The impact of AI on the labour market. Tony Blair Institute for Global Change. https://www.institute.global/insights/economic-prosperity/the-impact-of-ai-on-the-labour-market

Shay, D. (1993). *The making of Jurassic Park: An adventure 65 million years in the making*. Ballantine Books.

Smith, A. (1776). An inquiry into the nature and causes of the wealth of nations (Book 1, Chap. 1). In E. Cannan (Ed.), *Library of Economics and Liberty*. https://www.econlib.org/library/Smith/smWN.html

Society of Authors Policy Team. (2024, April 11) [SOA]. SoA survey reveals a third of translators and quarter of illustrators losing work to AI. Society of Authors. https://societyofauthors.org/2024/04/11/soa-survey-reveals-a-third-of-translators-and-quarter-of-illustrators-losing-work-to-ai/

Solow, R.M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics, 70*(1), 65–94.

St. Louis Fed. (2024, September 23). The rapid adoption of generative AI. *On the Economy*. https://www.stlouisfed.org/on-the-economy/2024/sep/rapid-adoption-generative-ai

SteamDB. (2025). Steam game releases tagged "AI." https://steamdb.info/stats/releases/?tagid=492

Syed, A. (2023). Key moments from King Charles' state welcome for South Korea. *TIME*. https://time.com/6338761/king-charles-speech-south-korea-banquet-highlights/

The Japan Research Institute [JRI]. (2022, July). Restoring Japan's economic competitiveness: Regeneration and adaptation to globalization and digitalization is essential. https://www.jri.co.jp/en/MediaLibrary/file/english/periodical/jrirj/2022/10/makita.pdf

Musicians' Union History [MU]. (2016). A history (1893–2013). https://www.muhistory.com/contact-us/1971-1980/

U.S. Bureau of Economic Analysis [BEA]. (2025). Arts and Cultural Production Satellite Account (ACPSA), National Data: 1998–2023. Retrieved April 2025, from https://www.bea.gov/data/special-topics/arts-and-culture

U.S. Bureau of Labor Statistics [BLS]. (2024, April 3). May 2023 National Industry-Specific Occupational Employment and Wage Estimates: NAICS 512000 – Motion Picture and Sound Recording Industries. https://www.bls.gov/oes/2023/may/naics3_512000.htm

U.S. Department of Commerce, Bureau of Industry and Security. (2025, February). *Supplement No. 1 to Part 740*. *Electronic Code of Federal Regulations*. Retrieved from https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-740/appendix-Supplement%20No.%201%20to%20Part%20740

UNESCO. (2021). *Cultural and creative industries in the face of COVID-19: An economic impact outlook* (CLT/CEE/2021/RP/4). https://unesdoc.unesco.org/ark:/48223/pf0000377863

Wall Street Journal [WSJ]. (2024, June 18). Adobe and the AI race. https://www.wsj.com/video/events/adobe-and-the-ai-race/3C71C553-3292-4D02-8AEB-CF8D5A4ECF79

Wang, S.L., Nehring, R., & Mosheim, R. (2018). Agricultural productivity growth in the United States: 1948–2015. *Amber Waves*. United States Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/amber-waves/2018/march/agricultural-productivity-growth-in-the-united-states-1948-2015

Warren, T. (2023). Microsoft partners with Inworld to build Xbox generative AI game dialogue and narrative tools. *The Verge*. November 6https://www.theverge.com/2023/11/6/23948454/microsoft-xbox-generative-ai-developer-tools-inworld-partnership

Watanabe, H. (2015). Concerning the anime directing method for limiting the quantity of drawings to 3500 sheets per episode of a TV series in Toei Animation Studio Co. Ltd. (Part 2): The directorial strategy in Japanese TV anime. *Japanese Journal of Animation Studies, 17*(1), 25–31. https://doi.org/10.34370/jjas.17.1_25

Wayte, L. (2023). *Pay for play: How the music industry works, where the money goes, and why*.

Wilbur, S.K. (1978). The history of television in Los Angeles, 1931–1952: Part III. *Southern California Quarterly, 60*(3), 255–285. https://www.jstor.org/stable/41170786

World Economic Forum [WEF]. (2020). *The Global Competitiveness Report: How countries are performing on the road to recovery*. https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2020.pdf

World Economic Forum [WEF]. (2024, February 28). This is how AI is impacting—and shaping—the creative industries, according to experts at Davos. https://www.weforum.org/stories/2024/02/ai-creative-industries-davos/

Xiang Hui, O.R., & Zhou, L. (2024). The short-term effects of generative artificial intelligence on employment: Evidence from an online labor market. *Organization Science, 35*(6), 1977–1989.

Zhao, E. (2021). Anime studios are exploiting their animators. *34th Street Magazine*. October 25. https://www.34st.com/article/2021/10/japanese-anime-production-attack-on-titan-mappa-wit-studio-controversy-animators-freelancers-exploitative-labor-practices