

Adoption of artificial intelligence in Spanish firms: an initial analysis based on the Banco de España Business Activity Survey

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Rationale

Artificial intelligence (AI) has the potential to revolutionise economies and labour markets. Using the Banco de España Business Activity Survey (EBAE), this article analyses the adoption of AI by Spanish firms.

Takeaways

- Almost 20% of the Spanish firms surveyed are using AI systems. This is less than their German counterparts, but higher than the adoption rate in Italy, according to similar surveys conducted in those countries. However, most firms are still just experimenting with AI.
- The AI adoption rate is higher in technology services and in large, productive and young firms. The main obstacles are the lack of skilled labour, high implementation costs and data availability.
- Spanish firms use AI mainly to optimise internal processes and for marketing. It is used less for task automation and innovation. 80% of firms believe that AI will not affect employment, and those that are already using it expect it to have a positive impact.

Keywords

Artificial intelligence, adoption of technology, productivity.

JEL classification

E22, H32, L25, O33.

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Introduction

The rapid advancement of digital technologies is prompting far-reaching changes in multiple fields of knowledge. Specifically, AI is shaping up to be a technology that, from an economic perspective, can be integrated into all productive sectors (Agrawal, Gans and Goldfarb, 2019; Brynjolfsson, Rock and Syverson, 2019), because it allows for process optimisation, thereby improving efficiency in a broad set of industries (Filippucci, Gal and Schief, 2024). This would significantly boost productivity, although considerable uncertainty surrounds the quantification of its long-term impacts.¹

AI adoption rates are increasing rapidly, yet they are still relatively low. For instance, Acemoglu et al. (2022) found that 3% of US firms used AI technologies in 2018. Later, Bonney et al. (2024) showed that, in early 2024, this figure had risen to 6% and was expected to reach 9% by the end of that year. Among the large global firms surveyed by McKinsey (2024), the AI adoption rate rose from 20% in 2017 to 55% in 2023 and 72% in 2024, largely driven by ChatGPT bursting onto the scene. According to Eurostat data, the AI adoption rate in European Union firms with ten or more employees rose from 7.7% in 2021 (the same percentage as in Spain) to 13.5% in 2024 (11.3% in Spain).² Yet this figure is still well below the targets set by the European Commission in the Digital Decade.³

However, these surveys have some limitations. For example, they do not provide information on the intensity of AI use in firms, its specific applications, the obstacles to greater adoption and, above all, they do not allow for analysis of the role that firms' characteristics – beyond their sector of activity – play. Given this situation, the 2024 Q4 edition of the EBAE included an ad hoc module on this topic. The survey's fieldwork was conducted between 11 and 25 November 2024 and 6,300 firms participated.⁴ The information compiled in this module was combined with data drawn from the Banco de España's integrated CBSO database (CBI)⁵ in order to study the adoption landscape of these technologies in Spain.

1 These estimates range from a 1% increase in total factor productivity (TFP) in ten years (Acemoglu, 2025) to a 28% rise in labour productivity over the same time horizon (Baily, Brynjolfsson and Korinek, 2023).

2 According to the "Survey on the use of ICT and e-commerce in enterprises", the AI adoption rate is defined as the percentage of firms that use at least one of the following AI: machine learning for data analysis, chatbots, service robots and internal analysis of large datasets with natural language processing, natural language generation or speech recognition.

3 "Europe's Digital Decade: digital targets for 2030" expected 75% of European firms to be using cloud, AI or Big Data services by that date, while in Spain the digital strategy is targeting 25% of firms using AI and Big Data by 2025.

4 Fernández Cerezo and Izquierdo (2024).

5 The CBI contains comprehensive information on the financial statements and profit and loss accounts of over 800,000 Spanish non-financial corporations on average for each financial year up to and including 2023. This article uses CBI data for 2023.

Degree of AI adoption by Spanish firms

According to the EBAE results,⁶ the AI adoption rate in Spanish firms is lower than that for other more mature digital technologies, such as cloud computing.⁷ Specifically, 19.9% of the firms surveyed currently use some form of AI.⁸ Broken down by the AI tool used, the adoption rate for generative AI⁹ (18.1%) is somewhat higher than the rate for predictive AI¹⁰ (14.6%) (see Chart 1.a).

However, when asked about the intensity of use, 60% of firms using AI (around 12% of the total sample) are experimenting with it or using it in pilot projects, while 34% (7% of the total sample) are using it moderately and only 6% are using it significantly (1% of the total sample). By contrast, cloud computing has been more widely adopted in the Spanish business sector (44% of users), with a higher percentage of firms using it moderately or significantly. This suggests that this technology is more developed than AI, in line with the existing evidence in the digital transformation indicators of the European Commission's Digital Economy and Society Index (DESI).¹¹

To perform an international comparison, comparable results are available for Italy and Germany, whose central banks included this question in their respective business surveys.¹² They show that AI has been taken up more widely by Spanish firms (30.9%) than by their Italian counterparts (13%), but that the adoption rate is considerably lower than among German firms (46%). However, most AI users in the three countries state that they are experimenting with it (see Chart 1.b).¹³

The adoption rate for AI in Spain varies greatly across sectors (see Chart 2.a). According to the EBAE, AI use is more widespread in business services sectors, such as information and communication, with 31.6% and 45.7% of firms using predictive AI and generative AI, respectively, and in professional, scientific and technical activities (adoption rates of 26.6% and 30.4%, respectively), in contrast to the AI adoption rates observed in agriculture and construction, which stand below 10%. AI adoption is also low in other services sectors, such as accommodation and food service activities and real estate activities (just under 15%). By contrast, adoption of cloud

6 Question: "Specify the degree of use in your firm of the following technologies: cloud computing, predictive AI, generative AI, advanced robotics, interconnected production equipment". Possible answers: "Not currently in use and no short-term plans to use it", "Not currently in use, but there are plans to start using it over the next 12 months", "Very infrequent use or in pilot projects/ experimentally", "Moderate use", "Significant use".

7 Cloud computing includes hardware and software for remote data storage and processing.

8 Firms that answered "Very infrequent use or in pilot projects/experimentally", "Moderate use" or "Significant use" for at least one of the two AI technologies considered in the EBAE (predictive AI or generative AI) are deemed AI users. Of the 19.9% of AI users, almost 65% report using both predictive AI and generative AI, 26% only generative AI and 9% only predictive AI.

9 In the EBAE generative AI means those models capable of producing content such as texts, code, images, video or other multimedia content, including chatbots.

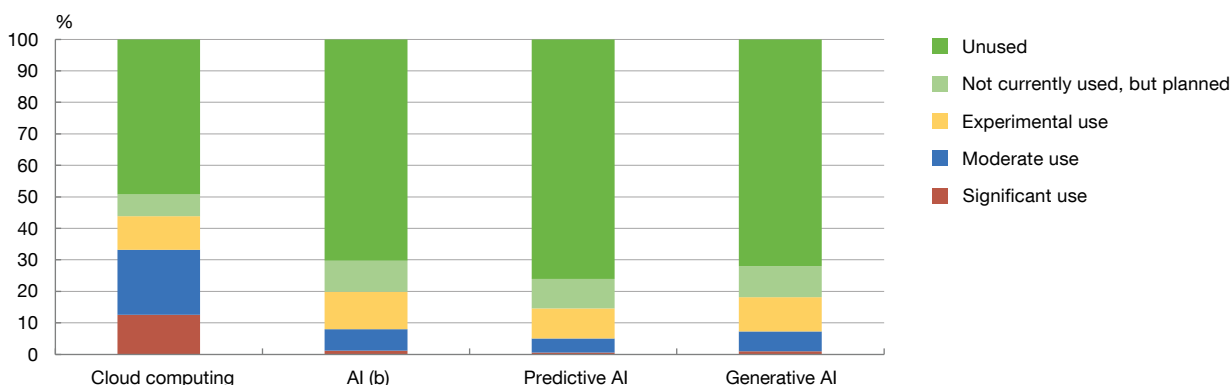
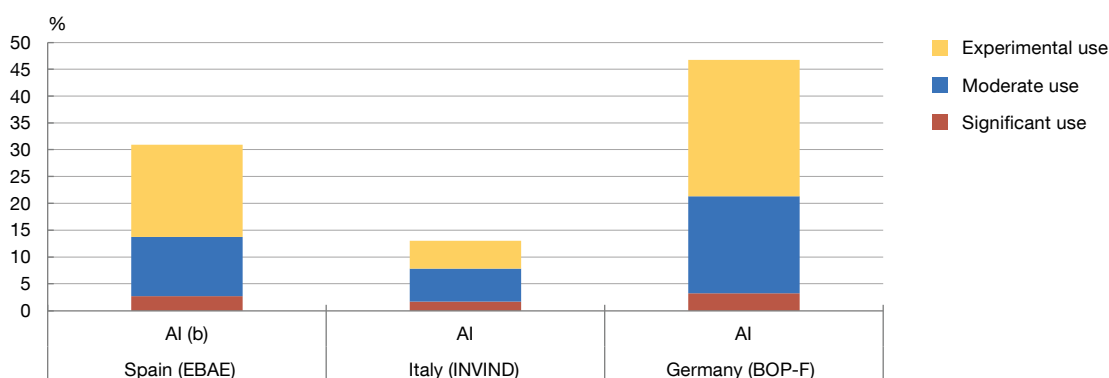
10 In the EBAE predictive AI means those models for forecasting, summarising or clustering big data, including machine learning techniques.

11 According to the [DESI dashboard](#), cloud computing technologies were used by 45.2% of European firms and 36% of Spanish firms in 2024.

12 The sample is restricted to firms with 20 or more employees in the market economy, excluding agriculture and construction, to obtain results comparable with the surveys conducted by the [Banca d'Italia](#) and the [Deutsche Bundesbank](#), which both conducted the fieldwork in 2024 Q2.

13 These results are consistent with the survey on ICT use conducted by Eurostat, which shows that AI is used less in Spain than in Germany, but more than in Italy.

Chart 1

Adoption of advanced technologies in the business sector**1.a Use of digital technologies in Spanish firms (a)****1.b Use of AI in firms with 20 or more employees, excluding agriculture, construction and non-market and financial services (a)**

SOURCES: EBAE (Banco de España), Survey of Industrial and Service Firms (INVIND, Banca d'Italia) and Bundesbank Online Panel – Firms (BOP-F, Deutsche Bundesbank).

- a** Question: "Specify the degree of use in your firm of the following technologies." Possible answers: "Not currently in use and no short-term plans to use it", "Not currently in use, but there are plans to start using it over the next 12 months", "Very infrequent use or in pilot projects/experimentally", "Moderate use", "Significant use". Firms with fewer than 20 employees and firms from the agricultural, financial and public sectors are excluded.
- b** Use of predictive AI or generative AI, taking as degree of intensity of use the higher of those reported by each firm for the two AI technologies.



computing services is somewhat more consistent across sectors, ranging from 75% in information and communication to 43% in real estate activities.

In addition to cross-sectoral differences, the information from the EBAE can be used to explore the heterogeneity in AI adoption decisions based on other firm characteristics. Specifically, we analyse the relationship between the degree of AI adoption and a set of variables from the CBI, such as productivity,¹⁴ size (in terms of number of employees), firm age and share of intangible assets (such as software, databases or patents), controlling for differences in other dimensions such as sector of activity.¹⁵

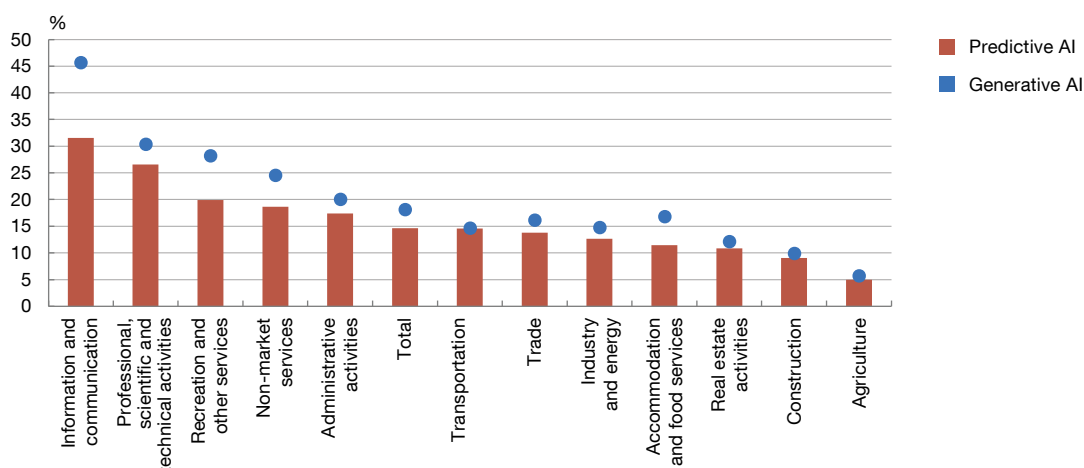
¹⁴ Productivity is measured as total factor productivity using the Wooldridge approach, at NACE Rev. 2 division level (Rovigatti and Mollisi, 2018).

¹⁵ We perform a regression to estimate the relationship between the dependent variable, which takes the value 1 if the firm reports using AI (be it experimentally, moderately or significantly), and the above-mentioned explanatory variables.

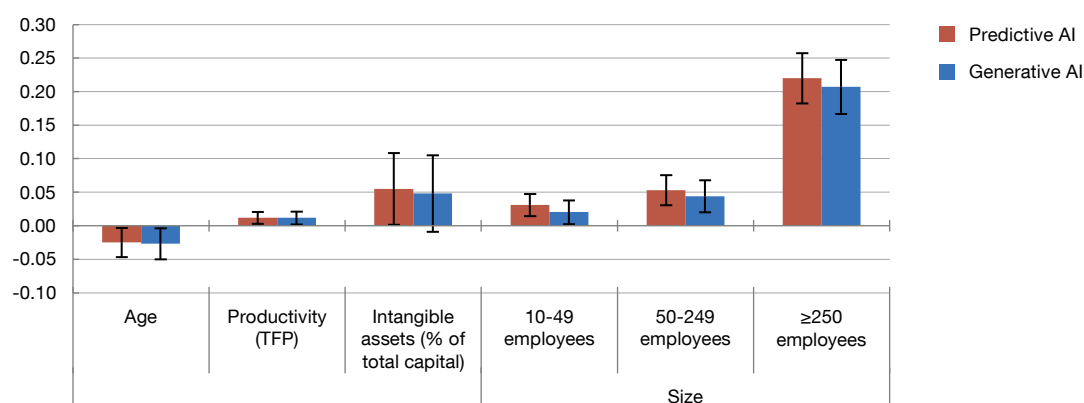
Chart 2

Characteristics of Spanish firms using AI

2.a Adoption of AI in Spanish firms, by sector (a)



2.b Effects of firms' characteristics on AI use (b)



SOURCES: EBAE and CBI.

a Question: "Specify the degree of use in your firm of the following technologies." Possible answers: "Not currently in use and no short-term plans to use it", "Not currently in use, but there are plans to start using it over the next 12 months", "Very infrequent use or in pilot projects/experimentally", "Moderate use", "Significant use".

b The chart depicts the coefficients of a regression whose dependent variable takes the value 1 if the firm answers infrequent, moderate or significant use of AI to the question "Specify the degree of use in your firm of the following technologies." Possible answers: "Not currently in use and no short-term plans to use it", "Not currently in use, but there are plans to start using it over the next 12 months", "Very infrequent use or in pilot projects/experimentally", "Moderate use", "Significant use".

The explanatory variables are: "Age" calculated from the firm's date of incorporation; "TFP", calculated using the Wooldridge approach, at NACE Rev. 2 division level (Rovigatti and Mollisi, 2018); and "Intangible assets", defined as intangible assets/total capital. The three variables have been standardised. The sector at NACE Rev. 2 section level is included as a control. Firms with fewer than ten employees are omitted. The coefficients represent the increase in AI adoption compared with the omitted category. The error bars represent the 95% confidence interval.



The results show that, among the firms operating in the same sector of activity, AI use is positively related to productivity and firm size, with adoption being considerably higher in firms with 250 or more employees (see Chart 2.b). In addition, the adoption of AI is associated with the presence of complementary assets, proxied by intangible assets as a percentage of the firm's total capital. As Calvino and Fontanelli (2023) suggest, firms with bigger digital infrastructures and capabilities and with more staff trained in new technologies are more likely to use AI. Meanwhile, the youngest firms tend to have a higher AI adoption rate, as they are more inclined to experiment with innovative

solutions because they have fewer legacy systems and processes that can hinder the adoption of new technologies (Bonney et al., 2024).

Drivers of firms' decisions on AI adoption

There are various reasons that firms may consider for adopting AI solutions. First, AI enables the automation of tasks performed by people, such as driving vehicles, processing invoices and tracking inventory. Second, AI can improve existing production processes through automated procedures (e.g. optimising the use of robots on assembly lines) and can analyse sales data to identify patterns to generate better marketing strategies. Third, AI helps improve the quality and reliability of key processes through, for example, predictive monitoring systems that detect faults in machinery before they occur, thereby avoiding costly downtime. Lastly, AI facilitates an increase in the range of goods and services provided, such as customer service chatbots, telehealth and the development of new products that anticipate demand.

To understand the reasons behind AI adoption, the EBAE module included a question asking firms to identify the most relevant factor underlying its adoption.¹⁶ According to the results, 35.5% of firms using or planning to use predictive AI state that the most relevant reason for using AI is to optimise already automated processes. This percentage rises to 40% in the case of generative AI (see Chart 3.a), with no significant differences across sectors and other business characteristics. Improving the quality and reliability of the firm's processes is the second-most relevant reason for both generative and predictive AI, as given by 29% and 30% of firms, respectively. These results are in line with Acemoglu et al. (2022) who show that improving process quality and reliability is the main driver of AI adoption among US firms. In contrast, less than a quarter of firms consider automating human processes to be the main motivation (although 35% of industrial firms state that it is a factor), while expanding the range of goods and services is a reason given by less than 10% of firms (except in information and communication, where this percentage rises to 15%).

In this context, the available evidence shows that firms investing in AI experience significant growth in sales and employment, mainly through product innovation and less so via lower costs (Babina, Fedyk, He and Hodson, 2024). In this respect, the EBAE results regarding the reasons for AI use suggest that firms prefer using it to optimise processes rather than innovate.

The general nature of AI makes it a potentially revolutionary technology in multiple fields, hence the interest in analysing the specific tasks for which AI is being used. Chart 3.b shows the percentage of firms using or planning to use AI for each of the six applications considered.¹⁷ Regarding the most common applications of AI, more than half of firms (over 60% in some sectors)

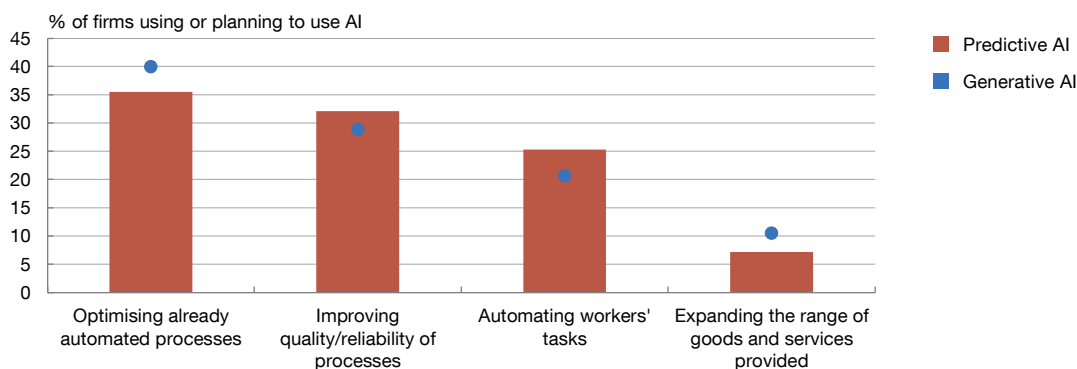
16 Question: "If your firm uses any of the technologies mentioned in question 1, mark the main reason why." Possible answers: "To automate tasks or processes previously performed by your firm's workers", "To improve production processes already automated", "To improve the quality or reliability of key processes", "To expand the range of goods or services provided".

17 Question: "Does your firm use or plan to use AI (predictive or generative) for any of the following purposes? Marketing or sales; Production or service provision; Organisation of administrative or business/accounting/financial management; Logistics; ICT security (cyber security); R&D." Possible answers: "Yes", "No".

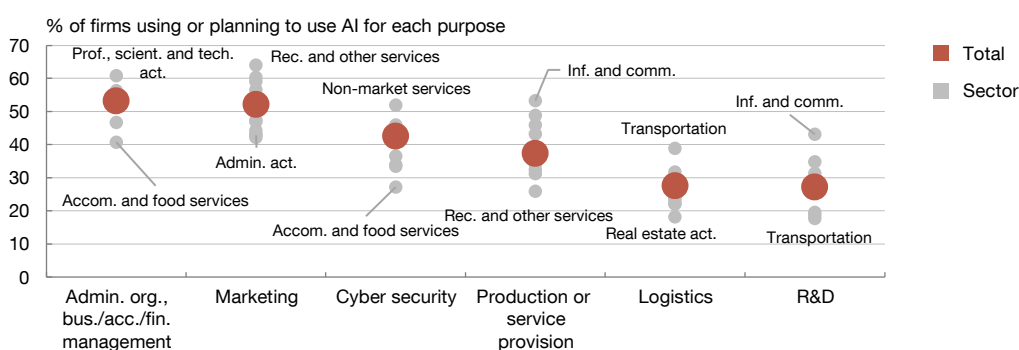
Chart 3

Reasons behind Spanish firms' decisions on AI use

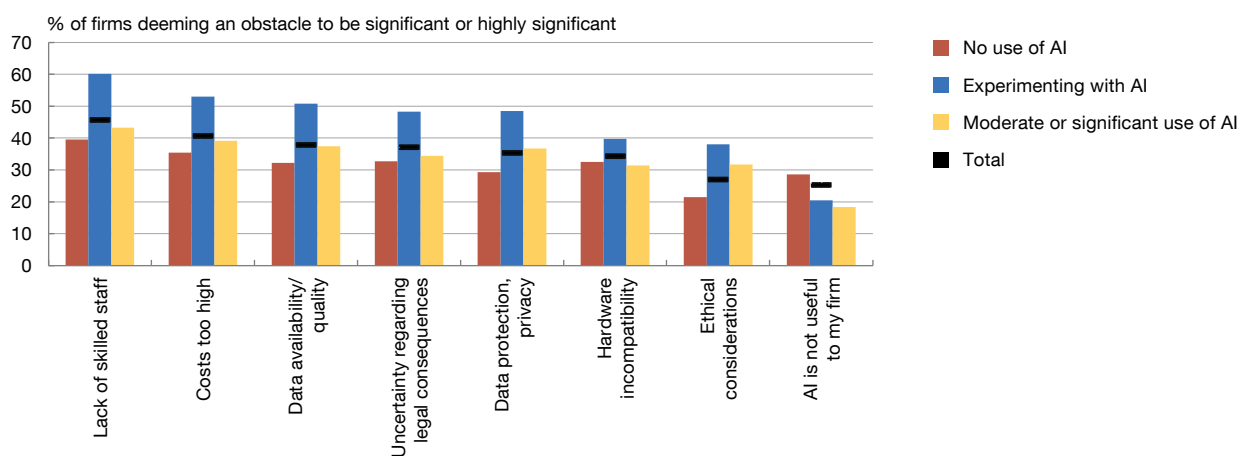
3.a Aims when adopting AI (a)



3.b AI applications in Spanish firms (b)



3.c Obstacles to AI adoption (c)



SOURCE: EBAE.

a Question: "If your firm uses any of the technologies mentioned in question 1, mark the main reason why".

b Question: "Does your firm use or plan to use AI systems (predictive or generative) for any of the following purposes?". Possible answers: "Yes", "No".

c Question: "If your firm does not use or plan to use any of the mentioned AI technologies in the short term, indicate the significance of each of the following obstacles." Possible answers: "Insignificant", "Of little significance", "Significant", "Highly significant".



use it for organisational and management improvements (such as accounting, reporting and other administrative tasks) and commercial purposes (marketing). 43% of firms have adopted or plan to adopt AI for cyber security, with over 50% doing so in non-market services, while 37% state that AI is used in production or service provision, with this percentage exceeding 50% in the information and communication sector. In terms of the uses of AI least mentioned by firms, less than 30% report implementing it in logistics and R&D, which is consistent with the responses relating to the reasons behind AI adoption, which showed that product innovation was only a minor factor. In general, the percentage of firms using AI for each of the applications listed grows with firm size, except in the case of applications in marketing, where small firms report a similar degree of AI use for commercial purposes to that of large firms.

As shown in the previous section, most firms (80%) state that they have not yet adopted AI tools. To understand the mechanisms that may be limiting AI adoption, firms were asked about the importance of various obstacles to its use.¹⁸ Chart 3.c shows the percentage of firms that consider a particular obstacle to be relevant or highly relevant. The results show that the main obstacle to AI use is the lack of skilled staff, which negatively affects almost half of firms (45.8%), followed by the perception of high adoption costs (40.8%) and the availability of the necessary data to implement AI-based solutions (37.8%).¹⁹ Depending on the extent to which AI is used, firms that are experimenting with AI (and are, therefore, at an early stage in the use of these technologies) report encountering more of these obstacles than firms that do not use AI or already use it moderately or significantly.²⁰ However, the lack of a business use case for AI is the only obstacle that is deemed more relevant by firms that do not use AI than by those that do.

Possible impact of AI on firms' employment level

One of the aspects of corporate AI use that has gained traction in the debate is its possible impact on the labour market and employment (Albanesi, Dias da Silva, Jimeno, Lamo and Wabitsch, 2025). For this reason, a question was also included on firms' perception of the potential impact of AI deployment on their employment level.²¹ According to the survey results, 79.3% of firms in the sample believe that AI will not affect employment levels, 13.6% believe that AI use will lead to lower employment ("pessimists"), while 7.1% believe that AI will have a positive effect ("optimists").

The perceived impact of AI on the employment level varies significantly across sectors (see Chart 4.a). In all sectors, the percentage of pessimistic firms is greater than that of optimistic

18 Question: "If your firm does not use or plan to use any of the mentioned AI technologies in the short term, indicate the relevance of each of the following obstacles. Costs too high; Lack of skilled staff; Incompatibility with existing corporate hardware, software or systems; Difficulties with data availability or quality; Regulatory obstacles (data protection, privacy); Uncertainty regarding legal consequences; Ethical considerations; AI is not useful to my firm." Possible answers: "Irrelevant", "Of little relevance", "Relevant", "Highly relevant".

19 These three obstacles to AI adoption are also those most reported by Spanish firms that do not use AI, according to the "Survey on the use of ICT and e-commerce in enterprises".

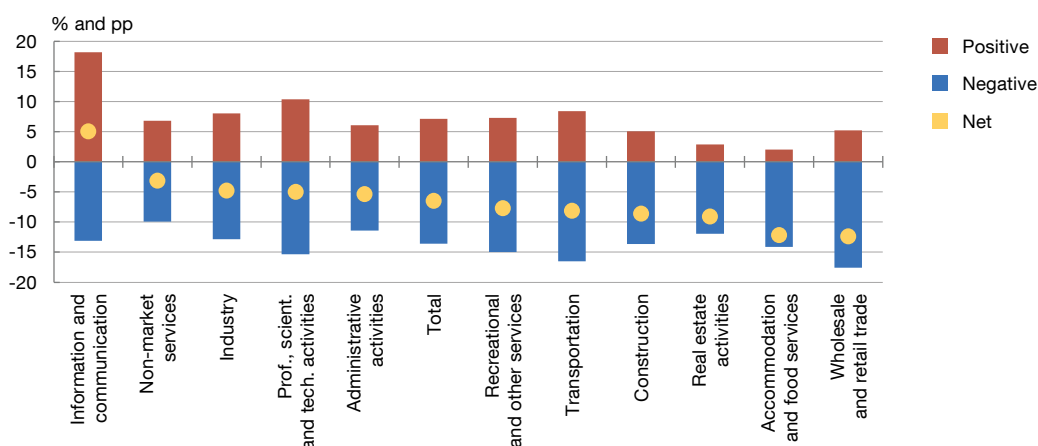
20 For firms that use AI moderately or significantly, encountering obstacles can act as a disincentive to greater use.

21 Question: "What impact do you think using AI will have on the employment level in your firm?" Possible answers: "Negative", "Neutral", "Positive".

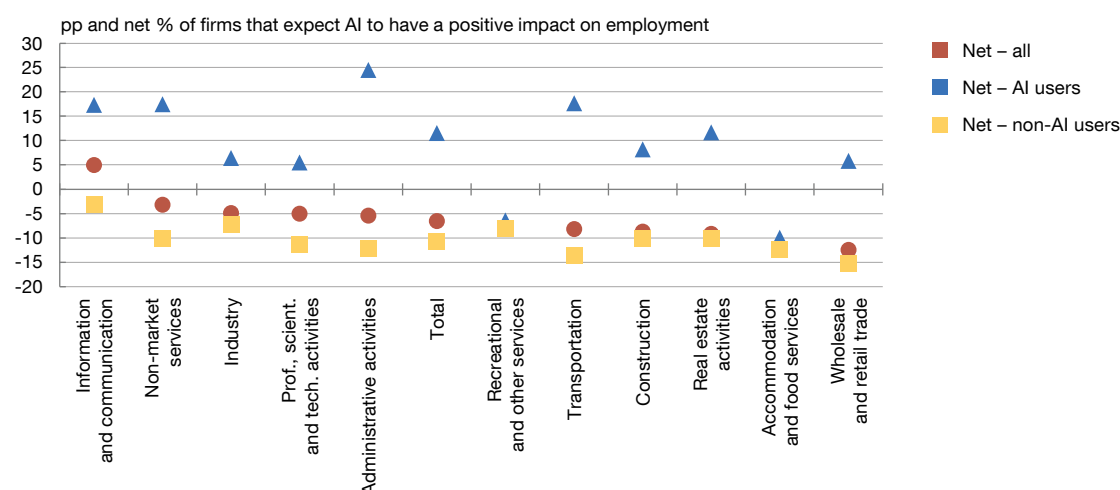
Chart 4

Firms' perception of AI's possible impact on their employment level

4.a Perceived impact of AI on employment, by sector (a)



4.b Net perceived impact of AI on employment, by sector and AI use (a)



SOURCE: EBAE.

a Question: "What impact do you think using AI will have on the employment level in your firm?". Possible answers: "Negative", "Neutral" or "Positive".



ones, except in the information and communication sector, which stands to gain as a sector directly involved in developing AI solutions for other productive sectors. This result is in line with Albanesi, Dias da Silva, Jimeno, Lamo and Wabitsch (2025), who show that employment has increased more in occupations with greater exposure to AI.

However, it is worth noting that firms already using AI tend to have a more optimistic view of AI's impact on employment than those that do not yet use it (see Chart 4.b). Among firms using AI, the proportion of optimists – those that foresee a positive impact on employment – is higher than that of pessimists in all sectors except accommodation and food services and recreation. In contrast, among firms that do not use AI (most firms in the survey), pessimism significantly outweighs optimism, especially in the wholesale and retail trade and transportation sectors. These results

are consistent with other surveys on AI's impact on the outlook for employment. Workers who use AI tools (who are mostly young and university-educated) tend to have more favourable views than those who do not (Dias da Silva and Weißler, 2025). This may be because a positive view of AI tends to encourage its use, but also because using these tools has helped them discover the potential benefits.

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