Generative AI and its impact on labor productivity and the Global Economy

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Abstract

This paper explores the transformative impact of generative AI on various business sectors and its potential to enhance labor productivity. It contextualizes generative AI within the broader field of artificial intelligence, highlighting its novel capacities for natural language processing, content generation, and data summarization. The study delves into its integration across diverse industries, from healthcare and finance to game development and manufacturing, emphasizing its role in driving innovation and efficiency. Through comprehensive analysis, this paper examines both the technological advancements and the associated ethical, legal, and social challenges posed by generative AI. Findings underscore the significant economic implications of generative AI, projecting its influence on future business models and global economic growth

Keywords

Generative AI, generative pre-trained transformer, machine learning, productivity, economics

1. Introduction

Before the emergence of generative AI, there were already AI technologies being actively used and refined, such as decision-making systems, computer vision, and speech recognition technologies. However, generative AI represents a new stage in AI development, focusing on its ability to generate natural language, create, expand, and enhance media content, and summarize large data arrays by identifying common patterns and trends. With the advent of generative AI, questions immediately arose regarding the effective use of this new technology. It became necessary to understand how to implement and integrate generative AI across various fields of business activity and how it might impact the global economy as a whole. The influence of generative AI cannot be

CITI'2024: 2nd International Workshop on Computer Information Technologies in Industry 4.0, June 12–14, 2024, Ternopil, Ukraine

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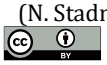

underestimated, as it has the potential to profoundly change how people understand and interact with technologies. This change brings a unique set of dilemmas, challenges, and opportunities that humanity has never before encountered. In this light, one of the most important tasks is to identify promising directions for integrating and implementing generative AI in business processes. By carefully considering the possibilities of generative AI as a catalyst for development and growth, organizations can strategically use its capabilities to discover new avenues of innovation and competitive advantages. This requires comprehensive exploration of the possibilities for interaction between generative AI and various business sectors, including marketing, design, and operations. Additionally, it requires careful analysis of the ethical, legal, and social implications associated with the integration of generative AI, ensuring responsible and accountable implementation of this new technology

2. Recent research and publications

The term "Artificial intelligence" (AI) first appeared in 1956 at the Dartmouth College conference [1] in the USA. Its use was associated with describing a field of science and engineering aimed at creating programs and systems capable of performing tasks that typically require human intelligence.

Generative AI emerged in the context of the development of generative models. The program "ELIZA," developed by Joseph Weizenbaum in 1966, is one of the earliest known examples of generative AI. It simulated a psychotherapist, communicating with users via a text interface, as shown in Figure 1.

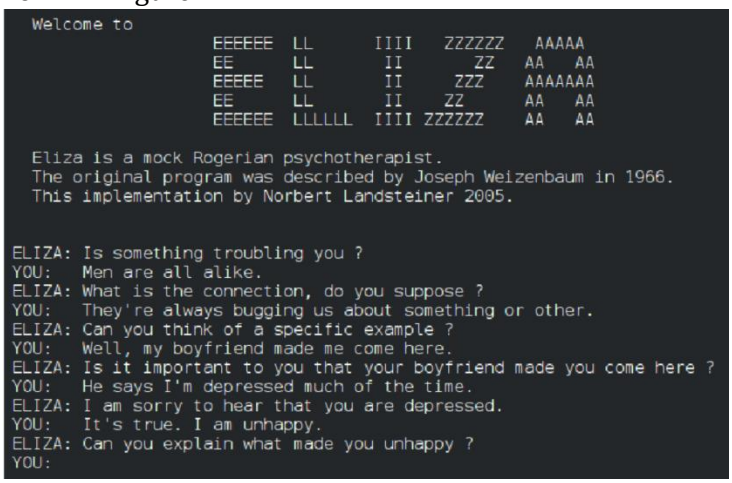

Figure 1: A conversation with ELIZA.

A key role in the development and popularization of generative AI was played by the non-profit research organization OpenAI [2]. Their GPT-3 model, which underlies the ChatGPT chatbot, has become a revolutionary technology capable of generating realistic text, conducting conversations, and adapting to various contexts. Another prominent example of recent achievements in the field is Google's Gemini model, introduced in December 2023. This model has more than 175 billion parameters and possesses impressive versatility, generating text, code, music, and images.

According to the World Bank, the generative AI market is expected to grow from USD 1.5 billion in 2021 to USD 6.5 billion in 2026, indicating the growing importance of this technology. Generative AI has potential applications in various sectors, extends across multiple sectors, from healthcare and manufacturing to media and entertainment [3].

In a study by B. Bjork, it is noted that the first base models, such as ChatGPT, focus on the ability of generative AI to complement creative work. By 2025, it is expected that more than 30% of new drugs and materials will be systematically discovered using methods of generative AI, compared to zero today. This is just one of many industry use cases. According to predictions by the team of experts from the consulting firm Gartner, by 2025, 30% of outbound marketing messages from large organizations will be synthetically created, compared to less than 2% in 2022. By 2030, a blockbuster movie, 90% of which will be created by AI (from text to video), will be released [4].

Gartner's studies on the directions of integrating generative AI into business processes indicate that the main challenges for leaders lie in determining where and how generative AI fits into existing and future business models and operational processes, as well as how to productively experiment with generative AI use cases and prepare for the long-term risks and opportunities arising from its development trends [5].

Analyzing the state of development of generative AI, A. Takyar notes that the world is entering a new era of AI, where generative AI occupies a central place, seamlessly combining human imagination with machine intelligence. This elevates machine learning models to a new level of cognition, where they can create art, music, design, and generate ideas. This remarkable technological progress is not just science fiction, it is a reality that is felt today [6].

Generative AI has potential for application in various sectors, including banking. In banking, it can be used for detecting fraudulent transactions, creating synthetic data for training ML models, protecting customer data using GANs for calculating risk assessments and predicting potential losses in specific scenarios. It is also applicable in education [7], for example, in creating courses or virtual modeling to enhance student learning and restore historical educational materials. In healthcare, it allows for the optimization of drug discovery and development, personalized treatment, medical imaging enhancement, and population health management. However, along with a promising future, the use of generative AI also brings undesirable consequences. These include perpetuating existing biases, concerns about intellectual property control and the ability to create convincing disinformation [8]. The issue of regulating generative AI and ethical questions are the most pressing tasks facing researchers [9].

3. Study results

Generative AI uses deep learning models proficient in generating text, images, or other types of informational content that mirror the data they were trained on. By deciphering patterns and dependencies, these algorithms develop the capability to generate unique outcomes by constructing new samples in analogous formats. Generative AI models can be assorted in diverse ways, such as by the type of outcome they generate (texts, images, multimodal objects, etc.) or by the foundational architecture they employ. Generally, models that produce images are recognized as Generative Adversarial Networks (GANs) or diffusion models, whereas those generating text or audio are typically autoregressive, predicting future outcomes by leveraging

previous data inputs. Each of these methodologies has culminated in the development of cutting-edge products that now promote the application of AI across various life spheres. Among the various families of deep learning models capable of generating new data samples, autoregressive and diffusion models have showcased the highest quality results in recent years. Diffusion models are exceptionally suited for creating visual and multimedia content or performing tasks such as image inpainting and coloring when provided with textual prompts describing the desired outcome. Noteworthy models for image creation include DALL-E 2, Image GPT, Midjourney, and Stable Diffusion. On the other hand, there are large language models (LLMs) that generate responses word-by-word, using the text input by the user as well as the text previously generated by the model. Typically, these are models with a transformer decoder architecture, and they excel in various natural language processing tasks. This high performance is achieved through knowledge acquired during training on vast amounts of public data available on the internet.

3.1. The evolution and current dynamics of generative AI

Over the past year, generative AI has transformed from a compelling concept into a mainstream technology, attracting attention and investments on an unprecedented scale, considering its brief history. Generative AI demonstrates extraordinary proficiency in creating coherent text, images, code, and a variety of other outputs based on simple textual prompts. This capability has captivated the world, fueling a growing interest that intensifies with each iteration of generative AI model release. It is important to note that the true potential of generative AI extends far beyond traditional natural language processing tasks. This technology has found applications across numerous industrial sectors, paving the way for complex algorithms that can be distilled into clear, concise explanations. This helps in creating bots, developing software, and conveying complex academic concepts with unprecedented ease. Creative fields such as animation, gaming, art, cinema, and architecture are undergoing profound transformations, spurred by powerful programs for converting text into images, such as DALL-E, Stable Diffusion, and Midjourney. The groundwork for contemporary AI was laid over more than a decade; however, 2022 marked a significant turning point—a key moment in the history of AI. That was the year when ChatGPT was launched, inaugurating a promising era of collaboration between humans and machines [10]. This significantly accelerated the development and implementation of generative AI across various sectors of life and business.

Currently, the development of generative AI is vigorously pursued by the American company OpenAI, often hailed as a pioneer in the field of AI. Founded with the goal of providing broad benefits of general AI to humanity, OpenAI has achieved significant progress. Their contributions extend beyond simple technologies; they facilitate open collaboration and ethical development of AI. Besides OpenAI, leaders in the development of generative AI include DeepMind, Google AI, Meta, Microsoft AI, LeewayHertz, Markovate, Stability AI, Anthropic, Cohere, Accubits, InData Labs, ExoMetrics Inc, and Sentient. The contemporary landscape of AI resembles the battle for search engines in the late 1990s. Currently, many companies are engaged in this process.

Today, generative AI enables systems to create high-value artifacts such as videos, narratives, training data, and even designs and schematics. For instance, the generative pre-trained transformer (GPT) is a large-scale natural language technology that uses deep learning to produce human-like text. This technology predicts the most likely next word in a sentence

based on accumulated learning, can write stories, songs, and poems, and even computer code. Besides text, digital image generators such as DALL-E 2, Stable Diffusion, and Midjourney can produce images from text. There are a variety of methods used for generative AI, but recently, foundational models have attracted attention. Foundational models are pre-trained on general data sources in a self-supervised manner, which can then be adapted to solve new problems. Mainly based on transformer architectures, which embody a type of deep neural network architecture that computes a numerical representation of the training data, transformer architectures study context and thus meaning, tracking connections in sequential data. Transformer models employ an evolving set of mathematical methods called attention or self-attention to detect subtle ways in which even distant elements of data in a series affect and depend on each other.

The pace at which generative AI technologies are evolving is accelerating. ChatGPT was released in November 2022. In early 2023, OpenAI launched a new large language model (LLM), named GPT-4, with notably improved capabilities. Similarly, by May 2023, the generative AI Anthropic, Claude, was able to process 100,000 tokens of text, equivalent to approximately 75,000 words per minute—the length of an average novel—compared to about 9,000 tokens when it was introduced in March 2023. In May 2023, Google announced several new features based on generative AI, including the Search Generative Experience and a new LLM named PaLM.

3.2. Applications of Generative AI in the business operations

Generative AI technologies are used widely in business to improve efficiency and drive innovation. They are capable of executing a multitude of tasks, including image creation and the synthesis of speech and text. This broad applicability makes generative AI a valuable asset across many industry sectors, helping businesses streamline operations and innovate in multiple areas.

3.2.1. Sales and marketing

Sales and marketing teams became early adopters of generative AI, recognizing its potential to streamline and enhance their operations. In sales, generative AI is employed extensively to automate generation of custom sales scripts, email templates, and communications that are precisely tailored to meet the needs and interests of prospective customers. This technology not only saves time but significantly boosts the efficacy of sales strategies by ensuring messages are both engaging and relevant. Marketing teams utilize this technology to create both text and visual content, conduct proofreading, brainstorm innovative ideas, and personalize advertisements. Generative AI also plays a crucial role in market research and opportunity validation. It can analyze large datasets to identify trends, forecast customer behaviors, and pinpoint profitable opportunities, equipping businesses with the insights needed to stay ahead in competitive markets [11].

3.2.2. Customer service

In the sphere of customer service, generative AI is revolutionizing the way businesses interact with their clients. AI-driven chatbots and virtual assistants, which are underpinned by sophisticated generative models, have the capacity to deal with a broad spectrum of customer inquiries. Their design allows them to learn and evolve from each interaction, leading to

progressively more adept service. These intelligent systems efficiently handle routine tasks such as managing bookings, providing personalized recommendations, and swiftly resolving complaints [12]. This automation enables human customer service agents to concentrate on more intricate issues that require human empathy and complex problem-solving skills.

Beyond direct customer interaction, generative AI has a pivotal role in preparing customer service teams for the challenges of their role. By simulating diverse customer service scenarios, generative AI offers a dynamic training environment for representatives. This method of training allows customer service teams to experience and respond to a variety of potential situations, thus improving their preparedness and the quality of their responses when real-life customer interactions occur. This advanced approach to training with AI simulation results in a more competent and confident customer service workforce, equipped to uphold high service standards.

3.2.3. Financial services

In the financial services sector, the application of generative AI is making significant strides, particularly in enhancing security and decision-making processes. One of the standout uses of generative AI is in the realm of fraud detection. Here, AI algorithms are employed to create simulations of fraudulent activities, which not only helps in understanding the mechanisms of such activities but also aids in developing predictive measures that can be applied to real-world scenarios to prevent potential fraud [13].

Generative AI also contributes to the efficiency of high-frequency trading. It achieves this by crafting predictive models that are capable of simulating a variety of market conditions, enabling traders and financial analysts to anticipate market movements and make informed decisions rapidly.

Another innovative use of generative AI in this domain is the personalization of financial advice. AI systems are designed to analyze individual risk preferences and financial objectives to generate customized investment portfolios. This approach ensures that financial advice is not one-size-fits-all but rather tailored to the specific needs and goals of each client, thereby optimizing their financial planning and investment strategies.

3.2.4. Healthcare

Generative AI is transforming healthcare by accelerating drug discovery and personalizing patient care. AI models can simulate the effects of drugs to predict efficacy and side effects, dramatically speeding up the drug development process [14].

Furthermore, generative AI is also expanding into areas such as medical imaging and diagnostics, where it aids in interpreting complex images more quickly and accurately than ever before, and in developing patient-centric health monitoring systems that can anticipate health events before they occur. The culmination of these advancements in generative AI is set to offer significant benefits in terms of patient care efficacy, the efficiency of healthcare providers, and the well-being of patients.

3.2.5. Game development

In the realm of game development, generative AI offers the potential to dramatically transform the creation of non-playable characters (NPCs). By incorporating AI, developers can

create NPCs with a level of autonomy, complexity, and interactivity previously unachievable. This enhancement could lead to more immersive gaming environments where NPCs respond and adapt to player actions with realistic finesse.

Generative AI enables dynamic behavior modeling in NPCs [15], allowing them to exhibit nuanced and context-dependent behaviors that contribute to a more engaging and believable gaming world. Additionally, NPCs can utilize AI for dynamic dialogue generation in real-time, tailored to the individual player's journey and actions, thus making each interaction distinct and personal.

Generative AI also can personalize the gaming experience by analyzing a player's style and preferences to adapt NPC behavior and game narratives accordingly. This personalization not only aims to enhance player engagement but also reduces the resources traditionally required in the creative processes of game development.

3.2.6. E-commerce

Generative AI is significantly altering the e-commerce industry by introducing various useful applications. One key application is in product description generation. Large language models enable online stores to quickly generate detailed and appealing descriptions that are specifically tailored to each product and its intended audience. This technology saves merchants a considerable amount of time and ensures that all product listings maintain a high standard of quality and consistency. For instance, LLMs can be trained to incorporate essential product features, adherence to brand style, and search engine optimization keywords into descriptions, making them not only informative but also more likely to appear in search results [16].

Another important use of generative AI is in analyzing customer reviews through sentiment analysis. This allows merchants to understand customer opinions and satisfaction levels by systematically examining large volumes of review text to identify trends and overall sentiments. This process provides deeper insights than manual analysis, enabling the identification of specific elements that customers like or dislike, which can guide product improvements and marketing approaches.

Additionally, generative AI helps with product tagging and categorization, which are crucial for making products easier to find on e-commerce sites. This technology automates the process of assigning tags and placing products into categories based on their descriptions, images, and other related data. This not only enhances the customer shopping experience by improving search and filtering options but also aids merchants in managing their inventories more effectively. By using LLMs to identify relevant product attributes, the process of categorization becomes more efficient and less prone to the errors often seen with manual tagging.

3.2.7. Manufacturing

Generative AI is becoming indispensable in the manufacturing sector, significantly enhancing productivity and fostering innovation across various processes. In the area of component development [17], generative AI is used to design and produce components that meet specific business objectives. This application of AI boosts productivity by overcoming traditional manufacturing constraints, enabling manufacturers to achieve greater precision and customization. This leads to more efficient production processes and potentially higher quality in the final products [18].

Material innovation also benefits from the use of generative AI. This technology assists in the creation of new materials and chemicals, advancing the field of material science. AI accelerates the development of innovative materials with improved performance or reduced costs, which is crucial for industries aiming to integrate new technologies and enhance product sustainability.

In quality control, generative AI's impact is particularly evident in high-precision industries like automotive manufacturing. For example, companies such as the BMW Group and Tesla utilize AI-driven automated image recognition and other AI capabilities [19] to maintain strict quality standards. This enables the detection of subtle imperfections that are often invisible to the human eye, ensuring consistent high-quality manufacturing outputs.

3.3. Forecasted growth of generative AI and its economic implications

Economists predict that the growing popularity of generative AI tools, such as ChatGPT from OpenAI, could revolutionize workplaces and stimulate economic growth by enhancing productivity [20]. However, the actual impact will depend on various factors, including widespread adoption and effective use of technologies by companies. Economists at Goldman Sachs have calculated that once generative AI is widely adopted, it could contribute an additional 1.5% annual growth in productivity in the U.S. over a 10-year period. This increase in productivity could lead to a corresponding growth in the U.S. gross domestic product. However, it is difficult to predict when widespread adoption will occur. There may be uncertainties regarding the timing of acceptance by companies and the ultimate capabilities of AI that could lead to productivity increases ranging from 0.3 to 2.9 percent. Senior economist Joseph Briggs from Goldman Sachs suggests that in the second half of this decade and in the 2030s, AI will begin to have a broad macroeconomic impact. Historical comparisons with technologies such as electricity and the Internet show that the impact on productivity growth may occur gradually. It took several decades for electricity to have a significant impact on productivity growth in manufacturing. Similarly, the integration of generative AI into industries and companies may take time, as employees and organizations must incorporate the technology into their work processes.

Continuously evolving, generative AI will continue to influence product development, user experience, employee productivity, and innovation, having a significant effect on business productivity and development. According to Gartner forecasts:

- By 2025, 70% of enterprises will identify sustainable and ethical use of AI among their top concerns [21].
- By 2025, 45% of B2B revenue organizations will list “prompt engineering” as a required skill on job descriptions for messaging strategist roles [22].
- By 2025, 30% of outbound marketing messages from large organizations will be synthetically generated, up from less than 2% in 2022 [4].
- By 2026, more than 80% of enterprises will have used generative AI APIs or deployed generative AI-enabled applications [23].
- By 2030, AI could consume up to 3.5% of the world’s electricity [24].

Overall, the business community is at the beginning of the journey to understanding the power, scope, and opportunities of generative AI. It transforms and enhances the efficiency of

business functions such as sales and marketing, customer service, and software development. Research conducted by McKinsey & Company [25] suggests that generative AI has the potential to contribute up to $7.9 trillion annually to the global GDP, as shown in Figure 2.

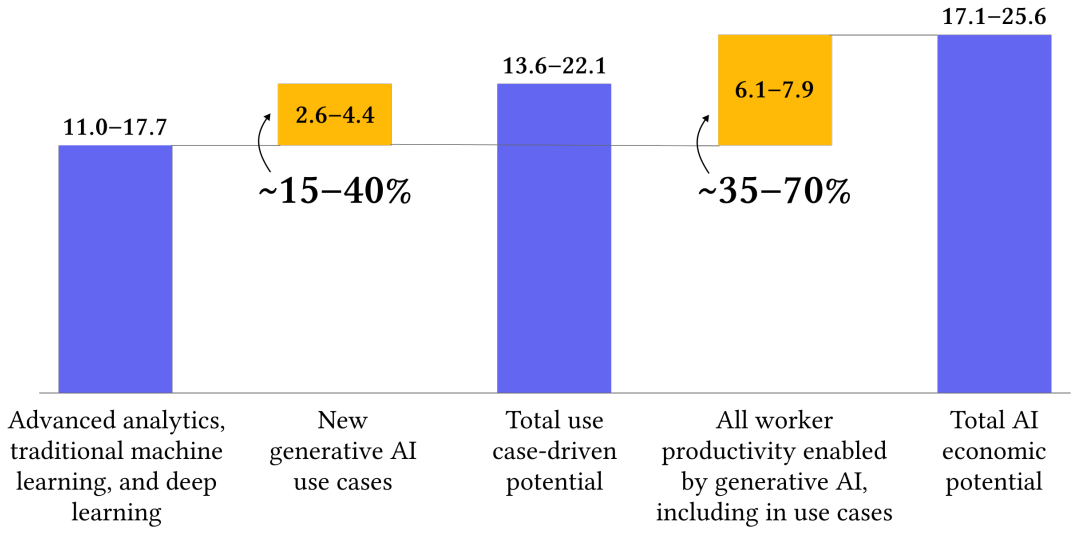

Figure 2: The potential impact of AI on the global economy, $ trillion.

4. Discussion

This paper provides a comprehensive examination of the transformative role of generative AI in enhancing labor productivity across various business sectors and its broader economic implications globally. The findings confirm that generative AI significantly boosts operational efficiency, reduces costs, and speeds up service delivery, particularly in healthcare, manufacturing, and education. This enhancement stems largely from its capacity to automate and innovate within creative processes.

The research also uncovers discrepancies between the anticipated benefits of generative AI and its actual utilization. These discrepancies highlight that the efficacy of AI technology is not solely technology-driven but also depends heavily on the rate of its adoption and the specific needs of each sector. For instance, while some sectors swiftly integrate new AI technologies to gain competitive advantage, others may lag due to various barriers such as lack of infrastructure, regulatory challenges, or skills.

The findings prompt a reconsideration of the broader implications of generative AI. While the technology promises substantial economic benefits, it also poses challenges, such as potential job displacement and ethical concerns, which require careful management.

5. Conclusions

The capability of generative AI technologies to exhibit creativity significantly impacts the business environment and reforms it in many dimensions. Generative AI unveils not only a broad spectrum of possibilities for businesses but also presents associated real and tangible threats. Among these threats are the potential for creating deep fakes, intellectual property issues, and other malicious uses of generative AI technology within the business context.

The current landscape of generative AI is experiencing a phase of remarkable growth unparalleled in history. Leading companies are drawing billions of dollars in investments and are pioneers in shaping the future of AI. The advancement of generative AI holds the potential to spark a new economic revolution that could fundamentally alter perceptions of business productivity. With effective implementation, enterprises may anticipate revolutionary changes in business processes and strategies. However, despite the significant potential of generative AI and its contribution to economic growth, the actual impact and the timing of its widespread deployment remain subjects of active research and discussion.

This transformative phase mirrors the proactive adaptation seen in the implementation of digital twins with augmented reality interfaces, poised as a powerful catalyst for unlocking human creative potential in smart manufacturing—a key stepping stone toward the transition to Industry 5.0 [26]. Digital twins prove particularly invaluable in enhancing manufacturing workflows, where decisions need to be made by human operators. Concurrently, the gathering of pertinent information facilitates ongoing process optimization, which can yield numerous advantages, such as enhanced product quality, increased energy efficiency, and effective predictive maintenance, integrating seamlessly with smart city ecosystems.

Various levels of digitalization and stages in the implementation of digital twins can be augmented by reality assets—from a virtual copy of an individual object, which can be remotely monitored to perform quality checks and control its behavior, to a virtual twin of the entire production pipeline. This not only enables remote control in real time but also opens up opportunities to employ novel big data processing methods for predictive analytics and process optimization. As we transition to the principles and practices of Industry 5.0, where human creativity will play a central role in production processes, innovative human-centered interfaces, such as those based on augmented reality technology, will be crucial. The specific examples of digital twins discussed in the literature underscore the importance of adopting and properly implementing a secure-by-design approach for digital twins' design, highlighting their characteristic features and the potential paths for further implementation in smart manufacturing. This ongoing dialogue and exploration underscore the importance of maintaining a vigilant and proactive approach to understanding and harnessing the capabilities of generative AI within the business environment.

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