

THE EFFECTS OF GENERATIVE AI ON PRODUCTIVITY, INNOVATION AND ENTREPRENEURSHIP

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The effects of generative AI on productivity, innovation and entrepreneurship

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This document reviews experimental research on the impact of generative artificial intelligence (AI) on productivity, innovation, and entrepreneurship. It highlights to what extent AI automates tasks, enhances skills, and transforms business operations. Additionally, this study discusses the role of AI in fostering creativity, accelerating research and development and lowering entry barriers for businesses, while also noting challenges related to trust and human expertise. Findings suggest that AI's effectiveness depends on the user's experience and the task carried out, with human-AI collaboration being key to maximising its potential. The review identifies gaps in current research, particularly regarding AI's long-term business effects and workers' understanding of its limitations, emphasising the need for further studies to guide its responsible and effective use.

Keywords: Artificial Intelligence, Productivity, Innovation, Entrepreneurship

JEL codes: C93, O33, J24, L26

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Executive summary

Generative AI can bring significant opportunities for productivity, innovation and entrepreneurship, which are key drivers of economic growth and well-being. At the same time, it also poses challenges, e.g. related to its potential misuse. As the technology rapidly spreads, an increasing number of studies has been analysing these issues in different contexts through experiments, aimed at uncovering causal effects about the impacts of generative AI on productivity, innovation and entrepreneurship.

This paper critically reviews the available evidence in this new but rapidly growing field of research, discussing key policy-relevant insights from the most recent experiments. It focuses on significant mechanisms through which generative AI can affect i) productivity – by automating tasks, enhancing skill development, and transforming business operations –, ii) innovation – by fostering idea generation, creativity and R&D –, and iii) entrepreneurship – lowering entry barriers and supporting early-stage growth.

Experimental evidence has shown relevant gains from generative AI's use across all these fields, but challenges remain. Trust in AI-generated outputs and a deep understanding of its limitations are crucial to leverage the potential of the technology, with human expertise and oversight needed to ensure that generative AI remains a valuable tool in creative, operational and technical processes. This is of particular importance when navigating complex tasks where generative AI's inputs may require even more careful contextualisation through deep domain knowledge.

For instance, individuals with less experience or fewer skills tend to benefit more from generative AI's capabilities when tasks are well-defined and bounded. In such cases, AI can help provide guidance and structure, thereby possibly bridging productivity gaps and enhancing overall performance. Conversely, for more experienced workers who already possess a core set of skills, the technology needs to complement their expertise to unlock significant gains. Such experience or relevant domain knowledge may allow them to better allocate efforts based on the strengths and capabilities of AI, and to interpret and apply its insights more seamlessly.

Ultimately, the technology's impact appears to be highly dependent on how it is utilised, for which task and purpose, by whom, and on their level of expertise and trust in generative AI. An effective approach to leverage the potential of generative AI appears to be through human-AI collaborations that consider both context and users' expertise, with AI serving as a complement rather than a substitute for human capabilities.

Although existing research provides valuable insights into specific tasks and industries, these findings cannot be easily generalised to other contexts. The field is also evolving rapidly, and experimental research on AI's impact on firms and entrepreneurship remains scarce. Key gaps include how workers handle AI-generated errors, their awareness of AI's capabilities and limitations, and the long-term business implications of AI integration. Expanding research in these areas will be crucial for developing a more comprehensive understanding of generative AI's role in the economy and ensuring its trustworthy and effective use.

1 Introduction

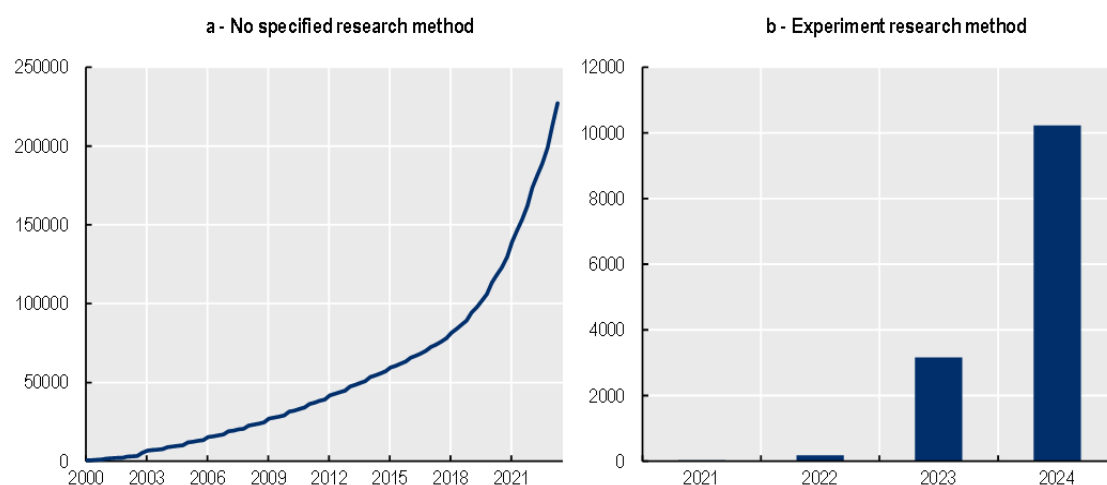
The rapid diffusion of generative artificial intelligence (generative AI) over the past years has sparked significant attention due to its transformative potential for driving economic and social outcomes. Generative AI has indeed the potential to reshape industries by enhancing productivity, fostering innovation, and stimulating entrepreneurship, themes highlighted by G7 members as the key opportunities brought by generative AI (OECD, 2023^[1]).

While generative AI brings significant opportunities, it also poses relevant challenges, including for intellectual property rights, perpetuation of biases and potential for misuse, e.g. in the creation of manipulated content (Lorenz, Perset and Berryhill, 2023^[2]). Discussions about the extent to which AI may rather increase work intensity, and about challenges related to data governance and privacy, also remain central in the policy debate (see, for instance, Broecke (2023^[3]), Lane, Williams and Broecke (2023^[4]), and OECD (2024^[5])).

Generative AI refers to AI models or systems that are specifically designed to produce content, such as text, programme code, images, videos, or sounds, in response to human language queries or prompts. This type of AI differs from other non-generative AI applications that focus primarily e.g. on analysis or classification tasks. A well-known example of generative AI is ChatGPT – a tool that uses Large Language Models (LLM) to generate content based on given inputs (prompts). LLMs are trained on large amounts of data and use algorithms to predict the most likely next word or phrase in a sequence. This characteristic allows these models to produce coherent and contextually relevant content. The development of generative AI has seen key milestones, notably with the introduction of transformer-based architectures in 2017. This advancement made AI models more efficient and scalable, with models increasingly growing in size and complexity, now having billions of parameters (Lorenz, Perset and Berryhill, 2023^[2]). These breakthroughs have expanded the use of generative AI across different industries, enabling its potential as a general-purpose technology (Calvino, Haerle and Liu, 2025^[6]).

Although generative AI itself is not a new concept, academic research in this field has only experienced a significant surge in recent years, notably since 2017 (Figure 1.1, panel a). This surge in research surrounding generative AI follows technological advancements and greater access to large datasets and computing power. Next to technical developments of generative AI, this large body of research covers the applications and benefits of generative AI and discusses risks and challenges such as those related to intellectual property rights and ethics. However, the availability of a broad range of systems with user-friendly interfaces has allowed many individuals to incorporate generative AI into a wide range of tasks into their daily lives.¹

This means that the use and impact of generative AI can now be studied in a more controlled setting through experimental studies, enabling researchers to quantify the impact of generative AI and to test relevant hypotheses. By manipulating variables such as AI availability, tasks to perform, tasks complexity, and user expertise, experimental research can isolate the effects of generative AI, leading to sharp insights about its potential and limitations. Publication trends substantiate this increasing academic interest. Since late 2022, when ChatGPT was first released to the public, the number of academic articles on generative AI with an experimental research method has grown significantly (Figure 1.1, panel b).²

Figure 1.1. Total number of academic publications within the field of generative AI

Note: The Figure displays the cumulative sum of generative AI publications per year. The left panel illustrates the total number of publications, while the right panel focuses on those employing an experimental research method exclusively.

Source: Left panel: OECD.AI (using data from OpenAlex for research publications). Right panel: authors' elaboration based on OpenAlex data.

As the capabilities of generative AI rapidly expand, a comprehensive understanding of its implications relevantly requires a combination of different research perspectives, notably including theoretical, observational and experimental ones. Existing reviews that analyse the impact of generative AI across various fields often rely on analyses that are of more observational or theoretical nature. Some of these studies highlight significant productivity gains and accelerated workforce transformation, especially in areas such as customer operations, marketing, software engineering and R&D, highlighting the need for support in workforce adaptation (Chui et al., 2023^[7]). With the potential of generative AI, especially LLMs, to automate and enhance a substantial portion of work tasks across many industries, highly educated workers often appear particularly affected (Eloundou et al., 2023^[8]; Felten, Raj and Seamans, 2023^[9]).

These findings provide highly valuable insights, with relevant advantages, for instance, related to the representativeness of the underlying data, or to their ability to uncover economic mechanisms. However, they sometimes lack a causal perspective, and often suffer from constraints related to data availability, e.g. with respect to the time lags with which data become available or with respect to the degree of generality of the available information. Furthermore, many of these studies are limited by insufficient data, still restricting a comprehensive analysis of the most recent rise of the use of generative AI.

This paper aims to address these gaps by focusing specifically on experimental research, offering a critical summary of the most recent insights about the measurable impacts of generative AI on productivity, innovation, and entrepreneurship.³ A key limitation of experimental approaches is often their difficulty in capturing long-term impacts, often due to constraints in study duration and data tracking. However, experimental studies conducted in both real-world and controlled settings provide key insights that can highlight trends in, e.g. skill development, idea generation or business creation, which might be difficult to measure otherwise or not yet visible in other data, making them especially valuable for policymakers.

The experimental approach is at the cornerstone of scientific research, aiming at testing theories, support or reject hypotheses and uncovering causal relations. Based on the level of control and the naturalness of the environment in which they are carried out, several types of experiments can be distinguished (Harrison and List, 2004^[10]). The most controlled forms are the conventional *laboratory experiments*, conducted in a controlled lab environment, for instance, involving student participants (see e.g. Smith (1994^[11])).⁴ Due to their controlled setting, they allow researchers to isolate the effects of the independent variable on the treatment group, ensuring strong internal validity. However, this control sometimes limits the ability to

generalise the results to real-world situations, a concept known as *external validity*. To overcome this, experiments can also be conducted outside the laboratory, in natural, real-world settings: these are called *field experiments* (see also Levitt and List (2009^[12])).⁵ While field experiments offer the advantage of testing hypotheses in more natural environments, they also introduce complicating factors that are more difficult to control for. As a result, there is typically a trade-off between internal and external validity. In addition to traditional experimental research designs, other relevant methods include natural or quasi-experiments,⁶ in which exogenous variation is generated by factors outside the control of researchers such as policy or environmental changes (see e.g. Meyer (1995^[13])), or computational experiments, notably based on simulations and assessment of simulated behaviour (see e.g. Kydland and Prescott (1996^[14])).⁷

Although some existing literature reviews already summarise experimental research on generative AI, many focus on one specific aspect, and thereby do not integrate the broader impacts on productivity, innovation, and entrepreneurship.⁸ This paper, however, aims to offer a comprehensive overview that examines these three themes, providing a holistic perspective about the effects of generative AI through different channels.⁹ Therefore, the central research question guiding this review is “*How does generative AI influence productivity, innovation, and entrepreneurship, and what are the key implications of these effects?*”.

To address these questions, a comprehensive research effort was conducted to ensure the inclusion of studies relevant to the research focus. The goal was to identify, to the extent possible, recent analyses that contribute to the understanding of the impact of generative AI across the three core themes. This was achieved through keyword searches in several electronic databases. Key authors were identified, and relevant studies were selected by manually screening bibliographies of their works. Additionally, databases dedicated to pre-registrations of experimental studies, such as the American Economic Association registry and the Open Science Framework for Economic Research, were investigated. Agendas of research conferences relevant to the field were also reviewed, and AI tools like ChatGPT were utilised to help identify other pertinent studies. No study was excluded based on citation count – often used as an indicator of quality – as the majority of research in this field is relatively recent and therefore has few citations. For the same reason, several of the analyses quoted are pre-prints and not necessarily peer-reviewed publications. This should be kept in mind when relating to the findings discussed. Moreover, the goal was not to provide a fully exhaustive overview of the existing literature, as the literature in this field is evolving rapidly, but rather to present a comprehensive summary of the key insights that emerge from relevant research available at the time of writing. In doing so, while pointing to some methodological elements of the studies reviewed, this paper does not systematically emphasise the methodological strengths or limitations of the different experimental approaches, which are discussed in more detail in each of the analyses referenced. The aim is to present key findings from recent experimental work across productivity, innovation, and entrepreneurship, while highlighting the policy-relevant links between the different analyses and preserving the readability of the review. Further information emerging from the body of literature reviewed is also schematically presented in Annex A.

These insights are presented in the next sections, which are organised as follows. Section 2 discusses the most recent experimental evidence about the effects of generative AI on productivity; Section 3 focuses on innovation; and Section 4 looks at the impacts of generative AI on entrepreneurship. Section 5 concludes summarising the key insights and policy implications, outlines the limitations of this work, and discusses potential areas for further research.

2 Productivity

Generative AI can significantly impact firms' outcomes by driving productivity through three key mechanisms:

1. Automating tasks, such as writing, summarising, editing or translating texts or codes
 - Generative AI primarily can support workers with specific aspects of their jobs, freeing up **time for more complex tasks** (AI augmentation).
 - Productivity gains are especially pronounced among **lower-skilled or less experienced workers**, as AI automates and enhances simpler tasks, potentially helping narrow skill-based productivity gaps.
 - Workers with substantial **experience in performing certain tasks**, however, can be better equipped to acquire, interpret, and effectively apply AI-generated insights effectively, leading to **more seamless AI integration** and reflecting greater **absorptive capacity**.
 - Significant impacts of generative AI on productivity are observed among **well-defined and bounded tasks**, where clear objectives are set.
 - Effective **human-AI collaboration** is not straightforward: **trust** in AI-generated outputs and **users' understanding** of AI capabilities are crucial in determining its effectiveness.
 - Beyond boosting overall performance, generative AI can also enhance **team processes** and improve **collaboration**.
2. Enhancing skill development
 - Generative AI can support **personalised learning experiences** by providing cost-effective and instant access to information, acting as a subject matter expert also to teachers or when traditional learning resources are limited. These benefits are particularly pronounced among learners with **lower proficiency** in the task at hand.
 - **Overreliance** on AI-generated content may reduce critical thinking over time, particularly if users accept information without evaluation, which is amplified when plausible, but incorrect or misleading information is produced (hallucination).
 - Careful integration, including **training** and **support**, is critical to balance immediate performance gains with sustained learning outcomes, especially because long-term effects remain uncertain and depend on patterns of use and AI's capabilities.
3. Transforming business operations
 - Generative AI can enhance efficiency and effectiveness across **various business functions**, including marketing content creation, sales, supply chain management and customer service, by reducing time and costs while often improving quality and profitability.
 - It can also support more effective **decision-making** and **organisational efficiency** by enhancing forecasting capabilities.

Generative AI has the potential to significantly enhance productivity, both at the individual and organisational levels, with relevant aggregate implications. Productivity is in fact a key driver of economic growth and well-being, and generative AI may unlock critical opportunities in this respect (Filippucci, Gal and Schief, 2024^[15]). Achieving productivity benefits, however, largely depends on a number of complementary assets (OECD, 2024^[16]), notably including *absorptive capacity*, which is the ability of

individuals and organisations to acquire, interpret and effectively apply new knowledge (Cohen and Levinthal, 1990^[17]). This capability is a critical enabler of returns to AI adoption, influencing how individuals and organisations integrate and leverage generative AI for productivity improvements. At the individual level, absorptive capacity enables workers to effectively incorporate AI tools into their daily workflows, facilitating automation, fostering augmentation and operational efficiencies while also enabling the development of new skills and competencies. At the organisational level, firms with strong absorptive capacity can better recognise the transformative potential of the technology and implement more systemic organisational changes to leverage it, creating work environments that foster collaboration and strategic AI use to enhance overall firm performance. Experimental studies provide valuable insights into how firms and their workers can develop these capabilities to maximise generative AI's impact.

Emerging evidence highlights the financial implications of productivity improvements driven by generative AI. For example, in a quasi-natural experiment, Mbanyele (2025^[18]) analyses firms' discussions of generative AI-related terms in their quarterly reports filed with the U.S. Securities and Exchange Commission (SEC) to explore the relationship between exposure to generative AI and investment efficiency, defined as a firm's ability to increase investment when profitable opportunities arise and refrain from investing when opportunities are limited. The availability of investment opportunities is proxied by Tobin's Q, which is calculated as the ratio of the market value to the replacement cost of a firm's assets. Finding a positive association, the author suggests that firms more exposed to generative AI tend to make more informed and strategic investment decisions and thereby maximise returns, though establishing causality remains a challenge because other external factors may also influence the observed outcomes.

The positive impact of generative AI on firms' financial performance is further reflected in higher stock market valuations. Eisfeldt, Schubert and Zhang (2023^[19]) construct a novel firm-level measure of exposure to generative AI that captures ChatGPT's ability to carry out tasks currently performed by labour, relying on occupational task-level assessments from Eloundou et al. (2023^[8]) and mapping occupations to publicly traded firms using data from Revelio Labs. Together with earnings calls data, they show that, following the release of ChatGPT, a portfolio investing in firms with high exposure to generative AI and shorting those with low exposure yields 0.45% daily returns. These returns represent the difference in stock market performance between firms with high and low exposure. Hence, investors generally perceived ChatGPT's release as valuable, although its impact appeared to vary across and within industries. Bertomeu et al. (2023^[20]) report similar findings. Following the temporary ban of ChatGPT in Italy, they study the capital market implications – such as stock value – to find that firms more exposed to generative AI underperformed during the ban period, experiencing a 9% decline in the stock price compared to less-exposed firms.

Given that generative AI can significantly influence firms' financial outcomes, it is important to highlight three key mechanisms through which it can drive their productivity, namely by automating tasks, enhancing skill development, and transforming business operations. Automating repetitive tasks and optimising workflows with generative AI can increase productivity and free up time for the workforce to focus on other tasks, such as more complex problem-solving and strategic decision-making. Generative AI can influence skill development and cognitive performance within firms, both critical elements for long run productivity growth. Successfully integrating AI tools requires workers to develop new competencies and adapt to evolving job demands. Finally, generative AI can drive business transformations, and firms may need to adapt their organisation, processes, and strategies to fully leverage its productivity potential. These mechanisms are explored in detail in the rest of the section.

Task automation and augmentation

Generative AI has the potential to significantly improve firms' productivity by improving their workforce efficiency, notably enhancing workers' short-term productivity by automating tasks and augmenting labour

within organisations.¹⁰ A growing number of studies assessed and quantified this impact, with overall findings highlighting a significant increase in average productivity across a diverse set of tasks when using generative AI tools.

Generative AI systems can help automate or replace certain tasks. In this respect, a considerable stream of experimental research has focused on writing, translating, or summarising text. In a recent experiment, Noy and Zhang (2023^[21]) found that a sample of about 450 mid-level professionals completed incentivised writing tasks significantly faster (with average time decreasing by 40%) and with higher quality (evaluators assessed a quality increase of 18%) when using generative AI. They suggest that, in the context under analysis, generative AI primarily substitutes for worker effort rather than complementing their skills, shifting tasks away from the mere rough drafting. The ability of generative AI to assist with writing texts appears relevant in various contexts, including for workers composing emails. In fact, an experiment by Liu et al. (2022^[22]) showed that respondents were generally less trusting of emails when they were told they were AI-written, even though all emails were actually written by humans. This suggests that the trust in AI generated content decreases when AI involvement is disclosed.

Beyond other applications, generative AI is transforming the way texts are translated. Previously, people would use machine translation (MT) systems that were specifically trained and designed for this task, offering an efficient and accurate way to translate straightforward, technical, or large-scale texts. However, generative AI tools provide more natural, context-aware translations, as they are trained to understand and generate human-like text. Lyu et al. (2023^[23]) provide an overview of experimental evidence that shows significant improvements in generative AI's performance across various domains of translation. Generative AI models not only deliver strong performance in standard translation tasks, but even surpass some specialised MT systems in certain areas, highlighting the competitive capabilities of generative AI systems for document translation. Merali (2024^[24]) provides further experimental evidence in the context of professional translation, showing that as model capabilities increase, translators complete tasks faster, produce higher quality work and earn more per minute. These effects are particularly pronounced for lower-skilled translators – translators who took above median time to complete a baseline prior to the experiment.

Generative AI also provides higher quality results for summarising long and complex legal case judgements (Deroy, Ghosh and Ghosh, 2024^[25]). As models are trained on large datasets likely containing diverse and relevant texts and codes, generative AI generally appears to perform well in writing, editing, and summarising texts. However, detailed investigation of the summarised legal cases sometimes revealed relevant errors, suggesting the need for human oversight and that full automatic deployment for such complex texts is not feasible at this point in time. Recent research by Schwarcz et al. (2025^[26]) demonstrates that generative AI tools incorporating reasoning models and retrieval-augmented generation (RAG) – a technique that enhances AI responses by integrating external knowledge sources – significantly increased productivity and quality of legal outputs. While their study confirms that generative AI can still produce plausible yet factually incorrect or misleading information (a phenomenon known as *hallucination*), the analysis highlights the potential for domain-specific AI tools to mitigate such issues.

Generative AI's ability to assist in writing and editing extends to software code, where experimental evidence highlights significant productivity gains. For example, in a controlled trial, developers using GitHub Copilot,¹¹ a generative AI pair programmer, completed their tasks 56% faster than developers who did not use it, with less experienced and older programmers benefitting the most (Peng et al., 2023^[27]). Similarly, a recent field experiment on CodeFuse (a software development assistant) found that software developers who use this tool produced 55% more lines of code than those who did not (Gambacorta et al., 2024^[28]). While shorter codes can be just as efficient as longer ones, the authors found that one-third of this increase was directly attributable to the LLM. The remaining increase likely resulted from improved coding efficiency elsewhere due to the additional time available for other programming tasks. However, although the rate of acceptance of the models' suggestions remained similar across experience levels, productivity gains were primarily significant among junior programmers with senior programmers demonstrating less engagement with the LLM.

Generative AI can however have heterogeneous effects among different groups of workers, for instance, based on users' skill levels and experience. In particular, less experienced individuals often exhibit greater productivity gains when using generative AI tools (e.g., Brynjolfsson et al. (2023^[29]) study the impact on customer support agents, Cui et al. (2024^[30]) and Hoffmann et al. (2024^[31]) focus on software developers, while Noy and Zhang (2023^[21]) analyse writing tasks), suggesting that generative AI may potentially help narrow productivity gaps between different skill levels.¹² In a study with Boston Consulting Group, 758 consultants were assigned to perform 18 realistic, complex consulting tasks with or without access to generative AI (Dell'Acqua et al., 2023^[32]). Consultants who used AI completed 12% more tasks on average, finished tasks 25% faster, and achieved over 40% higher quality compared to those without AI. Quality was assessed by two human graders, who evaluated each answered question, and GPT-4 which independently assigned scores. The most significant improvements were seen among the bottom 50% of participants in terms of performance. However, the authors found that AI's capabilities create a "jagged" technological frontier where generative AI excelled at some tasks and struggled with others of seemingly similar difficulty, resulting in performance decreases for some consultant. Successful users were either those who strategically delegated tasks between themselves and generative AI, or those that integrated it fully into their workflow, both emphasising the need to understand AI's capabilities and limitations.

The impact of generative AI appears to be often evident in well-defined and bounded tasks, notably including some aspects of content creation and coding. For instance, beyond some of the studies mentioned above, Choi and Schwarcz (2023^[33]) conducted an experiment to study the effect of access to AI on law school students' exam performance, and find that it significantly improved results on simple multiple-choice questions, but not on the more complex essay questions, with a mitigating effect on inequalities between law students performing at the bottom and the top of the class. Similarly, an experiment within the context of data analysis shows that participants expressed a preference to use AI assistance for relatively simple tasks, such as error-checking or report generation, rather than for the main analysis (Gu et al., 2024^[34]).

At the same time, other studies suggest that higher digital proficiency or task-specific experience can positively affect the returns to generative AI's use. For instance, Song, Agarwal, and Wen (2023^[35]) observed productivity gains among open-source software developers that used a generative AI tool, especially evident among those who likely benefitted from deeper familiarity of the software projects (core developers). Nakavachara et al. (2024^[36]) found that students with stronger digital skills performed significantly better with ChatGPT in writing, math and data analysis tasks. Wang, Gao and Agarwal (2019^[37]) report similar findings, showing that – in the context of medical chart coding – AI mostly benefits workers with greater task-based experience.¹³ These observations align with the concept of absorptive capacity as individuals with greater prior knowledge might be better able to acquire, interpret, and effectively apply new knowledge, enabling more efficient integration and utilisation of AI tools.

While the observed differences in productivity gains between experienced and less experienced workers might seem contradictory at first glance, they could be rationalised by the fact that less experienced users may see greater improvements in simpler tasks, where the current AI capabilities can more effectively provide guidance or structure. For this group, generative AI may help compensate for skill gaps, allowing workers to complete tasks that they were not able to do without generative AI. Experienced workers can reap from these benefits as well. However, since they already possess a core set of skills, the technology needs to complement their existing expertise in order to bring substantial gains. Conversely, if generative AI is applied to tasks which the technology is not capable of performing effectively, it can actually reduce performance potentially leading to errors or lower quality (Dell'Acqua et al., 2023^[32]). This underscores the importance of critically evaluating AI's outputs and understanding the limitations of AI tools to fully leverage their benefits, so that workers can apply these tools to tasks for which they are most effective. Trust in generative AI systems also plays an important role: more experienced users might be more cautious in adopting AI solutions, potentially limiting the immediate benefits they experience. Ultimately, whether

generative AI leads to better outcomes depends on a balance between AI capabilities, task complexity, users' skillset, and their level of trust in the technology.

These nuanced dynamics across different users underscore that the impact of generative AI also depends on how it is integrated into different tasks. While generative AI has the potential to fully automate some individual tasks, jobs typically involve a variety of tasks – some more suitable for automation, while others require more substantial human input (see OECD (2023^[38]) for broader discussions on AI's impacts on employment). As a result, generative AI is more likely to help workers with specific aspects of their jobs rather than replace them entirely. This more collaborative approach, known as *AI augmentation*, allows workers to work together with generative AI systems to improve their productivity and to focus on more complex or creative tasks.¹⁴

AI augmentation is notably evident from recent experimental research. In the context of software development, the launch of GitHub Copilot led to a significant increase in iterative tasks that built on existing work, compared to contributions that involved creating standalone code, suggesting that generative AI may be more effective in augmenting ongoing projects rather than initiating entirely new ones (Yeverechyahu, Mayya and Oestreicher-Singer, 2024^[39]). Furthermore, a large-scale meta-analysis of 106 experimental studies by Vaccaro, Almaatoug and Malone (2024^[40]) provides further evidence of human augmentation, showing that human-AI systems outperformed humans alone in tasks involving content creation rather than decision-making. However, they did not find human-AI synergy on average, i.e. human-AI combinations performed significantly worse than the best of humans or AI alone. The collaboration between humans and AI has also been studied by Randazzo et al. (2024^[41]) who argue that deep integration with AI fosters the acquisition of new skills, whereas a more controlled collaboration merely enhances existing ones. In addition, individuals who delegate tasks without actively interacting with AI do not develop new skills. Overall, these findings emphasise that human-AI collaboration is not always straightforward and that it is crucial to find effective processes that integrate humans and AI.

Teams are a key locus of human-AI interaction, and recent studies have increasingly focused on the integration of generative AI in team processes, such as communication, collaboration, role allocation and performance outcomes, including team-based innovation which is discussed later. For instance, Li, Zhou and Mikel-Hong (2024^[42]) conducted an experiment among 435 participants to study traditional team dynamics and found that AI-augmented teams outperformed human-only teams across various performance measures, such as quality, novelty, and usefulness, assessed by an online panel of judges. Furthermore, they highlight that comprehensive AI integration within teams led to better outcomes compared to partial AI involvement. Similarly, Yeon, Lee and Park (2024^[43]) report that teams who used an AI assistant in a team chat experienced better teamwork, which substantiates the earlier presented findings. Related findings are presented by Dell'Acqua et al. (2025^[44]). In a study among 776 professionals at Procter & Gamble, a global consumer packed goods company, the authors show that individuals demonstrate better performance in product innovation tasks when AI is introduced. While teams that use AI also show improvement, their performance was not significantly different from that of individuals using AI. The authors suggest that this indicates AI's immediate impact is more about enhancing individual cognitive abilities than transforming how people collaborate.

One relevant factor for the productivity improvements observed across various fields is that workers using generative AI tools have more time to dedicate to other tasks. For example, tools like GitHub Copilot enable developers to prioritise core coding tasks while reducing time spent on routine project management activities (Hoffmann et al., 2024^[31]). Similarly, Brynjolfsson et al. (2023^[29]) find that the introduction of a generative AI-based conversational assistant for customer support agents increases productivity (on average 14% more issues resolved) because the support agents benefit from reduced handle time, the ability to manage more chats simultaneously, and improved resolution rates. This mechanism can apply to other use cases, such as for doctors who can dedicate more time to patient care and complex decision-making if generative AI tools can assist in early detection of potential health issues. Similarly, data analysts could benefit from generative AI automating data processing and initial analysis, enabling them to focus

on interpreting results and deriving meaningful insights. In short, because generative AI can help streamline some tasks, it can allow workers to concentrate on more complex or core responsibilities, including e.g. refining ideas and polishing outputs, possibly improving the overall quality of their work.

A note of caution is needed to highlight that the context in which generative AI is applied significantly influences its impact. In other words, the external validity of the abovementioned results remains unknown. In fact, while positive effects on worker's productivity tend to emerge from different analyses, most of the experimental studies on generative AI discussed above have been conducted in specific industries or contexts, such as technology, customer service, and content creation. This sectoral concentration, and the specific tasks analysed, may limit the generalisability of findings across the broader economy. Furthermore, the varying magnitudes of the effects and the degrees of impact across different use cases suggests that effects relevantly depend on how generative AI is implemented within each industry or context.

Skill development and cognitive impact

Generative AI is playing an increasingly transformative role in the development of human capital, which is a crucial driver of longer-run productivity growth. By reshaping how individuals learn, upskill or reskill, and engage in problem-solving (OECD, 2023^[45]; 2023^[46]), generative AI potentially enhances skill development and cognitive growth of students as well as workers, and in turn firm performance. While generative AI can offer many benefits for personalised learning and improving cognitive and educational outcomes, it also presents challenges, including potential overreliance, erosion or obsolescence of long-term critical thinking or other specialised skills, and the risk of errors from inaccurately generated content (see, for instance, Lorenz, Perset and Berryhill (2023^[2]) and Beane (2024^[47]) among others for further discussion).

One of the notable advantages of generative AI is its ability to personalise learning experiences to individuals (see, for instance, Mollick et al. (2024^[48]) for further discussion about the potential of generative AI in creating adaptive educational simulations). In a randomised field experiment involving 363 language learners, Cheon et al. (2025^[49]) found that educational tools driven by generative AI can offer personalised, “anxiety-free” learning environments. The study also highlights that AI conversational agents significantly enhanced English-speaking skills, and that this benefit is particularly pronounced among learners with lower proficiency, echoing some of the findings discussed in the previous subsection.

Several studies report further improvements in educational outcomes linked to the use of generative AI. Generative AI has indeed the potential to transform classrooms by shifting teacher's roles from transmitting knowledge to facilitating learning (Pons, 2023^[50]). For instance, Zhang et al. (2024^[51]) conducted a meta-analysis, showing that, among others, generative AI not only improves learning performance by helping students complete and optimise tasks, but also serves as a subject matter expert to support teachers. Kestin et al. (2024^[52]) found students to learn more than twice as much in less time when using an AI tutor compared to traditional active learning methods. In their randomised controlled study, 194 college students in an undergraduate physics course were assigned to either an AI-supported lesson or an instructor-guided active learning class. Students using the AI tutor achieved significantly better learning outcomes, learning the material faster while feeling more engaged and motivated. In a different context, Henkel et al (2024^[53]) examined the impact of an AI-powered math tutor delivered via WhatsApp on 1 000 students in Ghana. Students using the AI tutor showed substantial improvements in their math scores compared to a control group. Given WhatsApp's compatibility with basic mobile phones and low-bandwidth networks, the authors argue this approach offers a cost-effective way to improve learning outcomes in developing countries. Similarly, a pilot study in Nigeria demonstrated the effectiveness of generative AI as a tutor, further supporting its potential in educational contexts where traditional methods may be less accessible (De Simone et al., 2025^[54]).

Beyond the performance of students, generative AI has also been shown to improve their problem-solving skills. Urban et al. (2024^[55]) found that university students using generative AI tools for complex creative problem-solving reported improved self-efficacy and produced higher quality work.

However, the impact of generative AI is not uniformly positive and evidence on its relationship with self-efficacy is mixed. For instance, in a meta-analysis of experimental studies, Deng et al. (2025^[56]) also found a positive effect of generative AI on academic performance and motivation, and a reduction in mental effort, but no significant effect on self-efficacy. Furthermore, even though most interventions in this meta-analysis show a significant effect on higher order thinking propensities such as critical thinking skills, these results are self-reported. Therefore, the authors recommend for future research to include more objective measures, such as tests or problem-solving tasks, to better understand generative AI's impact on critical thinking. Adding to the mixed evidence, Amar and Benchouk (2024^[57]) conducted an experiment on the role of individual student preferences and found that some students felt more confident and participated more actively in class due to generative AI support, whereas others became less engaged with peers, relying on AI-generated information instead.

While the immediate benefits of generative AI appear largely evident, its long-term impact on cognitive development and critical thinking – elements critical to individuals' and in turn firms' absorptive capacities – is more complex. For example, overreliance on generative AI may erode critical thinking in the long run. In an experiment with 117 university students, the use of ChatGPT improved essay scores but also encouraged a behaviour known as metacognitive laziness (Fan et al., 2024^[58]) – a tendency to rely on generative AI rather than independent problem-solving. As generative AI models often provide quick and coherent answers, students and workers may be tempted to consume this information immediately rather than critically analyse and question it. Relatedly, Bastani et al. (2024^[59]) performed a field experiment involving almost 1 000 high school students and found that while access to ChatGPT improved student performance (as assessed by independent graders) significantly, students who later lost access performed 17% worse than those who had never used it, suggesting that caution is needed when implementing generative AI to ensure that humans continue to leverage their critical skills. In line with this, Lehmann, Cornelius and Sting (2024^[60]) conduct an experiment with students in a university-level coding course, and show that those who use LLMs as a personal tutor by conversing about the topic and asking for explanations benefit from usage. However, excessive reliance on LLMs to solve exercises refrains the students from investing own mental effort, which can impair learning in the long run. Therefore, while generative AI can support learning experiences by providing immediate access to information and facilitating personalised learning, it might harm sustained learning and skill development if students and workers become overly reliant on it, underscoring the need for careful integration to foster independent problem-solving and continuous professional growth.¹⁵

Evidence about the need for careful AI usage extends beyond education to workplace settings. Wiles et al. (2024^[61]) conducted a randomised control trial with Boston Consulting Group employees who lacked data science knowledge to test whether ChatGPT could assist in reskilling them for data science roles. The study found that workers given access to and training in using ChatGPT were more likely to solve data science tasks. However, these workers were not better at answering technical questions without ChatGPT after the experiment, suggesting that improved task performance did not translate into lasting knowledge acquisition. Furthermore, they developed a mistaken belief that ChatGPT could solve problems beyond its capabilities. Similar to earlier findings where students losing access to ChatGPT performed worse than those who had never used it, workers may have relied on AI-generated answers without critically engaging with the underlying concepts, potentially limiting long-term skill retention. Demonstrating new capabilities in this context does not equate to acquiring new knowledge, which appears in turn relevant for assessing and determining when and to what extent generative AI can be effectively leveraged (see also Autor (2024^[62]) for a related discussion).¹⁶ These results suggest that generative AI can support skill development and boost productivity, but it may not fully replace the depth of knowledge and expertise

required in specialised roles, such as data science. Careful integration appears crucial to balance immediate performance gains with sustained learning outcomes.

Overreliance on generative AI is indeed concerning, especially when it produces hallucinated content. This issue is compounded if fact-checking is lacking, critical thinking skills are eroded and metacognitive laziness emerges, all of which make individuals more vulnerable to incorrect information generated by generative AI tools. To mitigate these risks, effective integration of generative AI in educational and professional contexts requires both engagement with the technology as well as an understanding of its underlying mechanisms and limitations.¹⁷

Research on AI-assisted decision-making shows that it can be a valuable tool when its outputs are used to provide additional context rather than being blindly trusted or dismissed outright. For instance, Agarwal et al. (2023^[63]) carried out an experiment involving 227 professional radiologists, who undervalued AI-generated predictions compared to their own judgement and hence did not integrate these predictions into their decision-making. While additional contextual information enhanced their performance in medical image analysis, AI-generated predictions alone did not. Although the study focused on image classification rather than on generative AI, its findings remain relevant, as both types of systems can be used as a decision-support tool, and the challenges – such as user trust and optimal collaboration – are equally pertinent to generative AI. This suggests the need for training and support on how to find the most effective distribution of tasks, whether in classification, generative tasks, or other AI-augmented decision-making processes.

Firms could in fact help enable workers to leverage generative AI's potential while reducing risks by providing guidelines or training on effective use. This is supported by Humlum and Vestergaard (2024^[64]), who report that workers with a high exposure to AI see a substantial productivity potential in ChatGPT, but many of them indicate the need for training to fully utilise the tool's capabilities. This is also in line with the findings by Lane, Williams and Broecke (2023^[4]), which, in a broader context, highlight that training is associated with AI-related improvements in performance and working conditions. Additionally, Huang, Jin and Li (2024^[65]) argue that effective use of AI tools depends also on education. This further highlights the need to also stimulate broader cognitive and foundational skills to maximise the impact of AI in diverse work environments (see also the further discussion in Borgonovi et al. (2023^[66])).

While the evidence reviewed above suggests that generative AI can offer relevant benefits, such as enhancing learning and skill development, its long-term effects remain uncertain and largely depend on how it is used. Overreliance on generative AI can negatively affect critical thinking and hinder cognitive development over time, especially if users fail to critically analyse the generated content. In addition, the use of generative AI brings relevant challenges that require careful consideration, such as potential bias and lack of transparency. These issues affect the reliability of AI-generated content and complicate its trustworthy use in academic and professional settings, with relevant implications for skill development.¹⁸ These concerns, combined with the need to manage AI's long-term effects on critical thinking and skill development, corroborate the importance of thoughtful integration. Ultimately, sustained productivity gains depend not just on using generative AI but on where and how it is applied, underscoring the importance of absorptive capacity in ensuring that its integration leads to lasting improvements in learning and performance.

Generative AI-driven business transformation

While the previous sections focus on individual productivity impacts, this subsection shifts attention to how generative AI can lead to real-world, measurable benefits within firms. Beyond tasks' automation, augmentation and skill development, firms can leverage generative AI for productivity gains through transforming key elements of their operations or business functions, e.g. adapting or restructuring their organisation, improving process, or changing business strategies.

While empirical evidence on the links between (non-generative) AI and firm productivity continues to emerge (Acemoglu et al., 2022^[67]; Calvino and Fontanelli, 2023^[68]; Calvino and Fontanelli, 2024^[69]; McElheran et al., 2025^[70]) and will likely soon focus on generative AI use as new data become available, the experimental evidence discussed in this subsection highlights its impact on various business functions. These range from marketing, sales, to supply chain management and customer service, where generative AI helps firms enhance productivity, reduce costs, and drive operational efficiency.

For instance, generative AI can enhance the efficiency and effectiveness of creating marketing content. In this respect, Hartmann, Exner and Domdey (2023^[71]) analysed 254 400 human evaluations of AI-generated marketing images, assessing their quality, realism, and aesthetics against human-made images. Using ratings from online participants and algorithmic aesthetics assessments, they found that AI-generated images often surpass those created by humans across these dimensions. These findings suggest that generative AI reduces the time and costs associated with content creation, potentially improving firms' productivity. In marketing, LLMs are also known to help implement and scale personalised persuasion strategies, shaping people's attitudes and intended behaviours (Matz et al., 2024^[72]).

Further examples of how firms can leverage generative AI for a competitive edge, for example through streamlining their operations, are related to planning and optimising business processes. Focusing on sales, an experimental study with 64 Microsoft employees highlighted AI's potential to improve sales workflows. Sellers with access to a generative AI chatbot answered questions during customer sales calls quicker and with higher quality, which could increase revenue growth (Jaffe et al., 2024^[73]). In supply chain management, i.e. the process of planning, controlling, and optimising the flow of goods and services, traditional planning methods often struggle to keep up as supply chains grow in size and complexity. An experiment by Ahn et al. (2024^[74]), leveraging data from a global consumer goods company, shows that generative AI can optimise supply chains, resulting in profitability and performance improvements. This highlights the potential of AI to add value and enhance supply chain efficiency. Another well-documented application is in customer services. While some firms fully replace first line contact with AI-powered chatbots, or experiment with it, others use generative AI to assist their customer support agents. Experimental evidence suggests that this human-machine collaboration can improve productivity, operational efficiency as well as service quality (Brynjolfsson et al., 2023^[29]; Ni et al., 2024^[75]).

Generative AI can also improve firms' decision-making and organisational efficiency by improving forecasting.¹⁹ In fact, a study simulating economic predictions by professional forecasters found that LLM-based forecasts align closely with human accuracy and distribution of predictions (Hansen et al., 2024^[76]). Notably, AI models appear to perform particularly well for medium- and long-term forecasts, often outperforming human predictions. Although experimental research on firm-level outcomes remains limited, this study suggests that firms can potentially leverage generative AI-driven forecasts to make more accurate projections and better-informed decision.

3 Innovation

Generative AI has the potential to transform innovation through different channels, including:

1. Enhancing idea generation and creativity
 - Research shows that generative AI can help humans produce more **novel ideas**, including in writing and commercially viable designs, and enhances **early-stage innovation** by combining **human expertise with AI capabilities**.
 - In team settings, AI can **boost efficiency, diversify ideas**, and enhance **overall team innovation**.
 - However, while generative AI can enhance creativity, its outputs may **lack practicality, depth, diversity, and personal touch**. AI-generated ideas also tend to be **more similar** to each other, compared to those created by humans, potentially **reinforcing biases**.
 - The effectiveness of AI in fostering idea generation depends on **user expertise** – benefitting especially less experienced users, and sometimes conflicting with the thinking patterns of more experienced creators.
 - Generative AI is most effective when combined with **human oversight**, ensuring creative outputs remain fair, innovative and meaningful, and addressing **consumer acceptance challenges**.
2. Accelerating R&D in academia and in the private sector
 - Generative AI **supports research** by helping define problems, design studies, plan experiments, or streamline background research. Its increasing use, especially in technical fields, can enable researchers to **focus on tasks requiring human expertise**.
 - **Less experienced researchers** tend to be **more open** to integrating AI-driven suggestions into their work, while **more experienced researchers** tend to rely more on their **own knowledge**.
 - Generative AI also **supports the design and development** of new products, services, or technologies, by providing a broader range of possibilities, accelerating concept creation, speeding up iterations, reducing costs, improving product differentiation and optimising resource allocations.
 - However, effective **human-AI co-creation** (generative design) requires human expertise and oversight to ensure trustworthy use, feasibility and market alignment.

Generative AI has the potential to transform innovation through different channels. These range from boosting idea generation and individual creativity to accelerating research and development (R&D), a critical input for innovation.

By working alongside human expertise, generative AI can not only enhance research productivity but also enable new forms of innovation. In fact, as highlighted by recent and ongoing work, generative AI exhibits relevant characteristics of general-purpose technologies, notably including its continuous improvements over time and the spawning of innovation in application sectors beyond just the technology sector (see further discussion in Calvino, Haerle and Liu (2025^[6]); see also Bresnahan (2023^[77])).

However, despite this considerable potential, ongoing debates highlight relevant risks and challenges particularly related to how generative AI affects innovation. These include challenges related to intellectual

property rights, including with respect to the copyright of material used for models' training (OECD, 2025^[78]), debates around the patentability of AI-generated inventions (World Intellectual Property Organization, 2025^[79]), or more broadly about the role of AI for long run incentives to innovate (Filippucci et al., 2024^[80]).

While a more considerable literature has focused on the broader role of AI for research and innovation, more often focusing on pre-generative AI dynamics (see, for instance, OECD (2023^[81]), Calvino et al. (2023^[82]), Dernis et al. (2021^[83]), Besiroglu, Emery-Xu and Thompson (2024^[84])), this section examines key experimental studies uncovering initial causal evidence about the effects of generative AI on innovation. In particular, it delves into the role of generative AI for generating new ideas and unlocking creativity. It also explores its potential to accelerate R&D, focusing on academic research and on the development of new products, services or technologies.

Enhancing idea generation and creativity

A critical phase of innovation is related to novel idea generation. In this respect, generative AI has shown its potential to help humans be more creative, sometimes even generating ideas that surpass those created by humans alone in certain contexts. Several studies substantiate this statement, often assessing creativity through expert evaluations. Bohren, Hakimov and Lalive (2024^[85]) conducted an experiment where respondents used generative AI to write a creative text. ChatGPT significantly outperformed humans as its content was judged by participants to be more creative and novel. The authors also found that human ideas augmented by ChatGPT benefitted from this effect, albeit to a lesser extent than AI-generated content alone. Joosten et al. (2024^[86]) conducted a similar study in a professional setting to assess the capabilities of LLMs in innovative idea generation.²⁰ They evaluated 43 human- and 52 ChatGPT-generated ideas, finding that the latter (blindly evaluated by experts) were more novel and offered greater consumer benefits. They were more distinct from existing market norms and more effective at addressing the underlying problems but scored equally in terms of feasibility. Similarly, Meincke et al. (2024^[87]) showed in an experiment that the quality of new product ideas is also positively impacted by generative AI. These findings are echoed by an online experiment in which knowledge workers evaluated the innovativeness of 50 innovations, of which half were generated by ChatGPT (Stock-Homburg, 2023^[88]). Workers rated AI-generated innovations as more innovative, possibly due to their inability to identify them as such. Generative AI's ability to produce creative ideas also extends to academia, as further discussed in the next subsection. For example, Si, Yang and Hashimoto (2024^[89]) found in their experiment that expert reviewers judged LLM-generated research proposals in the field of natural language processing as statistically more novel than those produced by human experts, based on different evaluation metrics.

However, AI-generated ideas come with limitations. They can sometimes be less practical or executable in real-world scenarios compared to those created by humans. Si, Yang and Hashimoto (2024^[89]) however report this effect to be small. Another potential issue is that AI tends to produce ideas that sometimes lack diversity. For example, Doshi and Hauser (2024^[90]) demonstrate through a creative writing experiment that access to generative AI enhances the novelty and usefulness of short stories²¹ – two key dimensions of creativity linked to originality and publishability – particularly benefitting less creative writers. However, while AI assistance improves individual output, the resulting stories become less distinctive overall and more similar to one another compared to those written solely by humans, possibly leading to a narrower range of truly novel content at a collective level. This finding is further supported by Meincke, Mollick and Terwiesch (2024^[91]), who performed an experiment where participants proposed new consumer product ideas targeted to college students. By looking at cosine similarity, they found that AI-generated ideas were more alike. However, prompt engineering (a process of designing and refining inputs to guide AI models in generating desired responses) drastically reduced this similarity, specifically when longer and more elaborate prompts were used. Hence, overall, generative AI can foster the generation of innovative ideas, but its impact on novelty largely depends, once again, on how it is used.

Additionally, the effectiveness of generative AI in creative work seems to depend on the user's expertise. In line with the previously discussed findings on the pronounced impact of generative AI on less-skilled individuals' productivity, Hou et al. (2024^[92]) suggest that AI can assist creators with less experience by making idea generation easier. For more experienced creators, AI-generated suggestions may be counterproductive, as they often conflict with the creator's current ways of processing and working. Together, these studies underscore the challenges of relying on AI in idea generation.

Beyond idea generation, generative AI may also impact creative writing abilities. Niloy et al. (2024^[93]) performed an experiment with 600 university students who wrote 1 500-word essays. They found that AI-assisted idea generation can negatively affect students' creative writing abilities, measured by a creativity score including multiple relevant creativity factors. The study highlights the need to carefully integrate AI in creative writing tasks, as its exclusive use may not ensure the creation of unique and valuable content. Moreover, although AI can meet certain aesthetic criteria that make its output indistinguishable from human-made work,²² it may lack the deeper complexity and personal touch that comes from human creativity.

Creative industries, such as fashion and the arts, are also increasingly integrating AI into their creative processes, with tools like text-to-image technology. Research by Zhou and Lee (2024^[94]) shows that AI-generated outputs from these tools tend to achieve more "favourites" per view of the AI-generated image, indicating greater popularity. Similarly, in the luxury fashion industry, consumers seem to prefer AI-generated t-shirt designs if the origin of the design is not disclosed (Moreau, Prandelli and Schreier, 2023^[95]). These outcomes highlight the potential of generative AI to produce appealing and commercially viable designs, while also revealing the impact of consumer awareness on AI acceptance.

Rather than viewing generative AI as a replacement for human creativity, a more effective approach would be to integrate both, adapting AI's use based on the context and user's expertise. Research suggests that AI is most effective when combined with human judgment, maximising its potential in creative work. For instance, an experiment by Lane et al. (2024^[96]), involving 72 experts and 56 community screeners, evaluated 48 solutions for the 2024 Global Health Equity Challenge, a competition seeking technology- and community-driven solutions to improve access to quality health services. Evaluators using AI assistance were more likely to reject solutions based on subjective criteria, especially when AI provided explanations. This emphasises the need for human oversight in judgement-based evaluations, where AI should complement rather than replace human decision-making.

Human-AI collaboration can also improve the novelty and quality of creative outputs. For example, designers with both AI- and domain-expertise produced more innovative designs, as measured by the novelty level of the created designs based on image dissimilarity, when using AI tools (Zhao, Wang and Viswanathan, 2024^[97]). Boussioux et al. (2024^[98]) report similar findings in a crowdsourcing challenge focused on sustainable business ideas. While human-only solutions ranked higher in novelty, AI-assisted idea generation – when guided by human input – led to more valuable and creative outcomes. The authors argue that AI integration enhances early-stage innovation by combining human expertise with AI capabilities. In team-based innovation, AI can also boost efficiency, foster idea diversity, and enhance overall team innovation. Gindert and Müller (2024^[99]) indeed found that teams using a generative AI-augmented ideation tool significantly improved the originality, clarity, and completeness of their ideas, compared to teams solving identical problems without AI support.

Even if generative AI has the potential to significantly support individuals in creating new ideas, including in creative writing, it must be used with caution. Generative AI models can, unintentionally, reproduce or amplify biases from data they were trained on. For instance, an experiment conducted by Acerbi and Stubbersfield (2023^[100]) found that, in writing tasks, ChatGPT exhibited biases similar to those of humans, e.g. favouring content that was gender-stereotype-consistent. More generally, this highlights that AI might reinforce unfair ideas. Therefore, human oversight remains crucial in AI-driven creative processes. In line with previous findings, the most effective uses of generative AI for creativity appear to be those where AI

serves as a tool to complement human expertise. Human oversight ensures that AI's potential is maximised while also safeguarding that creative outputs continue to be fair, innovative and meaningful.

Accelerating research and development in academia and in the private sector

Generative AI has also found its way into R&D processes across various disciplines, with the potential to significantly accelerate them. This section covers two key areas where generative AI can have an impact. In academia, AI can assist in defining problems, setting up research designs, or planning experimentation. In the industry, it can help with the design and development of new products, services, or technologies.

AI in academic research

Generative AI can play a key role during the early stages of research, when ideas are generated, and hypotheses are formulated. A primary application is assisting researchers during brainstorming by analysing existing literature and suggesting novel ideas or hypotheses (Si, Yang and Hashimoto, 2024^[89]). Doshi, Chai and Troebinger (2024^[101]) performed an experiment with 310 scientists across various disciplines to study the impact of generative AI on researchers' perceptions of their research proposals. They show that, on average, generative AI did not influence the perceived novelty or feasibility of proposals. However, building on earlier findings that showed trust in output decreases when AI use is disclosed, the authors highlight that more experienced researchers were generally more hesitant to accept AI-generated ideas. Less experienced researchers were more open to integrating AI-driven suggestions into their work. While multiple factors contributed to hesitation, the dominant reason was that experienced researchers placed greater trust in their own knowledge and viewed AI-generated ideas as less valuable. Kumar et al. (2024^[102]) further evaluated the potential of different LLMs to generate research ideas in computer science, economics, chemistry, physics and medicine, highlighting that generative AI has domain-specific strengths in research idea generation. While LLMs often generated less novel or generic ideas, they also have a significant potential to generate novel and significant ones.

Once a research question is defined, generative AI can further help in designing the study and selecting appropriate methodologies. Wu et al. (2024^[103]) explored generative AI's role in supporting research by analysing methodological trade-offs. They demonstrate that AI can effectively identify these trade-offs and suggest research design improvements, although its effectiveness depends on the type of research. Similarly, Korinek (2024^[104]) provides an overview of multiple generative AI applications in different research phases. Rather than using respondents in an experiment, the author explores several use cases, finding that generative AI can improve reasoning capabilities, facilitate collaboration, and boost productivity in tasks such as literature searches and initial data analysis.

The capabilities of generative AI to assist in writing and creative tasks have been extensively discussed in earlier sections. Evidently, this ability can also be leveraged for the preparation of academic papers by automating tasks like grammar and spelling checks, drafting sections of text, and suggesting improvements for clarity and style. For example, Saunders et al. (2024^[105]) experiment with using several generative AI models to summarise research papers and show that these models have the potential to streamline the literature review process when writing an academic paper.

Generative AI also shows promising potential in enhancing experimental research itself. For example, a recent paper by Charness, Jabarian and List (2023^[106]) indicates that generative AI can help improve the design of experiments by optimising survey questions, coding experiments more efficiently, and automating documentation. In addition, experimental research could further leverage the use of generative agents, which, powered by LLMs, may simulate some human attitudes and behaviours (Park et al., 2024^[107]; Park et al., 2023^[108]).²³ These agents can participate in experiments, potentially complementing traditional experimental approaches. Some recent papers have in fact tested the performance of LLM-

agents as experimental subjects in specific contexts, finding that they tend to produce results consistent with theoretical predictions and mirror certain aspects of human behaviour (Tranchero et al., 2024^[109]; Manning et al., 2024^[110]; Aher, Arriaga and Kalai, 2022^[111]). Furthermore, Anthis et al. (2025^[112]) highlight that, despite current limitations, LLM-based social simulations appear promising to serve exploratory research purposes across a variety of fields by generating synthetic data and opening new directions of research. Hence, while the intrinsic limitations of the approach should be carefully considered, this may unlock the potential for further research, including possible simulation or projection applications, or allow for additional controlled reproducible analyses, possibly making them a valuable complement to traditional experimental methods.

The growing role of generative AI in academic research is not just theoretical: its use among a large group of researchers suggests that it can indeed provide relevant added value. Liang et al. (2024^[113]) carried out a meta-analysis and found that approximately 20% of the content in computer science conference papers has been substantially AI-modified. This trend highlights the increasing use of generative AI in research, particularly in highly technical fields.²⁴ Building on earlier findings suggesting that access to generative AI tools frees up time for other tasks, their integration into the research process can not only enhance output quality but also enables researchers to focus on critical tasks that require human insight and expertise. Despite these promising use cases, most studies have focused on theoretical applications or small-scale experiments. Therefore, more large-scale, controlled studies are needed to fully understand the long-term impacts and practical limitations of generative AI in R&D.

Developing new products, services, and technologies

Humans can also collaborate with generative AI tools to enhance innovation in industrial product design. Bilgram and Laarmann (2023^[114]) explore the use of LLMs in internal and client innovation across various use cases, arguing that generative AI could be a game changer in early prototyping. By delegating tasks to an artificial agent, firms can achieve faster iterations and reduce costs. López-Forniés and Asión-Suñer (2024^[115]) substantiate this by studying 80 engineering students who created a concept that introduced innovative functionality into an everyday object, some using generative AI as creative assistants throughout the design process. While the results are primarily descriptive in nature, they found that generative AI accelerated concept creation and enhanced creative capabilities by enabling co-creation between humans and AI – a process known as *generative design*.

By helping during the conceptualisation phase, generative design can allow designers to experiment with a broader range of possibilities, fostering originality and innovation. This observation is echoed by Barbieri and Muzzapappa (2024^[116]), who compared the design of stools, some of which were designed with the support of generative AI. The authors found that generative AI tools encouraged design creativity in the early stages of the product development process. Furthermore, in line with earlier findings in other contexts, they emphasise that generative AI helps free up time, which allows designers to focus on refining the usability and aesthetics of the AI-generated concepts further, leading to higher average ratings. This implies that AI-generated design concepts often introduce novel, aesthetic elements, comparable to other creative tasks discussed earlier. However, their integration into the design process still requires human oversight to ensure feasibility and alignment with market expectations. Therefore, some form of interaction between generative AI and industrial product designers remains essential.

Generative AI also plays a potential role in accelerating innovation in software R&D. For example, Wijk et al. (2024^[117]) evaluate the performance of LLM agents in automating well-defined AI R&D tasks. Their results show that AI agents can perform better under tight time constraints, while humans achieve better results when more time is available, ultimately outperforming AI agents in less-time pressured settings. While agents appear to perform close to the average level of human experts when allocated eight hours of computing time, the authors highlight that the gap between AI agents and top human performers remains significant. Importantly, the authors caution that these benchmarks may give a misleading impression of

AI's abilities. Real-world R&D tasks are typically more complex, take considerably longer to complete, and require managing multiple, overlapping workstreams.

In summary, effectively integrating generative AI into development processes can offer firms relevant benefits, including faster iterations, cost reductions, and better product differentiation. By embedding AI into their operations, firms can accelerate innovation, improve research quality, and optimise resource allocation, ultimately gaining a competitive edge. However, to fully realise these benefits, a balanced approach that combines AI automation with human expertise and a trustworthy use of the technology appear essential.

4 Entrepreneurship

Generative AI already affects the entrepreneurial landscape, but experimental studies exploring its direct impacts remain limited at the time of writing. The following mechanisms highlight how generative AI influences entrepreneurship:

1. Lowering entry barriers

- Entrepreneurs actively use generative AI already, expressing optimism about its potential to **reduce bureaucratic burdens** and **improve services**.
- Although **external validity may be limited**, experiments highlight how generative AI can **empower entrepreneurs** with limited technical knowledge, helping them overcome traditional barriers and facilitating the creation of products or services, thus **levelling the playing field** in new business ventures.
- More specifically, generative AI can enhance operational efficiency, streamline resource management, make essential entrepreneurial tools more accessible, and support learning, business model improvements and idea generation during the prototyping phase, **enabling entrepreneurs to focus on other areas**.

2. Supporting early-stage growth

- Generative AI can continue to **influence start-up performance after launch**, particularly by reducing the time required to secure critical funding, as well as enhancing decision-making and strategy development.
- Its **impact varies** depending on how entrepreneurs use the technology and their individual characteristics, such as pre-treatment business performance, emphasising the importance of **human-AI collaboration** and **context**.

This section discusses recent experimental evidence analysing how generative AI impacts entrepreneurship, focusing on two key phases: the entry and the early-stage phase.²⁵

Given its potential as a general-purpose technology, generative AI can enable the creation of new business models, new products, and applications across sectors, which can be brought to the market by new firms. As typical at the beginning of the life-cycle of innovative industries (Calvino and Criscuolo, 2019^[118]), new entrants can be a driving force of the introduction of new business models or products that leverage the potential of a new technology. In fact, as highlighted by recent data, worldwide venture capital investments in generative AI have been recently growing (OECD.AI, 2025^[119]), although limited experimental research has been directly focusing on this aspect.

Generative AI can be also leveraged by entrepreneurs directly, for instance as an additional AI-based “co-founder”.²⁶ Furthermore, AI can affect entrepreneurship indirectly, by affecting local and sectoral labour markets (see Fossen, McLemore and Sorgner (2024^[120]) for a broader survey on the impacts of AI on entrepreneurship).

Although AI can provide significant benefits for entrepreneurs, for start-ups at different stages, and for business dynamism more broadly, relevant challenges remain. Some of the literature highlights the possible tendency of generative AI development toward market concentration, and the implications this may have for business dynamism. Although a few firms currently dominate the frontier of generative AI, with access to computational resources, data, and talent, the AI sector itself seems to remain contestable (see Korinek and Vipra (2024^[121]), Unsal et al. (2025^[122]), and OECD (2024^[123]) for broader discussions). Still, challenges may persist related to data access constraints, and their implications for creative destruction (Norbäck and Persson, 2023^[124]), as well as concerns about bias and discrimination, for example, in accessing finance for the creation or growth of new ventures (see OECD (2024^[125]) for further discussion about regulatory approaches to AI in finance).

While a comprehensive review of the links between AI and entrepreneurship is beyond the scope of the current work, this section focuses on early experimental evidence on the topic. By examining recent experimental studies, it indeed provides early insight into how generative AI already affects the entrepreneurial landscape, notably focusing on its impact on the creation of new businesses through lowering entry barriers and boosting the performance of start-ups during their early stages.

Lowering entry barriers

Starting a business often involves overcoming significant barriers, such as securing sufficient financial resources and acquiring the necessary technical expertise to build a new product or service. Generative AI is transforming this landscape by reducing these entry barriers, making it easier for individuals to launch new businesses. Entrepreneurs can use generative AI in various ways, as demonstrated by Tran and Murphy (2023^[126]), who highlight in their editorial how AI can lower entry barriers by enhancing operational efficiency, streamlining resource management, and making essential entrepreneurial tools more widely accessible. More specifically, by automating content creation, optimising operations, assisting with financial planning and supporting business ideation, generative AI can enable entrepreneurs to develop marketing materials, streamline workflows, generate business plans and even prototype products without requiring large financial investments.

One area where generative AI can play a key role is in the development of new business models. Kostis et al. (2024^[127]) studied how entrepreneurs used a generative AI tool to refine their business ideas. Collecting feedback through discussions and interviews with entrepreneurs, they found that generative AI can be an effective tool in learning and improving business models during the early stages of entrepreneurship. An experiment previously discussed by Boussioux et al. (2024^[98]) substantiates this finding, showing that humans can create business ideas more effectively when collaborating with AI. Furthermore, Sorin and Pagani (2023^[128]) found that generative AI can be used as an input for idea generation among entrepreneurs, presenting several use cases alongside experimental evidence. Relatedly, Hammada (2024^[129]) explored the use of AI in entrepreneurship courses, specifically in assisting students with forming founding teams for a new business – a task often described as challenging, but one that can have important and long-term consequences. In the experiment, three student teams used ChatGPT to generate recommendations for key decisions in the team-building process. ChatGPT helped identify potential team member profiles, suggested their roles, and proposed equity splits based on inputs, such as their business ideas and individual skills. After presenting their findings and participating in group discussions, students were surveyed, revealing strong support for generative AI as a helpful and effective learning tool. Although the external validity of the results might be limited, these studies highlight the potential of generative AI in facilitating the process of starting a new business.

Moreover, additional implications discussed earlier more broadly also benefit aspiring entrepreneurs. For instance, as generative AI can offer significant advantages in the prototyping phase by improving creative processes (Bilgram and Laarmann, 2023^[114]), both established firms and new businesses can speed up

development and reduce costs. By decreasing time-to-market, generative AI can enable entrepreneurs to focus more on other aspects, such as market fit and customer feedback, rather than spending time on the initial product design phase. Therefore, generative AI not only can help lower entry barriers, but can also free up time for strategic tasks, thereby increasing the likelihood of success for new ventures. In addition, for well-defined and bounded tasks with clear objectives, such as coding, individuals without prior experience can leverage generative AI tools to build websites or design marketing materials. This capability enables them to grasp novel business opportunities more easily, possibly lowering entry barriers and improving access to markets. Therefore, generative AI can empower entrepreneurs with limited technical expertise to develop products or services that would otherwise be more challenging to create. This democratisation of technical skills can level the playing field, enabling a more diverse range of individuals to launch a business. Consequently, entrepreneurs can, at least potentially, accomplish more tasks on their own before needing to hire more specialised staff. Although the broader labour market implications of generative AI are beyond the scope of this study (see e.g. OECD (2024^[130]) for a more detailed discussion), the cost-saving potential it offers to entrepreneurs appears to be a relevant aspect to consider.

Generative AI can offer significant benefits not only for entrepreneurs themselves but also for public services relevant for entrepreneurs. Many key capabilities of generative AI systems are in fact already being leveraged within the public sector. A survey of nearly a thousand public sector professionals shows that 22% actively use the technology, with many expressing their optimism about its potential to reduce bureaucratic burdens and improve services (Bright et al., 2025^[131]). By automating administrative and regulatory tasks, such as grant applications and compliance checks, generative AI accelerates crucial processes, potentially enabling faster and more efficient interactions with public institutions, fostering a more business-friendly environment for new firms. Reducing the regulatory burden and improving framework conditions is indeed critical for the entry and post-entry performance of new firms, especially in highly digital sectors that are more relevantly affected by AI (Calvino, Criscuolo and Menon, 2016^[132]; Calvino and Criscuolo, 2019^[118]; Calvino et al., 2024^[133]).

Supporting early-stage growth

Once a start-up is operational, generative AI can continue to impact its performance. Generative AI can support faster business scaling by automating processes and operations, enabling start-ups to grow in early stages. While the broader impact of task automation on productivity has been explored in previous sections, its specific effect on entrepreneurial performance remains an area requiring further research. AI's ability to streamline business operations could enhance start-up efficiency, allowing founders to allocate resources more effectively toward innovation and market expansion.

Using generative AI can also speed up the process for start-ups to secure critical funding, alongside its other impacts. Heller and Asam (2024^[134]) provide evidence of this effect through a quasi-natural experiment that used the release of GitHub Copilot for software start-ups. The study shows that software start-ups leveraging generative AI tools experienced a 20% reduction in time-to-initial-funding, with the most pronounced effect among founders with more technological or managerial expertise, further illustrating how generative AI can support early-stage start-up growth.

Beyond funding, generative AI can influence how start-ups approach decision-making and strategy development. Csaszar, Ketkar and Kim (2024^[135]) use data from an accelerator programme and a start-up competition to show that LLMs can generate and assess strategies similarly to entrepreneurs and investors, suggesting that AI can improve the speed, quality, and scale of strategic analysis, while enabling new methods like virtual strategy simulations.²⁷ This challenges the notion that AI is limited to incremental innovations, showing that AI can also help push the boundaries of innovation by supporting hypothesis testing and theory development.

Similarly, Otis et al. (2024^[136]) demonstrate that the impact of AI tools, including generative AI, varies significantly depending on the characteristics of the entrepreneur. They find that benefits are most pronounced for high-performing firms, where entrepreneurs who effectively leverage these tools see significant gains. In their field experiment, they gave Kenyan entrepreneurs access to a generative AI business assistant via WhatsApp to test its impact on revenues and profits. While the results show no overall average effect, they reveal that high-performing entrepreneurs (assessed through four post-treatment surveys) experienced a 15% improvement in revenues and profits, while low performers saw a decline of about 8%. The authors attribute these differences not to the quality of the AI-generated advice but to the way entrepreneurs used the technology, which again underscores the importance of human-AI collaboration and suggests that generative AI's impact on business performance is highly context-dependent.

While the potential of generative AI in entrepreneurship is evident, experimental evidence exploring its direct impacts remains limited at the time of writing. Future research could further address these gaps, particularly in real-world settings, to provide a more comprehensive understanding of how generative AI can affect entrepreneurship and start-up performance.

5 Concluding remarks

The recent diffusion of generative AI has gained significant attention, not only due to its speed but also because of the transformative potential its rapid advancement holds for various industries. Generative AI models, such as ChatGPT, are designed to generate content in response to human prompts, distinguishing them from other AI models focused on analysis or classification. While the concept of generative AI is not new, academic research in that area surged following increased access to large datasets and computational power.

By focusing on experimental research, this literature review presents a thorough overview of the latest findings on the measurable impacts of generative AI on productivity, innovation, and entrepreneurship, areas in which the potential of generative AI is critically recognised. The experiments discussed in this review predominantly rely on publicly available generative AI tools such as ChatGPT, GitHub Copilot, and similar platforms, or make use of publicly available LLMs such as GPT-4 or BERT. Many of these tools offer free versions or limited-access tiers, enabling the assessment of its impacts across a wide range of users, and not just those paying for costly premium services.

Generative AI has proven particularly effective in automating tasks that are well-defined and have clear objectives, notably including some writing and coding tasks. It can also play a critical role for skill development and business model transformation, where it can serve as a catalyst for personalised learning and organisational efficiency gains, respectively. In creative industries, generative AI aids in producing novel ideas and designs, helping diversify thought processes and speed up the innovation cycle. In R&D, it assists in problem-solving, study design, and product development. In academia and industry alike, it enables faster knowledge recombination and cost reductions, accelerating the pace of discovery. Entrepreneurs are also using the technology to automate routine tasks, optimise resource management, and free up time for strategic decision-making, thereby possibly levelling the playing field in new business ventures. Early-stage start-ups have particularly benefitted from generative AI's ability to expedite processes like refining business ideas or funding.

However, these potential gains are not without challenges. Trust in AI-generated outputs and a deep understanding of its limitations are crucial to leverage the potential of the technology. The reviewed experiments highlight the ongoing need for human expertise and oversight to ensure that generative AI remains a valuable tool in creative, operational and technical processes rather than a substitute for authentic human creativity and knowledge, especially in the longer term. This is of particular importance when navigating complex tasks where AI's guidance may need even more to be contextualised by deep knowledge. For instance, individuals with more limited experience or skills tend to benefit more from generative AI's capabilities when tasks are well-defined and less knowledge-intensive, possibly bridging productivity gaps and enhancing overall performance. Conversely, for more experienced workers who already possess a core set of skills, generative AI needs to complement their expertise in order to unlock substantial gains. Such experience or relevant domain knowledge may allow them to allocate efforts based on the strengths and capabilities of AI, and interpret and apply its insights more seamlessly.

Therefore, the technology's impact appears to be highly dependent on how it is utilised, for which task and purpose, by whom, and on their level of expertise and trust in generative AI. While generative AI is making notable strides in boosting productivity, enhancing innovation and fostering entrepreneurship, these results show that its successful integration depends largely on its collaborative relationship with humans.

Ultimately, an effective approach to leverage generative AI appears to be through human-AI collaboration that considers both context and user expertise, with AI serving as a complement rather than a replacement for human capabilities. As its adoption continues to grow, the importance of critical thinking, human oversight, and responsible integration will be pivotal in ensuring that AI delivers sustained, meaningful impacts across industries.

Achieving this balance requires thoughtful regulatory frameworks and governance mechanisms, promoting transparency, accountability and trustworthy AI use, and the OECD's AI principles provide the first intergovernmental standard in this direction. Regulations will remain essential in ensuring that AI-generated content is reliable, reducing risks such as misinformation, bias and data privacy concerns. Additionally, investments in digital literacy programmes and workforce training initiatives, also focusing on a broader set of skills including foundational ones, can help individuals and businesses maximise the benefits of generative AI while mitigating skills gaps. Proactive measures are also in fact needed to address the potential concentration of AI's economic benefits, ensuring that workers are supported through retraining and reskilling initiatives. At the same time, the impacts of generative AI on the environment need to be carefully assessed (OECD, 2022^[137]); notably, reducing human costs at the expense of energy or IT capital does not necessarily increase total factor productivity. By implementing policies that encourage trustworthy innovation while safeguarding societal and economic interest, governments can help shape an AI-driven future that enhances productivity, fosters sustainable and inclusive growth and maintains public trust in AI technologies.

While existing research reviewed in this analysis already provides valuable insights, the field is rapidly moving as the technology continues to evolve. At date, many studies discussed focus on specific tasks or industries, limiting the generalisability of findings across other contexts and highlighting the need for further investigation. Future studies should further explore how AI's benefits translate into practical and sustainable outcomes across diverse economies, broadening the specific contexts discussed in the papers covered in this literature review. Additionally, little is known about how workers respond to AI-generated errors like factually incorrect outputs, and the extent to which they understand AI's capabilities and limitations, which has significant implications for trust and adoption. Future work could also examine more in depth the role of AI agents, not just as tools but as subjects of experimental studies, to better understand their evolving impact on human decision-making and productivity. Experimental research is particularly limited in assessing the broader effects of generative AI on firms and entrepreneurship, especially for diverse business environments. Notably, the smaller and more clearly defined a task, the more conclusive the evidence tends to be. Yet, the long-term implications for business, learning and knowledge acquisition of AI integration – positive or negative – remain largely unexamined. Expanding research in these areas will be crucial for developing a more comprehensive understanding of generative AI's role in the economy and ensuring its responsible and effective use.

Endnotes

¹ Liu and Wang (2024_[151]) present a selection of 40 generative AI tools along with monthly traffic data (March 2024) and report a combined monthly visit number of 2.8 billion, indicating a rapid adoption of these tools.

² The number of academic articles in the field of generative AI that employed experimental research methods was obtained from OpenAlex (see Priem, Piwowar and Orr (2022_[153]) for further information about OpenAlex). This was done by querying works that included both generative AI-related keywords (e.g., LLM and ChatGPT) and experimental research-related keywords (e.g., RCT and field experiment) in the title or abstract, and resulted in a total of more than 10,000 research papers.

³ The experiments reviewed in this paper mainly use publicly available generative AI tools such as ChatGPT, GitHub Copilot, and similar platforms, or publicly accessible LLMs such as GPT-4 or BERT. Many of these tools offer free versions or limited-access tiers, allowing for the evaluations of their impacts on a broad range of users, not just those paying for premium services.

⁴ When the participants are drawn from a broader subject pool, the experiment is referred to as an artefactual field experiment (Harrison and List, 2004_[10]).

⁵ If participants are aware they are part of an experiment, it is known as a framed field experiment. When the experiment takes place in a real-world context without participants knowing they are involved, it is called a natural field experiment, such as when the effects of a policy change are observed without notifying the subjects. See Harrison and List (2004_[10]) for further discussion.

⁶ Although these are observational studies, they share similarities with experimental research notably including the ability to uncover causal insights. Therefore, some of these studies will be discussed throughout the rest of the analysis.

⁷ Some studies focusing on generative AI also use a form of applied or computational experiments where researchers themselves experiment with AI systems and report outcomes. These may be conducted in controlled or real-world environments, often using simulations to test hypotheses about AI behaviour and its effects. While less controlled than traditional methods, these are also critical to better understand the impacts of generative AI on productivity, innovation, and entrepreneurship, reflecting its real-world applications.

⁸ For example, several meta-analyses discuss experimental evidence on the impact of generative AI within the context of education, such as Zhang et al. (2024_[51]), and Deng et al. (2025_[56]). A recent meta-analysis

discusses the effects of human-AI collaborations, focusing on when the combination of humans and AI outperforms either alone (Vaccaro, Almaatouq and Malone, 2024^[40]).

⁹ The current review provides an overview of the impact of generative AI on productivity, innovation, and entrepreneurship, without systematically exploring extensive empirical evidence on specific mechanisms beyond the experimental work discussed. For a broader discussion on the channels through which generative AI operates, and the debate on whether it qualifies as a General-Purpose Technology, see Calvino, Haerle, and Liu (2025^[6]).

¹⁰ This is in line with insights from recent OECD work which, although not specifically focusing on generative AI, highlights that a key motivation of employers to adopt AI systems is related to the improvement of worker performance (Lane, Williams and Broecke, 2023^[4]).

¹¹ GitHub Copilot is an AI-powered coding assistant that suggests code snippets and autocompletes lines.

¹² See also Georgieff (2024^[140]) for related evidence on the links between AI and wage inequality.

¹³ However, Wang, Gao and Agarwal (2024^[25]) also report that senior workers gain less from AI than their junior colleagues, primarily due to lower trust in AI systems.

¹⁴ A related debate focuses on whether more or less automation is preferable, the differences between augmentation in some tasks and automation in others, the extent to which policymakers should steer the development of AI, as well as the promises and perils of human-like AI (see e.g. Agrawal, Gans and Goldfarb (2023^[144]), Brynjolfsson (2022^[145]) and Acemoglu and Johnson (2023^[146])).

¹⁵ This is in line with insights discussed in the latest OECD Skills Outlook (2023^[46]) that recognises the ability of AI to bring individualised and customised learning experiences. However, it also suggests that relying too much on AI systems without developing critical thinking and knowledge can weaken the ability to assess and effectively use AI-generated solutions in problem-solving.

¹⁶ Autor (2024^[62]) highlights how AI enables workers with solid foundations of expertise to level up, also drawing comparisons to previous digital tools, such as YouTube tutorials. He also suggests that while innovation can sometimes render expertise obsolete (e.g. taxi drivers, as discussed by Berger, Chen and Frey (2018^[149])), in other cases, it enables the creation of novel types of expert tasks (e.g. air traffic controllers with radar, GPS and radio tools), highlighting that AI offers a unique opportunity to extend the relevance and value of human expertise.

¹⁷ This is in line with the discussions in the latest OECD Skills Outlook (2023^[46]), which emphasises the need for understanding AI's capabilities, biases, and limitations, as well as active engagement with AI outputs.

¹⁸ See also Williams (2023^[154]) for a discussion of the ethical implications of using AI-powered chatbots in education. While a detailed exploration of these ethical concerns is beyond the scope of this review, they deserve careful consideration and can also impact how generative AI ultimately translates into productivity returns.

¹⁹ Traditional machine learning models excel at structured predictions, such as financial forecasting, where numerical accuracy is crucial. In comparison, generative AI is more suited for tasks involving simulations, reasoning and pattern recognition rather than precise numerical predictions.

²⁰ The experiment was carried out in a company supplying specialised packaging solutions.

²¹ Usefulness is measured by writers themselves, as well as by a separate group of evaluators, based on whether the stories are appropriate, feasible, and publishable.

²² See also Porter and Machery (2024^[139]), who demonstrated this by showing AI-generated poems to non-expert readers.

²³ AI agents are AI systems that can make plans to achieve goals, perform tasks adaptively and interact with the environment with limited or no human oversight (see Bengio et al., (2025^[150])).

²⁴ The adoption of LLM-based tools in academic research has raised concerns about potential ethical issues, including those related to intellectual property and copyright laws infringement, as discussed previously (Lund, Lamba and Oh, 2024^[152]). Addressing these concerns is crucial to maintaining academic integrity and ensuring responsible AI integration in research. Furthermore, many major publishers do not allow AI to be listed as a co-author on manuscripts, and the general consensus among publishers appears to be that authors should fully disclose AI usage in their manuscripts, when this is allowed (Spanjol and Noble, 2023^[147]).

²⁵ Although the concept of *early-stage business* lacks a universally agreed-upon definition, it generally refers to young firms, typically within their first years of operation (Wilson and Silva (2013^[148]); Fairlie and Desai (2020^[141])). These firms are in the initial phase of development, focusing on building legitimacy and may not yet be profitable. At this stage, they are working towards commercialising their products or services and may be seeking funding (Fisher, Kotha and Lahiri, 2016^[142]; Islam, Fremeth and Marcus, 2018^[143]).

²⁶ For further discussion, see for instance: <https://mitsloan.mit.edu/ideas-made-to-matter/how-generative-ai-changing-entrepreneurship>.

²⁷ This positive influence on decision-making is further supported by an experiment conducted by Conti and Messinese (2024^[138]). Their research on US software start-ups, which leveraged the quasi-random release of GA4, found that these tools significantly increased new customer acquisition, especially for innovative start-ups led by skilled founders. Although the study did not focus specifically on generative AI but rather on other predictive AI tools, it offers valuable insights into AI's impact on entrepreneurship, with potentially broader implications for generative AI.

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Annex A. Overview of reviewed studies

Table A A.1. Literature overview

Summary of the setting and the main impact of generative AI for selected studies

Author(s), year	Topic	Study type	Year data	Location	Setting	Task type	Participants	Model or tool used	Main impact of generative AI
Acerbi and Stubbersfield, 2023	Simulating human behaviour	Transmission chain experiment	2023	Not specified	Cultural evolution	Summarising and reproducing text	LLMs	ChatGPT-3	The LLM ChatGPT-3 reflects human biases for certain types of content in its production.
Agarwal et al., 2023	Human-AI collaboration	RCT	Not specified	United States, Viet Nam	Radiology	Diagnosing X-ray images	Professional radiologists	AI algorithm trained on 250,000 labelled X-rays	AI assistance does not always improve diagnostic accuracy of radiologists, because radiologists sometimes undervalue AI outcomes.
Aher, Arriaga and Kalai, 2022	Simulating human behaviour	Turing experiment	2023	NA	Simulated environment using LLMs	Participating in classic economic experiments	Simulated participants	Several GPT-models	LLMs can replicate human behaviour in most classic experiments but can sometimes be too accurate compared to human behaviour.
Ahn et al., 2024	Transforming business operations	Simulation-based study	Historical data	Global	Global consumer goods company	Supply chain planning	NA	Generative Probabilistic Planning model by Daybreak	Generative AI improves supply chain performance and profitability.
Amar and Benchouk, 2024	Skill development, AI in academia	Pre-post experimental study	Not specified	Not specified	STEM education	Answering classroom questions	Undergraduate engineering students in STEM	ChatGPT or any chosen more suitable application	Integration of generative AI makes some students feel more confident and participating more actively in class, whereas others become less engaged

									with peers, relying on AI-generated information instead.
Barbieri and Muzzupappa, 2024	Idea generation and creativity	Within-subject experimental study	Not specified	Italy	Furniture design in an academic setting	Designing furniture	Mechanical engineering master's students	Generative Design tool Autodesk Fusion 360	Generative Design increased creativity and aesthetics in furniture design concepts, allowing designers to focus on refining the usability and aesthetics of the AI-generated concepts further.
Bastani et al., 2024	Skill development	RCT	2023-24	Türkiye	High school	Solving math exam problems	High school students	GPT-4	Access to generative AI improves student performance, but when access is removed, students perform worse than those who never had access.
Bertomeu et al., 2023	Economic implications	Natural experiment	2023	Italy	Implications of ChatGPT ban for Italian firms	NA	Italian firms	ChatGPT	Firms more exposed to generative AI underperformed during the ban period, experiencing a 9% decline in the stock price compared to less-exposed firms.
Bilgram and Laarmann, 2023	Idea generation and creativity	Qualitative study (first-hand AI assistance experiences)	Not specified	Not specified	Internal and client innovation projects	Multiple tasks, such as journey mapping, idea generation and prototyping	Non-technical users experimenting with LLMs	ChatGPT	Generative AI can augment the early phases of innovation, especially exploration, ideation, and digital prototyping. It can speed up iterations and reduce costs in early prototyping, as non-technical users can create functional prototypes.
Bohren, Hakimov and Lalive, 2024	Idea generation and creativity	Large-scale online experiment	2023	United States	Online	Creative tasks and a strategic game	Participants recruited through Prolific	ChatGPT and Bard	AI chatbots (especially ChatGPT) can generate more creative ideas than humans. Augmenting humans with AI improves creativity, but not as much as ChatGPT alone.
Boussioux et al., 2024	Idea generation and creativity	Field experiment	2023	Global participants, evaluators based in the United States	Crowdsourcing challenge (circular economy)	Submitting and evaluating business ideas	Participants were global solvers from various industries, and evaluators were recruited through Prolific	GPT-4	Human-only solutions ranked higher in novelty, but AI-assisted idea generation – when guided by human input – led to more valuable and creative outcomes.

Bright et al., 2024	Lowering entry barriers	Survey-based study	2023	United Kingdom	Public sector	Answering questions about AI usage, trust, understanding, concerns and optimism	Public service professionals	ChatGPT	Out of all participants, 22% actively uses generative AI, with many expressing their optimism about its potential to reduce bureaucratic burdens and improve services.
Brynjolfsson et al., 2023	Automating tasks, transforming business operations	Natural experiment	2020-21	Philippines, United States, and other countries	Customer service sector of a Fortune 500 software firm	Answering technical support questions via chat	Customer support agents	A tool built on a GPT from OpenAI	Access to the AI tool increased productivity by 14% on average. The improvement was 34% for new and lower-skilled workers.
Cheon et al., 2025	Skill development	Randomized field experiment	Not specified	Korea	Learning English through a mobile application	Practicing English skills via mobile devices	Students recruited through online university communities	Not specified	AI conversational agents significantly enhanced English-speaking skills, and this benefit is particularly pronounced among learners with lower proficiency. Educational tools driven by generative AI can offer personalised, “anxiety-free” learning environments.
Choi and Schwarcz, 2023	Task automation, AI in academia	Controlled experiment	2022-23	United States	Law school classes at the University of Minnesota	Taking law school exams (both multiple-choice and essay questions)	Students in two law school classes	GPT-4	Assistance from GPT-4 significantly enhanced performance on simple multiple-choice questions but not on complex essay questions. Furthermore, students at the bottom of the class saw huge performance gains with AI assistance, while students at the top of the class saw performance decline. Also, the performance of GPT-4 varied substantially depending on prompting methodology.
Conti and Messinese, 2024	Early-stage firm growth	Quasi-random natural experiment	2017-23	United States	US software startups	NA	US software-related startups listed on Crunchbase	Google Analytics 4 (GA4), which includes AI predictive tools	The release of GA4 significantly increased new customer acquisition, especially for innovative start-ups led by skilled founders.
Csaszar, Ketkar and Kim, 2024	Early-stage firm growth	Field experiment	2021-24	European countries, United States	Startup environment	Evaluating business plans	Entrepreneurs, investors, and online-recruited evaluators	GPT-3.5, GPT-4	LLMs can generate and evaluate strategies at a level comparable to entrepreneurs and investors. LLM-generated strategies attracted as much investor interest as those from

									entrepreneurs and LLM evaluations correlated positively with those of experienced investors.
Cui et al., 2024	Automating tasks	RCT	2022-23	United States, Asian countries	Real-world professional environment	Software development tasks	Software developers at Microsoft, Accenture and an anonymous Fortune 100 company	GitHub Copilot	Use of generative AI leads to an increase of 26% in completed tasks among developers. Less experienced developers had higher adoption rates and greater productivity gains.
De Simone et al., 2025	Skill development	RCT	2024	Nigeria	Education	Performing tests in English, AI knowledge and digital skills	Students	Microsoft Copilot	Students in the program outperformed their peers in English, AI knowledge, and digital skills. Students who engaged effectively with AI leveraged these skills to explore and master other topics independently.
Dell'Acqua et al., 2025	Task automation, transforming business operations	Field experiment	2024	Global	Professional setting (Procter & Gamble)	Developing new product solutions	Professionals from R&D and commercial teams at P&G	GPT-4 (accessed through Microsoft Azure)	AI integration enhances individual performance, enabling AI to substitute certain collaborative functions. Teams with AI demonstrated similar performance gains, suggesting AI strengthens individual cognitive capabilities more than transforming human-to-human collaboration.
Dell'Acqua et al., 2023	Task automation, transforming business operations	Field experiment	2023	Not specified, but conducted within a global management consulting firm	Professional setting (BCG)	Solving realistic consulting tasks, such as product innovation, problem-solving, and writing tasks	Consultants	GPT-4	Consultants using AI were significantly more productive and produced higher quality results for tasks within the AI capabilities frontier. For a task outside the frontier, consultants using AI were less likely to produce correct solutions.
Deroy, Ghosh and Ghosh, 2024	Task automation	Comparative analysis of LLM performance	Not specified	United Kingdom, India, United States	Legal environment	Summarising legal case judgments	LLMs act as participants, human evaluation performed by law students	Large variety of LLMs	LLMs generally outperform traditional summary quality metrics. However, inconsistencies and hallucinations are present in the outputs of generative models.
Doshi, Chai and Troebinger, 2024	Idea generation and creativity	Online experiment (randomised)	Not specified	Mostly United States	Academic research	Writing future research proposals	Scientists across	GPT-4	Generative AI did not influence the perceived novelty or feasibility of proposals. However, more experienced

							research disciplines		researchers were generally more hesitant to accept AI-generated ideas. Less experienced researchers were more open to integrating AI-driven suggestions into their work. The dominant reason was that experienced researchers placed greater trust in their own knowledge and viewed AI-generated ideas as less valuable.
Doshi and Hauser, 2024	Idea generation and creativity	Online experiment	Not specified	United Kingdom	Online writing exercise	Writing a short story on a randomly assigned topic	Writers and evaluators, recruited through Prolific	GPT-4	Access to generative AI ideas increases individual creativity, making stories more creative, better written, and more enjoyable, especially among less creative writers. However, it reduces the collective diversity of novel content, leading to more similar stories.
Eloundou et al., 2023	Automating tasks, Transforming business operations	AI impact assessment study	2020-21	United States	US labor market	Assessing occupations	US workforce	GPT-4	Around 80% of the U.S. workforce could have at least 10% of their work tasks affected by the introduction of LLMs, while about 19% may see at least 50% of their tasks impacted.
Fan et al., 2024	Skill development, AI in academia	RCT	2023	People's Republic of China (hereafter China)	Laboratory setting	English reading and writing tasks	University students	ChatGPT	ChatGPT improved essay scores but may also promote learners' dependence on technology and potentially trigger "metacognitive laziness".
Fossen, McLemore and Sorgner, 2024	Lowering entry barriers, early-stage firm growth	Survey-based study	2019-20	Germany	Professional environment	NA	Paid employees, self-employed individuals, and employers	NA	AI that replaces jobs drives necessity-based businesses, while AI that enhances jobs boosts opportunity-driven ones. It reshapes regional entrepreneurship and reduces the importance of location.
Gambacorta et al., 2024	Automating tasks	Field experiment	2023	China	Professional environment of Ant Group, a large tech company	Coding	Programmers	CodeFuse	Use of generative AI increased code output by more than 50%, with productivity gains statistically significant among entry-level or junior staff.

Gindert and Müller, 2024	Idea generation and creativity	Controlled field experiment	Not specified	Germany	Innovation in the healthcare sector and automotive industry	Designing a product/service or business model, and evaluating the solutions	Students	GPT-4 Turbo	AI-augmented teams generated higher quality ideas in less time, with improved efficiency, knowledge exchange, increased satisfaction and engagement, and enhanced idea diversity.
Gu et al., 2024	Task automation, human-AI collaboration	Qualitative user study	Not specified	Not specified	Data analysis setting through an online prototype interface	Inspecting and engaging with data	Professional data analysts	OpenAI	Data analysts do not stick to one approach; they fluidly move between focusing on the AI's procedure and focusing on the data itself. Furthermore, some participants expressed a preference to use AI assistance for relatively simple tasks, such as error-checking or report generation, rather than for the main analysis.
Hammoda, 2024	Lowering entry barriers	Classroom-based intervention with survey	Not specified	Not specified	Classroom	Using ChatGPT for recommendations on essential team members, their roles, and equity split	Students	ChatGPT	ChatGPT helped identify potential team member profiles, suggested their roles, and proposed equity splits based on inputs, such as their business ideas and individual skills. After presenting their findings and participating in group discussions, students were surveyed, revealing strong support for generative AI as a helpful and effective learning tool.
Hansen et al., 2024	Transforming business operations, simulating human behavior	Simulation-based study	1990-2024	United States	Economic forecasting	Simulating economic forecasts using LLMs	Human and AI forecasters	GPT-3.5, GPT-4, and GPT-4o	AI and human forecasts are qualitatively similar, but AI-generated forecasts often achieve superior accuracy compared to human forecasts.
Hartmann, Exner and Domdey, 2023	Transforming business operations, idea generation and creativity	Two lab studies, one field study	2023-24	Not specified	Marketing	Evaluating and comparing AI-generated images, and measuring effectiveness of AI-generated ads	Panelists through Prolific, Amazon MTurk workers, and online marketing professionals	DALL-E 3, Midjourney v6, Firefly 2, Imagen 2, Imagine, Realistic Vision, and Stable	AI-generated marketing imagery can surpass human-made images in quality, realism, and aesthetics. AI-generated banner ads can compete with professional human-made stock photos.

								Diffusion XL Turbo	
Heller and Asam, 2024	Early-stage growth	Quasi-natural experiment	2020-23	United States, Canada, and European countries	Startup ecosystem	NA	Startups	GitHub Copilot	GitHub Copilot significantly reduces the time-to-initial-funding for software-developing startups, especially those with experienced founders.
Henkel et al., 2024	Skill development	RCT	2023	Ghana	Classroom	Answering math questions	Students (8-15 years old)	Unspecified LLM	Students receiving extra math instruction from the LLM-powered tool had substantially higher math growth scores.
Hoffmann et al., 2024	Task automation	Natural experiment	2022-24	Not specified	Software development setting	Coding and project management activities	Software developers	GitHub Copilot	Access to Copilot leads developers to shift task allocation towards coding activities and away from project management.
Huang, Jin and Li, 2024	Skill development	Two random controlled experiments	Not specified	China	Creative setting	Fiction writing and song lyric composition	University students, professionals, and individuals from online music platforms	GPT-4	AI improves general skills like thinking and learning but reduces the importance of specialised knowledge. AI may increase skill gaps.
Humlum and Vestergaard, 2024	Automating tasks	RCT	2023	Denmark	Professional setting	Answering survey questions, and evaluate the effect of expert assessments of time savings from using ChatGPT	100,000 workers from 11 exposed occupations	ChatGPT	Workers see substantial productivity potential in ChatGPT but are often hindered by employer restrictions and required training. Informing workers about expert assessments of ChatGPT shifts their beliefs and intentions but has limited impacts on actual adoption.
Jaffe et al., 2024	Transforming business operations	Lab study	Not specified	Not specified	Professional setting (Microsoft)	Answering customer questions	Microsoft sellers	GitHub Copilot	Sellers with access to a generative AI chatbot answered questions during customer sales calls quicker and with higher quality, which could increase revenue growth

Joosten et al., 2024	Idea generation and creativity	Comparative analysis of LLM performance	2023	European countries	Professional setting	Generating innovative ideas for packaging solutions, evaluating ideas	Professionals	ChatGPT	ChatGPT-generated ideas were more novel and offered greater consumer benefits. They were more distinct from existing market norms and more effective at addressing the underlying problems and scored equally in terms of feasibility.
Kestin et al., 2024	Skill development, AI in academia	Randomized controlled experiment	2023	United States	Classroom	Answering test questions	College students in an introductory physics course	GPT-4	Students learn more than twice as much in less time with an AI tutor compared to an active learning classroom. They also feel more engaged and more motivated.
Kostis et al., 2024	Lowering entry-barriers, idea generation and creativity	Qualitative study	2023-24	Sweden, Finland	Startup environment	Designing business models	Entrepreneurs, business coaches, innovation support actors, incubators	Generative AI powered tool 'Generative Business Modeler (GBM)'	Generative AI can be an effective tool in learning and improving business models during the early stages of entrepreneurship, through learning-by-conversing.
Kumar et al., 2024	AI in academia, idea generation and creativity	Comparative analysis of LLM performance	2023-24	India	Academic research environment	Generating future research ideas from scientific papers	LLMs generate research ideas, humans evaluate, annotate and score	Gemini, Claude-2, GPT-3.5, GPT-4	LLMs possess domain-specific strengths in idea generation. They often produce non-novel and generic ideas but have the potential to generate relevant, novel, and diverse ideas.
Lane et al., 2024	Idea generation and creativity	Field experiment	2024	United States	Problem-solving within the context of social impact	Evaluating solutions for the Global Health Equity Challenge	Experts and community screeners	GPT-4	When AI provides clear reasoning, evaluators are more likely to override objective failure recommendations but follow subjective ones. In contrast, with black-box AI, deeper engagement leads to greater alignment with its subjective failure recommendations.
Lehmann, Cornelius and Sting, 2024	Skill development	Field experiment and two laboratory experiments	2023-24	European countries and Germany	Classroom	Coding in Python	University students following a master's course in data science	GPT-3.5 Turbo	Those who use LLMs as a personal tutor by conversing about the topic and asking for explanations benefit from usage. However, excessive reliance on LLMs to solve exercises refrains the students from investing own mental

									effort, which can impair learning in the long run.
Li, Zhou and Mikel-Hong, 2024	Task automation	Randomized controlled experiment	Not specified	Not specified	Laboratory setting to study team dynamics	Content generation and strategy development tasks	Working professionals and college students	ChatGPT	AI-augmented teams outperformed human-only teams. Furthermore, comprehensive AI integration within teams led to better outcomes compared to partial AI involvement.
Liu et al., 2022	Task automation	Survey- and interview-based study	Not specified	Not specified	Online assessment of written texts	Answering questions about human-written email messages	Amazon MTurk workers and computer science students	NA	Trust in email writers decreased when AI involvement was disclosed (although all emails were written by humans). Trust increased when AI was used for writing more interpersonal emails.
López-Forniés and Asión-Suñer, 2024	R&D, idea generation and creativity	Observational classroom experiment	Not specified	Spain	Classroom	Introducing innovative functionality into a simple, everyday object	Students industrial design engineering	Multiple AI image tools, based on text-image interaction	Generative AI accelerated concept creation and enhanced creative capabilities by enabling co-creation between humans and AI.
Manning et al., 2024	AI in academia, automating tasks	In silico experiment	Not specified	NA	Simulation of social scenarios	Simulating social interactions and predicting outcomes (bargaining, bail hearing, job interview, auction)	LLM-powered agents simulating humans	GPT-4	Simulations can help LLM reveal information it couldn't directly express before. Simulations with LLMs give results that closely match what economic theory predicts.
Matz et al., 2024	Transforming business operations	Several comparative analyses to assess LLM performance	2023	Not specified	Marketing	Reviewing (AI-generated) marketing messages about various topics	Participants recruited through Prolific	ChatGPT	LLMs can automate and scale the use of personalised persuasion such that it enhances its effectiveness and efficiency. Personalised messages created by ChatGPT exhibit significantly more influence than non-personalised messages across different domains.
Mbanye, 2025	Economic implications	Quasi-natural experiment	2021-23	United States	Publicly traded (non-financial) companies	Analysing firms' discussion of generative AI-	Executives of companies whose reports are analysed	ChatGPT	Exposure to generative AI is positively associated with improved investment efficiency. The effect is particularly pronounced for firms operating in highly

						related words in quarterly reports			competitive product markets and those where there is a lot of uncertainty or uneven access to critical information before decisions are made.
Meincke et al., 2024	Idea generation and creativity	Comparative analysis	2021 and 2023	United States	University product design course	Generating ideas for a physical product	Students enrolled in a product design course, and college-age individuals recruited through Prolific	GPT-4	AI-generated ideas outperform human-generated ideas in terms of average purchase intent but are perceived as less novel and exhibit higher pairwise similarity.
Meincke, Mollick and Terwiesch, 2024	Idea generation and creativity	Comparative analysis	Not specified	Not specified	Innovation	Generating new product ideas for college students	LLMs generate ideas, compared with ideas generated by MBA students	GPT-4	AI-generated ideas with no special prompting are less diverse than those from human subjects. Prompt engineering can substantially improve the diversity of AI-generated ideas.
Merali, 2024	Task automation	RCT	2024	Not specified	Professional translation setting	Translation from English into Spanish, Hindi, and Arabic	Professional translators, recruited through Freelancer and Fiverr	Multiple LLMs	As AI-model capabilities increase, translators complete tasks faster, produce higher quality work and earn more per minute. These effects are particularly pronounced for lower-skilled translators.
Mollick, 2024	Skill development	Prototype demonstration	Not specified	Not specified	Education	Teacher training and entrepreneurial pitching	Students	GPT-4	Generative AI can help in creating adaptive educational simulations, offering personalised learning experiences and practice opportunities with AI-generated mentors and evaluators. It can significantly lower the barriers to creating effective, engaging simulations, opening new possibilities for experiential learning at scale.
Moreau, Prandelli and Schreier, 2023	Idea generation and creativity	Controlled experiment	2022-23	Italy, United Arab Emirates	Retail (online and physical)	Reviewing t-shirt designs and indicating the willingness to	Students (bachelor and masters at a European	IBM Watson	Consumers preferred AI-designed t-shirts when unaware of the design source, leading to a sales lift of AI-designed t-shirts of 127%.

						pay and choice of t-shirt	business school)		
Nakavachara, Potipiti and Chaiwat, 2024	Task automation, skill development	RCT	Not specified	Thailand	Education	Writing analysis tasks in Thai and math & data analysis task in Stata	Economics students	ChatGPT	Participants on average performed better using ChatGPT. Higher-ability students performed worse in writing analysis with ChatGPT, while students with better digital skills performed better with ChatGPT
Niloy et al., 2024	Idea generation and creativity, skill development	Pre-post experiment	Not specified	Bangladesh	Education	Creative writing tasks (writing an essay)	University students	ChatGPT	AI-assisted idea generation can negatively affect students' creative writing abilities, measured by a creativity score including multiple relevant creativity factors.
Ni et al., 2024	Transforming business operations	Large-scale randomized field experiment	2023-24	China	E-commerce	Customer support through digital chat	Customer service agents of Alibaba	Gen AI assistant developed by Alibaba	Gen AI assistant significantly enhanced service speed and quality. Low performers experienced greater improvements, narrowing the performance gap, while high performers saw a decline in service quality.
Noy and Zhang, 2023	Task automation	RCT	Not specified	Not specified	Professional setting (online)	Writing tasks for mid-level professionals	College-educated professionals	ChatGPT	ChatGPT substantially raises average productivity: time taken decreases, and output quality rises. Inequality between workers decreases. ChatGPT mostly substitutes for worker effort. Exposure to ChatGPT increases job satisfaction and self-efficacy and heightens both concern and excitement about automation technologies
Otis et al., 2024	Early-stage firm growth	RCT	2023	Kenya	Small and medium business environment	Using a GPT-4-powered AI business assistant via WhatsApp to get business advice	Kenyan entrepreneurs	GPT-4	There is no overall effect, but high-performing entrepreneurs (assessed through four post-treatment surveys) experienced a 15% improvement in revenues and profits, while low performers saw a decline of about 8%.

Park et al., 2023	AI in academia, simulating human behaviour	Simulation based evaluation	Not specified	Not specified	Interactive sandbox environment	Agents populate the game environment; evaluators assess the believability of the behaviour	LLM agents in a game environment, and human evaluators	ChatGPT	Generative agents produce believable individual and emergent social behaviors.
Park et al., 2024	AI in academia, simulating human behaviour	Comparative analysis	Not specified	United States	Social environment setting	Participants completed voice-to-voice interviews, surveys, economic games, and experiments	Human participants	GPT-4o, OpenAI Audio, OpenAI Whisper	The generative agents replicate participants' responses on the General Social Survey 85% as accurately as participants replicate their own answers two weeks later and perform comparably in predicting personality traits and outcomes in experimental replications.
Peng et al., 2023	Task automation	RCT	2022	Mainly from India and Pakistan	Professional software development environment	Programming (implementing an HTTP server in JavaScript)	Professional programmers recruited through Upwork	GitHub Copilot	Developers using GitHub Copilot completed the task significantly faster than the control group. Less experienced, older, and those programming more hours per day benefited the most.
Porter and Machery, 2024	Idea generation and creativity	Two comparative survey-based studies	Not specified	United States	Poetry	Identifying poem authorship and rating poems	Participants recruited through Prolific	ChatGPT	Participants performed below chance in identifying AI-generated poems and were more likely to judge AI-generated poems as human-authored. AI-generated poems were rated more favourably in qualities such as rhythm and beauty, contributing to their mistaken identification as human-authored. Participants evaluate poems more negatively when told that the poem is generated by AI.
Saunders et al., 2024	Task automation, AI in academia	Comparative analysis of LLM performance	2023-24	Not specified	Academic environment	Summarising papers from undergraduate students	LLMs processing undergraduate students' papers	ChatGPT-4o, Google Gemini, Microsoft Copilot, and Claude 3 Sonnet	ChatGPT-4o performed the best overall in generating concise, relevant summaries. Generative AI can potentially optimize the literature review process by providing quick summaries of research paper.

Schwarcz et al., 2025	Automating tasks	RCT	2024	United States	Academic environment	Legal assignments (including drafting e-mails, legal memos, etc.)	Law students from two US universities	Vincent AI and o1-preview	Access to both o1-preview and Vincent AI led to significant improvements in the speed and overall quality of legal work, with o1-preview showing larger quality gains. Vincent AI also reduced hallucinations.
Si, Yang and Hashimoto, 2024	Idea generation and creativity, AI in academia	Comparative analysis	2024	Mainly United States	Academic environment	Generating research ideas and reviewing them	Idea writers and NLP expert reviewers	Claude 3.5 Sonnet	LLM-generated ideas are judged as more novel than human expert ideas, while being judged slightly weaker on feasibility.
Song, Agarwal and Wen, 2023	Task automation, transforming business operations	Natural experiment	2021-22	Not specified	Open-source software development	Developing software for open-source projects (code published on GitHub)	Software developers	GitHub Copilot	Copilot enhances project-level productivity, increases individual productivity and participation, but also increases integration time. Core developers achieve greater project-level productivity gains compared to peripheral developers.
Sorin and Pagani, 2023	Lowering entry barriers, idea generation and creativity	RCT	Not specified	Not specified	Entrepreneurial environment	Generating new venture ideas	Entrepreneurs	GPT-3	Generative AI can boost creative idea generation in two ways. When AI-generated ideas enhance cognitive flexibility, individuals come up with more creative ideas overall. Additionally, even if AI does not improve cognitive flexibility, it still directly increases participants' average creativity levels.
Stock-Homburg, 2023	Idea generation and creativity, simulating human behaviour	Turing experiment	2023	European countries	Professional environment	Rating whether an innovation was conceived by a human or AI, and ranking the innovation based on perceived novelty	Knowledge workers recruited through Clickwork	ChatGPT-4	Knowledge workers were unable to correctly identify the innovations generated by ChatGPT. AI-generated innovations were perceived as more innovative than human-generated innovations.
Trancharo et al., 2024	Simulating human behaviour, AI in academics	Simulation-based study	Not specified	NA	Simulated environment using LLMs	Decision-making games under uncertainty	AI agents (LLMs)	GPT-4	LLMs can closely approximate human behavior in strategic group settings. The framework proposed in the paper can replicate results from experiments

									with human subjects at a much lower cost, extend theory, clarify boundary conditions, and uncover mechanisms.
Urban et al., 2024	Skill development	RCT	Not specified	Czech Republic	Educational laboratory setting	Divergent thinking task, problem solving task	University students	ChatGPT-3.5	ChatGPT use significantly improved self-efficacy for task resolution and enhanced the quality, elaboration, and originality of solutions. Participants with ChatGPT assistance perceived the task as easier and requiring less mental effort.
Wang, Gao and Agarwal, 2019	Task automation	Quasi-experimental field study	2017-18	United States	Healthcare sector	Medical chart coding to identify patient conditions	Medical coders	Machine learning-based AI for medical coding	AI boosts productivity for all workers, more so for workers with greater task-based experience and less so for workers with greater time-based experience.
Wijk et al., 2024	R&D	Benchmarking study	Not specified	NA	ML research engineering environment	ML research engineering tasks	ML experts, AI agents	Multiple (such as Claude 3.5 Sonnet and o1-preview)	AI agents perform much better than humans when both have only 2 hours. However, humans improve more with extra time, slightly beating AI after 8 hours and scoring twice as high with 32 hours. AI is very skilled in machine learning and can create and test ideas much faster than people.
Wiles et al., 2024	Skill development	RCT	2024	Not specified	Global management consulting firm (BCG)	Data science tasks (coding, statistical understanding, and prediction)	Consultants	ChatGPT-4	Non-technical professionals with access to and training in generative AI chat-based tools can significantly enhance their ability to accurately complete data science tasks. However, the newfound technical capabilities do not imply knowledge acquisition.
Wu et al., 2024	AI in academia	Comparative analysis	Not specified	Not specified	Academic environment	Evaluating research designs in articles from leading policy journals	LLMs	Claude Pro	The analysis demonstrates that AI can effectively identify methodological trade-offs and suggest design improvements within resource constraints, though its utility varies by research type.
Yeon, Lee and Park, 2024	Task automation	Controlled study with	Not specified	Korea	Online teamwork environment	Ice-breaking and assignment of roles,	University students	ChatGPT 3.5	The type of method used for team assistance affected how helpful the team processes were and how effective

		between-subjects design				information searches and discussions, and summarizing information, conversing, and making decisions			team members were seen. The AI Assistant in Chatroom (AAC) was more helpful than the AI Assistant on a Web Page (AAW) or a Search Engine (SE). Using AAC also led to better ratings of team member effectiveness
Yeverechyahu, Mayya and Oestreicher-Singer, 2024	Task automation	Natural experiments	2019-22	Not specified	Open-source development landscape	Contributing to open-source projects, including maintenance and code development	Expert programmers	GitHub Copilot	The launch of GitHub Copilot led to a significant jump in overall contributions, especially in maintenance-related tasks. This suggests that generative AI augments collaborative innovation, but the disparity between origination and iterative solutions may widen as generative AI models improve.
Zhao, Wang and Viswanathan, 2024	Idea generation and creativity	Natural experiment	2023	Not specified	Online crowd-sourcing design platform	Designers create and post images, both organic and AI-generated, on the platform. The study analyses the novelty of organic, human-generated design	Designers on a crowd-sourcing design platform	Vision Transformer (ViT) model	Initial use of generative AI may suppress creativity, but long-term use enhances it. AI-expertise and domain-expertise independently and jointly contribute to the novelty of organic designs, with designers possessing dual expertise benefiting the most. Designers with either AI-expertise or domain-expertise use more detailed prompts, leading to improved outcomes.
Zhou and Lee, 2024	Idea generation and creativity	Pre-post experiment	Not specified	Not specified	Art-sharing platform	Creating and publishing digital artworks	Artists	Text-to-image generative AI (e.g., Midjourney, Stable Diffusion, DALL-E)	Generative AI significantly boosts artists' productivity and leads to more favorable evaluations from their peers. Artists who effectively explore novel concepts and refine AI-generated outputs gain the most, highlighting the importance of human creativity and curation.

Note: This table summarises studies that utilised (generative) AI, including instances where ChatGPT or other LLMs were used as tools, participants, or in simulations, focusing on those that report quantitative outcomes.

Source: Various studies, see first column of the table.