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HOW DOES ARTIFICIAL INTELLIGENCE INFLUENCE THE SOCIO-ECONOMIC PERFORMANCE OF COMPANIES IN THE EUROPEAN UNION?

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Abstract

The main objective of the proposed study is to analyse how the implementation of Artificial Intelligence (AI) systems can influence the socio-economic performance of companies across different sectors in the European Union. In this context, we selected and processed companies' data from 27 EU Member States, operating in nine main sectors of activity. For the measurement of social performance, we used as indicators the number of employees and hours worked per employee, and for the measurement of economic performance, we used the net turnover and the added value of the company. The study's originality lies in its concurrent analysis of the impact of AI on both the economic and social performance of firms across nine sectors. The robust regression method with S estimator was applied to address the research objective. The results indicate a reduction in the number of employees and hours worked per employee following the implementation of AI in sectors such as manufacturing, accommodation and food services, and transportation. Regarding the economic performance of firms, the study's findings confirm the positive impact of AI implementation on the value added of firms in the manufacturing, transportation, trade, and water supply and waste management sectors, as well as on the increase in turnover of firms operating in the construction, transportation, information and communication technology, and trade sectors. The analysis conducted may contribute to guiding decisions in the technological and

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economic domains to support innovation and competitiveness of European enterprises in specific fields of activity.

Keywords: Artificial Intelligence, number of employees, number of hours per employee, added value of the companies, net turnover of the company, sectors of activity

JEL classification: O36, L25, J21

Introduction

According to Schwab (2018), the fourth industrial revolution is defined by blurring of the dividing lines between the physical, digital, and biological domains. This phenomenon is the result of significant technological progress, having a deep impact on economies, business environments, and on the personal lives of people globally. The European Union (EU) Member States are in the middle of this digital revolution, increasingly adopting and integrating AI technologies into various sectors and areas of society and the economy.

An issue often identified in relation to AI is that related to the effects of this technology on the workforce. There are studies stating that AI could replace human workers, particularly in sectors that require repetitive or low-level skills (Monaro et al., 2022), but they also highlight the opportunities of the AI use in human resource development (Lilly et al., 2022). A study (Brock and von Wangenheim, 2019) that set out to demystify AI observed that companies are optimistic about the integration of artificial intelligence into technology and the role that humans will play. Mainly, it is expected that AI and humans will collaborate in the future, rather than compete or replace each other, at least for a significant period.

The social performance of an organisation can be assessed through a multitude of indicators and from various perspectives. In this article, the number of employees is analysed as a measure of the organisation's commitment to job creation and providing a stable work environment for its community. The number of hours worked is considered an indicator of employees' level of commitment and can reflect the effort put forth to achieve the organisation's objectives, and, thus, the social performance of the organisation. In this paper, several indicators have been considered for economic performance for which data are available at the firm level across various sectors of activity in the 27 EU member states: value added and net turnover. Value added is essential not only as a performance indicator but also because it represents a measure of a company's contribution to GDP.

The purpose of this article is to analyse how the implementation of artificial intelligence (AI) systems can influence the socio-economic performance of firms across different sectors of activity in the European Union. The authors aim to assess the impact of AI on the number of employees, hours worked per employee, net turnover, and value added of firms from the 27 EU member states, operating in nine main sectors. A contribution of this study is that nine different sectors of activity are concurrently analysed, providing a comprehensive picture of how technology affects various industries and economic domains and allowing for the identification of specific trends and patterns for each sector. Although many studies focus exclusively on economic or solely on social aspects, this article investigates the impact of AI on both the economic and social performance of firms through the number of employees and hours worked per employee. From a practical standpoint, the analysis conducted can

contribute to guiding decisions in the technological and economic domains to support innovation and the competitiveness of European enterprises in certain fields of activity.

1. Scientific literature review

1.1. AI and companies in the accommodation and food services sector

Lately, big data and AI have become increasingly significant elements in the reshaping of the entire business process and in the methodology of analysing market and consumer trends by companies, including in the hospitality and tourism areas (Li et al., 2018). Line et al. (2020) believe that AI plays a crucial role in the evolution of the hospitality and tourism industry through the integration of new digital technologies and technological innovations. Li et al. (2017) have also highlighted the high importance of AI and Big Data in this evolution by improving the services and experiences offered within the industry. Therefore, tourism companies can generate personalised information for each traveller, through artificial intelligence that integrates this varied information and intentionally provided data, thus providing them with the travel-specific information they need at any given time (Bowen and Whalen, 2017). Ivanov et al. (2017) believe that it is essential to investigate the fundamental economics of adopting automation and robots within tourism companies. It is also important to assess the impact that robots, artificial intelligence, and service automation have on service quality, company competitiveness, and financial performance. Observations from previous research regarding the tourism sector have highlighted the effects of AI on economic and social performance, thus motivating the inclusion of this sector in our analysis. While there are evident benefits of utilising AI in the tourism sector, it is important to approach this issue with a balanced perspective and take into account potential challenges and social and ethical impacts.

1.2. AI and the administrative and support services sector

A study by Hatzius et al. (2023) suggests that about a quarter of the current work tasks could be automated using AI in the United States. Large exposures are seen in areas such as administration (46%) and legal professions (44%), while areas characterised by physically intensive activities, such as construction (6%) and maintenance (4%), show low exposures to automation. Similar results were found for the EU in terms of the degree of automation, both overall and across industries. The rhythm of adopting automation is likely to suddenly increase. According to Mc Kimsey's research (2023), without generative AI, automation could cover only 21.5% of the hours worked in the US economy by 2030. But with the implementation of this technology, this estimate has risen to 29.5%. In the literature, the impact of AI on the workforce in the administrative sector has been highlighted, leading us to include this sector in our analysis. It is essential to acknowledge that the impact of artificial intelligence on the administrative and support services sector is a complex process, with diverse consequences and potential social and economic challenges.

1.3. AI and the companies in the construction sector

Kumar et al. (2021) assessed the adoption level of the automated systems in the construction sector and the expanding use of artificial intelligence in construction projects. The aim of the study was to investigate whether artificial intelligence can be a critical success factor for projects in this field. Another paper by Pan and Zhang (2021) is a scientific and qualitative analysis on the adoption of Artificial Intelligence (AI) in the field of construction, engineering, and management (CEM) in the architecture and construction industry. The

results showed that various AI techniques have led to more reliable, time-saving, and cost-effective processes in the context of CEM, especially under conditions of increased uncertainty and intense data volume, thus highlighting the potential value of AI in supporting and improving CEM. Despite the highlighted advantages, the impact of AI on the economic performance of firms in the construction sector is well studied, while its effects on the social performance of these firms are less investigated. This observation underscores the need for more extensive and in-depth research that addresses the social and human aspects of the adoption of AI technologies in this field.

1.4. AI and companies in the information and communications sector

Hashmi (2023) considers it is crucial to understand the importance and the role of AI technology in ICT. Recent advances in machine learning, deep learning, and natural language processing have enabled the development of AI systems capable of tackling tasks that were previously thought to be destined for human intelligence. Johnson et al. (2022) observed variations between sectors where AI adoption is more common, such as the government, information, and communications technology (ICT), and the technology and software sectors. Thus, they deduced that AI development is mainly focused on new markets and areas of operations, rather than improving existing markets and activities. Moreover, it appears to support human labour rather than replace it; therefore, there appears to be no loss of AI-related jobs in research and development. Previous analysis of the ICT sector has highlighted the implications on economic and social performance, leading to the inclusion of this sector in our study. Despite the evident benefits brought by AI in the ICT sector, it is important to be aware of the social and economic implications of this technology.

1.5. AI and the companies in the manufacturing sector

The industrial era 4.0 has led to an increase in the manufacturing performance with the use of Artificial Intelligence (AI) applications and Internet of Things (IoT) technologies, which can increase the operational efficiency and effectiveness of the manufacturing processes (Vu et al., 2023). Mypati et al. (2023) have analysed AI and machine learning (ML) capabilities and how they can be implemented in the fields of production. In this paper, six manufacturing cases are presented: casting, forming, machining, welding, additive manufacturing, and supply chain management, and the way in which AI algorithms can be used in this case, performing a critical analysis on the manufacturing automation and AI benefits. The improvement of the operational performance through the adoption of digital technologies is oriented toward increasing both production capacity and product quality, thus contributing to increasing the profitability and competitiveness of enterprises. AI applications can be used to support production planning, helping to determine future requirements, and hence the optimal configuration of the manufacturing lines to ensure their efficiency (Jónás et al., 2014). Observations from previous research regarding the manufacturing sector have highlighted the effects on economic and social performance, thus motivating the inclusion of this sector in our analysis. However, it is important to recognise that the implementation of AI in the manufacturing sector comes with significant challenges and risks.

1.6. AI and the professional, scientific, and technical activities

The use of artificial intelligence in scientific research has increasingly become a topic of interest, and the AI tool that has generated a discussion is ChatGPT. This is a large language model (LLM) built on the OpenAI platform, which aims to emulate human writing and continuously improve through user interactions. Buholayka et al. (2023) studied the use of

ChatGPT and consider that the current version of ChatGPT requires an expert review of scientific information. Altmae et al. (2023) investigated the use of ChatGPT for scientific writing and showed that it has a great potential to become a great help for researchers in designing their study, performing analyses, and writing the results of the study into a scientific article. Schmitz (2023) investigated the use of artificial intelligence-based language models for the generation of simplified, consistent, and accurate summaries, reducing the risk of misinterpretation or bias. He noted that the generated abstracts proved to be of high linguistic quality and accurately showed the findings of the original articles, which can improve the visibility, impact, and transparency of the research. However, he still considers it necessary to validate the consistency and accuracy of AI language models before the extensive use in this direction. AI tools such as ChatGPT have generated a polarised debate among researchers. While some see it as a useful tool for speeding up the research, others see it as a threat to the integrity of authors (Salvagno et al., 2023). Although some researchers view AI as a useful tool for accelerating the research process, others express concerns about its impact on author integrity and the need for human oversight at all stages of the process.

1.7. AI and companies in the transportation and storage sector

The use of AI in the field of transport can lead to a more rational optimisation of the resource allocation, saving social costs, creating social wealth (Xia et al., 2020). Iyer (2021) compiled various issues affecting the transportation industry, especially from the categories of traffic management, public transportation, safety management, production, and logistics in intelligent transportation systems where the benefits of AI are implemented. In his paper, he also identified several solutions to solve the identified problems. The main goal of implementing various AI methodologies in transportation is to mitigate congestion, reduce travel times for commuters, and increase economic efficiency and productivity of the entire system (Abduljabbar et al., 2019). The use of AI in transportation helps to manage uncertainty and gain a competitive advantage because the transportation system is the key element in a logistics chain and provides links between separate logistics activities (Tseng et al., 2005). The use of AI in transportation offers the opportunity to manage uncertainty and gain a competitive advantage, as transportation plays a crucial role in logistics chains and in connecting various logistic activities.

1.8. AI and companies in the water supply, sewerage, waste management, and remediation activities sector

Uwamungu et al. (2022) consider that the water sector can benefit from the use of artificial intelligence to improve and monitor water resource management. Artificial intelligence can support operators by helping them make sophisticated and intelligent decisions, thus contributing to the increase of the accuracy and reliability of the treatment system, although it involves complex data analysis from operators. The adoption of AI techniques offers innovative alternatives for the solid waste management in various areas of DSM (generation, sorting, collection, vehicle routing, treatment, disposal, and waste management planning) to improve sustainable waste management practices (Andeobu et al., 2022). Technologies using artificial intelligence are now being adopted in many developed countries to optimise opportunities for resource utilisation, efficiency, and recovery throughout the solid waste management cycle from waste generation, sorting, collection, treatment, energy recovery, disposal, to waste management planning (Soni et al., 2019). Recent studies have highlighted the potential of AI technologies in monitoring and managing water and waste resources, contributing to smarter decision-making and increased system reliability.

1.9. AI and companies in the wholesale and retail trade; repair of motor vehicles and motorcycles sector

Dinu (2021) emphasised the need for a comprehensive analysis of the extension and adoption of Artificial Intelligence in the wholesale and retail sector, considering the entire value chain from the producers of the goods to the end user. Jian et al. (2023) conducted a study on the impact generated by AI on wholesale and retail trade, as its impact and dynamics are unclear. Thus, they noticed that in the Chinese provinces the quality of trade was consistent with the relative level of AI adoption, the influence of AI was significant on trade, along with the labour density or the percentage of employees in trade, and the existence of spatial variations in the influence of AI. Weber and Schütte (2019) identified that in the fields that require business predictions (such as marketing or inventory management), the use of AI is now well advanced both scientifically and practically. The integration of artificial intelligence into the wholesale and retail trade sector represents a complex and dynamic process, with the potential to bring significant benefits, as well as significant risks and challenges. Previous studies in the field of commerce have highlighted the influence on economic and social performance, which prompted us to include this sector in our research.

From the analysis of the literature, the lack of studies regarding the simultaneous impact of implementing artificial intelligence on the socio-economic performance of companies in different sectors of activity can be observed. Although there have been some studies examining the impact on employment and separate research on the influence of artificial intelligence (AI) on the financial performance of companies, to date, no concurrent analysis of the impact of AI on both categories of performance has been identified. Therefore, our study addresses these gaps in the literature by analysing the impact of implementing AI systems on both social aspects (number of employees, hours worked per employee) and financial aspects (value added of the firm, net turnover). In this regard, we formulated the following research hypotheses:

H1: The implementation of AI influences negatively the evolution of the number of employees in the companies.

H2: The implementation of AI leads to the reduction in working hours per employee.

H3: The implementation of AI contributes to an increased added value of the companies.

H4: The AI implementation determines an increased net turnover of the companies.

In the next section of our article, we provide an overview of the data and methodology. In Section 3 we present the results of our analysis and the discussions, and the last section includes the conclusions of the paper.

2. Data and methodology

The main objective of the research aims to quantify the impact of implementing artificial intelligence systems on the socio-economic performance of companies in different sectors of activity. In this regard, in table no. 1, we presented the indicators used in the analysis to address the stated objective. For each of the six indicators used, we selected and processed information from firms in the 27 member states of the European Union for the year 2021, forming a cross-sectional database. The data used were selected from the Eurostat database (Eurostat, 2023). These indicators are representative in quantifying the impact of

implementing artificial intelligence systems on the socio-economic performance of firms. The number of employees and the hours worked by the employees reflect the size and intensity of labour within a firm. The implementation of AI technologies can affect these aspects by automating processes and reducing the need for human labour in certain areas. Net turnover and value-added measure the financial performance of a firm and its contribution to the economy. The implementation of AI technologies can influence these indicators by improving operational efficiency, increasing productivity, and innovating in business processes.

Table no. 1. Indicators used in the analysis

Name of the indicator	Acronym	Type of variable	Measure unit	Source of the data
Number of employees	EMP	Dependent variable	Number of employees	Eurostat
Hours worked by the employees	HR	Dependent variable	Number of hours	Eurostat
Net turnover	NT	Dependent variable	Million Euros	Eurostat
Added value	VA	Dependent variable	Million Euros	Eurostat
Companies using at least one of the AI technologies	AI	Independent variable	Percentage from total companies	Eurostat
Companies not using any of the AI technologies	Non-AI	Independent variable	Percentage from total companies	Eurostat

The nine sectors of activity included in the study were identified and selected based on the information available in the Eurostat database.

The standard regression model proposed to assess the impact of artificial intelligence on the number of employees and financial performance of firms is based on the following mathematical equation:

$$Y_i = \beta_0 + \beta_1 X_{li} + \varepsilon_i \tag{1}$$

To select the optimal type of regression for the available dataset, it is necessary to analyse the size of the residuals (Doran et al., 2022). Considering that our datasets contain extreme values, ordinary least squares regression is not suitable for our analysis, and robust regression is recommended (Doran et al., 2023). Robust regression offers three types of estimators: the M estimator developed by Huber (1973), the S estimator proposed by researchers Rousseeuw and Yohai (1984), and the MM estimator developed by Yohai (1987), but we will use the scale estimator that focuses on outliers in the independent variables. Calculating the S estimator is complex, and there are several fast algorithms that provide accurate approximations. In our study, we will use the Fast-S algorithm by Salibian-Barrera and Yohai (2006). The S estimators find the set of coefficients β that provides the smallest estimation of the scale S such that:

$$\frac{1}{N-k} \sum_{i=1}^n h_0 \left(\frac{r_i(\beta)}{S} \right) = b \tag{2}$$

According to Rousseeuw and Yohai, we choose a function based on the integral of the Biweight function:

$$h_0(X) = \begin{cases} \left(\frac{X}{c}\right)^6 - 3\left(\frac{X}{c}\right)^4 + 3\left(\frac{X}{c}\right)^2 & \text{if } |X| \leq c \\ 1 & \text{on the contrary} \end{cases} \tag{3}$$

And we assess S using the method of absolute median deviation, focused on zero (Hubner, 1973):

$$\hat{\sigma}^{(0)} = \text{median} \left[\frac{\text{abs}(r_i^{(0-1)})}{0.6745} \right] \tag{4}$$

The causality test proposed by Granger (1969) is applied to identify possible directions of causality between the dependent variables and the explanatory variables included in the model.

3. Results and discussions

The results from Table no. 2 indicate a negative influence of AI on the number of employees in the accommodation and food services sector, due to the negative coefficient value for firms using AI of -0.0674 and its associated probability of 0.0624. Similarly, the impact on the number of hours worked per employee is negative according to the coefficient value for AI-utilising firms of -0.0576 and its associated probability of 0.0762. Thus, hypotheses H1 and H2 are confirmed. This is primarily due to automation systems that can take over repetitive tasks such as payment processing, reservation management, and inventory administration, reducing the need for manual labour in these areas. Additionally, robots in the food industry can be used mainly in kitchens and food production facilities for cutting, cooking, or assembling dishes.

Table no. 2. AI impact in the accommodation and food industry services

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	-0.0674	-0.0576	0.0620	0.0442
Probability	0.0624	0.0762	0.7485	0.8498
Non-AI coefficient	0.0569	0.0691	-0.0200	0.1272
Probability	0.3917	0.4896	0.8757	0.0578
Number of obs.	1,904,781 companies in the European Union			

Our results confirm the findings of the Cotec Foundation survey (2017), which showed that 66.6% of the participants expressed their opinion that many or quite a few jobs could be replaced by robots or computers, especially in repetitive tasks.

In the case of administrative and support service activities (Table no. 3), the coefficients associated with the explanatory variables do not indicate a statistically significant influence of artificial intelligence due to the probability values exceeding the 90% confidence interval. The number of firms in this sector included in the analysis is 1,685,997 from the 27 member

states of the European Union. The implementation of AI often requires adjustments to infrastructure, staff training, and adaptation periods.

Table no. 3. AI impact on the sector of administrative services and support activities

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0273	0.0150	0.0775	0.0688
<i>Probability</i>	<i>0.8510</i>	<i>0.9277</i>	<i>0.5439</i>	<i>0.7049</i>
Non-AI coefficient	-0.0524	-0.0678	-0.1049	-0.0925
<i>Probability</i>	<i>0.6360</i>	<i>0.4787</i>	<i>0.1089</i>	<i>0.3078</i>
Number of obs.	1,685,997 companies in the European Union			

The AI integration can optimise the administrative operations, allowing professionals to focus on strategic issues, significantly improving the overall efficiency and productivity (Aldoseri et al., 2023).

Analysing the results from table no. 4, we observe that in the construction sector, the coefficient for firms using AI is positive (0.0555), with an associated probability of 0.0557, rejecting hypothesis H1. Although in the construction sector there are robots and autonomous vehicles equipped with AI technologies that can perform construction tasks such as bricklaying or land leveling, this does not necessarily replace human labour, but rather creates new opportunities for operators of such equipment. However, concerning the number of hours worked, the coefficient for firms using AI is negative (-0.0149), with an associated probability of 0.0832, confirming hypothesis H2. AI systems can assist engineers and architects in the design and simulation process, reducing the time needed for plan development and increasing team efficiency.

Table no. 4. AI impact in the construction sector

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0555	-0.0149	0.0871	0.0687
<i>Probability</i>	<i>0.0557</i>	<i>0.0832</i>	<i>0.1767</i>	<i>0.0269</i>
Non-AI coefficient	0.1133	0.1116	0.1616	0.1679
<i>Probability</i>	<i>0.0279</i>	<i>0.0902</i>	<i>0.2527</i>	<i>0.0576</i>
Number of obs.	3,733,336 companies in the European Union			

It is important to note that while AI can bring significant improvements in construction, it can also influence and change the skills requirements of the workforce. According to the results obtained in table no. 4, for construction firms in the EU, artificial intelligence significantly contributes to the increase in net turnover, with the coefficient for firms using AI being positive (0.0687), and the associated probability of 0.0269, thus confirming hypothesis H4. The AI algorithms can analyse historical project data, site conditions, and other variables to optimise project planning and execution. This can lead to shorter completion times and reduced costs associated with delays, thus contributing to a growth of the net turnover. AI systems can optimise the allocation of resources, including manpower, equipment, and materials. There are divergent views among researchers about the potential of AI techniques to solve complex construction problems in uncertain environments (Tiruneh et al., 2020). On the one hand, some believe that AI-based approaches are adequate to solve these real-world difficulties. In contrast, other researchers argue that AI-based systems or models have limitations in addressing practical construction problems (Darko et al., 2020).

The first domain where AI was implemented was that of information and communications. This explains the nonsignificant results of the analysis (Table no. 5) regarding the number of employees and the number of hours worked per employee, since there were no significant changes in the information and communications sector during the analysed year. However, a significant positive impact of AI on the evolution of net turnover is observed, as indicated by the positive coefficient for firms using AI (0.0313) and the associated probability of 0.0089, confirming hypothesis H4. AI systems enable for rapid and efficient analysis of massive volumes of data.

Table no. 5. The AI impact in the information and communication field

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0094	0.0062	0.0322	0.0313
<i>Probability</i>	<i>0.8786</i>	<i>0.9386</i>	<i>0.6777</i>	<i>0.0089</i>
Non-AI coefficient	-0.0133	-0.0104	-0.0366	-0.0354
<i>Probability</i>	<i>0.8217</i>	<i>0.8973</i>	<i>0.6451</i>	<i>0.5573</i>
Number of obs.	1,281,164 companies in the European Union			

In the information and communications field, this translates into the ability to process and extract relevant information from structured and unverified data, helping to make more informed decisions. AI-based virtual assistants and chatbots are increasingly used to provide customer support, to answer common questions, and to facilitate online interactions. However, there are also challenges, including privacy, ethics, and security that need to be addressed as these technologies develop.

The negative coefficient value associated with firms using AI (-0.0013) and its associated probability (0.0033) recorded in Table no. 6 indicate that at the EU level in 2021, among the over 2 million firms included in the analysis, AI negatively impacted net turnover, thus refuting hypothesis H4. Although AI has the potential to enhance efficiency and productivity in many cases, implementing AI solutions in the manufacturing sector can entail significant costs, including for technology acquisition and implementation, staff training, and adjusting existing infrastructure. If these investments exceed the savings gained from increased efficiency, it may lead to a decrease in net turnover. Thus, the coefficient for firms using AI is positive (0.0228) and statistically significant (0.0367), confirming hypothesis H3 that AI implementation contributes to increasing the value added by firms. Although there are no studies referring to a possible link between AI implementation and economic performance in the manufacturing sector, we have identified research supporting a positive impact on the operational efficiency of companies' technical infrastructure (Vu et al., 2023).

Table no. 6. AI impact in the production sector

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	-0.0183	-0.0334	0.0228	-0.0013
<i>Probability</i>	<i>0.0462</i>	<i>0.0402</i>	<i>0.0367</i>	<i>0.0033</i>
Non-AI coefficient	-0.0102	0.0386	-0.0035	0.0392
<i>Probability</i>	<i>0.8235</i>	<i>0.6177</i>	<i>0.9855</i>	<i>0.6601</i>
Number of obs.	2,119,709 companies in the European Union			

On the other hand, employees may encounter resistance to change when new technologies, including AI, are introduced. According to the negative value associated with the coefficient

for firms using AI (-0.0183) and its probability, hypothesis H1 is confirmed in the sector, as well as hypothesis H2 due to the negative coefficient value for firms using AI (-0.0334) regarding the number of hours worked per employee.

Artificial intelligence contributes to the increase in the number of employees in professional, scientific, and technical activities as the AI coefficient is positive (0.0124), and its associated probability is 0.0480, indicating statistical significance at a confidence level of 95%, thus confirming hypothesis H1 (Table no. 7). Additionally, regarding the impact on the number of hours worked, the AI coefficient is positive (0.0110), and its associated probability is 0.0392, indicating statistical significance at a confidence level of 95% and confirming hypothesis H2. An increase in the use of AI implies a greater need for data analytics and data science professionals. They are involved in collecting, processing, and interpreting data, contributing to making decisions based on information. In the healthcare and research sector, the implementation of AI may lead to an increased demand for professionals in developing and using AI applications for diagnosis, research, and improved treatments. It is important to stress that, in addition to increasing demand for certain professional profiles, AI implementation may also lead to changes in skill requirements, requiring retraining and continuous development for the employees.

Table no. 7. The AI impact in the sector of professional, scientific and technical field

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0124	0.0110	0.0503	0.0523
<i>Probability</i>	<i>0.0480</i>	<i>0.0392</i>	<i>0.5003</i>	<i>0.6662</i>
Non-AI coefficient	-0.0278	-0.0397	-0.0635	-0.1428
<i>Probability</i>	<i>0.5266</i>	<i>0.1093</i>	<i>0.1414</i>	<i>0.0497</i>
Number of obs.	4,799,728 companies in the European Union			

Artificial intelligence is helping to reduce the number of employees and to improve the working hours in the field of transport and storage by automating processes, optimising routes, improving planning, and resource management. According to the results from Table no. 8, the coefficient of AI on the number of employees is negative (-0.0071), and its associated probability is 0.0090, indicating statistical significance at a confidence level of 95%, confirming hypothesis H1. Additionally, the coefficient testing the effects of AI on the number of hours worked per employee is negative (-0.0149), and its associated probability is 0.0086, confirming hypothesis H2. Furthermore, hypotheses H3 and H4 are also confirmed by the positive coefficients associated with firms implementing AI on value added (0.0595) and on turnover (0.0903), both statistically significant. AI can be used to monitor and manage traffic flow in real time, helping to optimise routes and avoid congestion. It can reduce the need for a large number of traffic operators and improve traffic flow.

Table no. 8. The AI impact in the field of transport and storage

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	-0.0071	-0.0149	0.0595	0.0903
<i>Probability</i>	<i>0.0090</i>	<i>0.0086</i>	<i>0.0452</i>	<i>0.0235</i>
Non-AI coefficient	0.0166	0.0149	-0.0702	-0.0650
<i>Probability</i>	<i>0.7423</i>	<i>0.8342</i>	<i>0.5801</i>	<i>0.6975</i>
Number of obs.	1,380,703 companies in the European Union			

The results obtained in Table no. 9 indicate that artificial intelligence can bring significant added value to firms in the field of water supply, sewerage, waste management, and remediation, due to the positive coefficient of firms implementing AI of 0.0665 and its associated probability of 0.0430, which confirms hypothesis H3.

Table no. 9. The AI impact in the water supply, sewage, waste management and remediation sector

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0157	0.1087	0.0665	0.0343
<i>Probability</i>	<i>0.1740</i>	<i>0.3710</i>	<i>0.0430</i>	<i>0.1697</i>
Non-AI coefficient	-0.0185	-0.0890	-0.2506	-0.2443
<i>Probability</i>	<i>0.6624</i>	<i>0.0976</i>	<i>0.0000</i>	<i>0.0000</i>
Number of obs.	79,675 companies in the European Union			

The AI-based monitoring systems can provide an overview of the water supply and sewerage infrastructure. AI systems can analyse waste generation patterns and can schedule collection routes efficiently, minimising distances, and reducing greenhouse gas emissions.

The coefficient values for firms utilising AI in the wholesale and retail trade and repair of motor vehicles and motorcycles sector indicate an increase in the number of employees (0.0137) and the number of hours worked per employee (0.0041), both statistically significant, thus contradicting hypotheses H1 and H2, according to the results from Table no. 10.

Table nr. 10. The AI impact in the wholesale and retail trade and in the vehicle and motorcycle repair

	No. of employees	Worked hours/employee	Added value	Net turnover
AI coefficient	0.0137	0.0041	0.0569	0.0418
<i>Probability</i>	<i>0.0480</i>	<i>0.0276</i>	<i>0.0360</i>	<i>0.0401</i>
Non-AI coefficient	-0.0484	-0.1212	-0.0844	-0.0718
<i>Probability</i>	<i>0.3788</i>	<i>0.0594</i>	<i>0.3532</i>	<i>0.3734</i>
Number of obs.	5,860,764 companies in the European Union			

From the table, positive coefficient values associated with the impact on the value added of firms (0.0569) and on the turnover (0.0418) can be observed, both statistically significant, confirming hypotheses H3 and H4. In the wholesale and retail sector, AI is being used to automate operational processes such as inventory management, order processing, inventory tracking, and supply chain management, reducing the need for manual activities but at the same time creating new job opportunities in the management and optimisation of these systems.

In order to get a complete overview of the Artificial Intelligence impact on business sectors, we considered it necessary to corroborate the results obtained by applying the robust regression with the results from the Granger causality test.

In figure 1, a synthesis of the coefficient sign associated with the explanatory variable (firms implementing at least one AI system) on the dependent variables for each sector of activity is depicted.

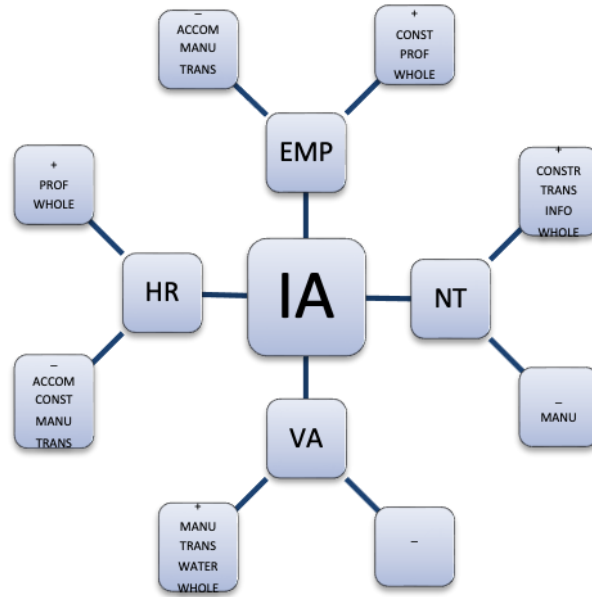


Figure no. 1. Causality direction and confirming the hypothesis

The correlation between the results in the figure and the categorisation of sectors of activity into boxes with a positive or negative sign, and the formulated hypotheses, is determined by the fact that in the case of the number of employees and hours worked per employee, hypotheses one and two are confirmed if the sectors of activity are classified into boxes with a negative sign, while in the case of hypotheses three and four, they are confirmed if the sectors of activity are classified into boxes with a positive sign.

Conclusions

The main objective of the study was to identify the impact of the implementation of AI systems on the socio-economic performance of the companies from different sectors. Therefore, this analysis also included data from the year 2021 on companies from the 27 EU Member States that have implemented at least one AI system in their business. The originality of the study lies primarily in the study of the existing connections between implementing the AI systems within the companies and their socio-economic performances, managing in this way to cover a lack of the reference literature in this field of research. Secondly, our methodology is innovative because using the robust regression in these studies has not been used so far. Moreover, our analysis is carried out on a large sample of countries including companies from all main fields of activity, offering a comprehensive view on the consequence of the implementation of Artificial Intelligence on their socio-economic performances.

The results of the study show that the implementation of the AI systems in the activities of the companies can affect the number of employees towards their reduction in the production, accommodation, food, and transport systems. Also, in terms of the number of worked hours per employee, the AI implementation leads to their reduction in the same sectors of activity

as in the case of the number of employees, to which the construction sector is also added. As for the economic performance of the companies, the results of the study confirm the positive impact of AI implementation on the added value of the companies from the production, transport, trade and water supply, waste management sectors, as well as on the turnover of the companies from the construction, transport, information technology, communications, and trade sector, leading to their increase.

The practical significance of this study is to offer a detailed overview on the way in which AI implementation can influence the socio-economic performances of the companies, supplying relevant data for the decision-making process and business strategies, the human resources management and the development of the companies' policies in the field. These should identify the trends in the technological development considering the needs of the users and of the employees to select adequate strategies of digital transformation which should continue to provide a positive impact of technology on the workforce, but which should also lead to the increase of the added value and of the turnover. Therefore, companies can adjust their priorities and their resources according to the predictable effect of the AI implementation in their activities.

The limits of the study are determined by the lack of data on a longer period; therefore, the future research will aim at the sample expansion by using panel data on a longer period, as more data becomes available. Moreover, the research should explore the ethical problems related to using robots, artificial intelligence, and automation in the field of travelling, tourism, and hospitality. It is obvious that robots have become a stable and persistent presence, but people will still be able to create and shape the future ways to use them.

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