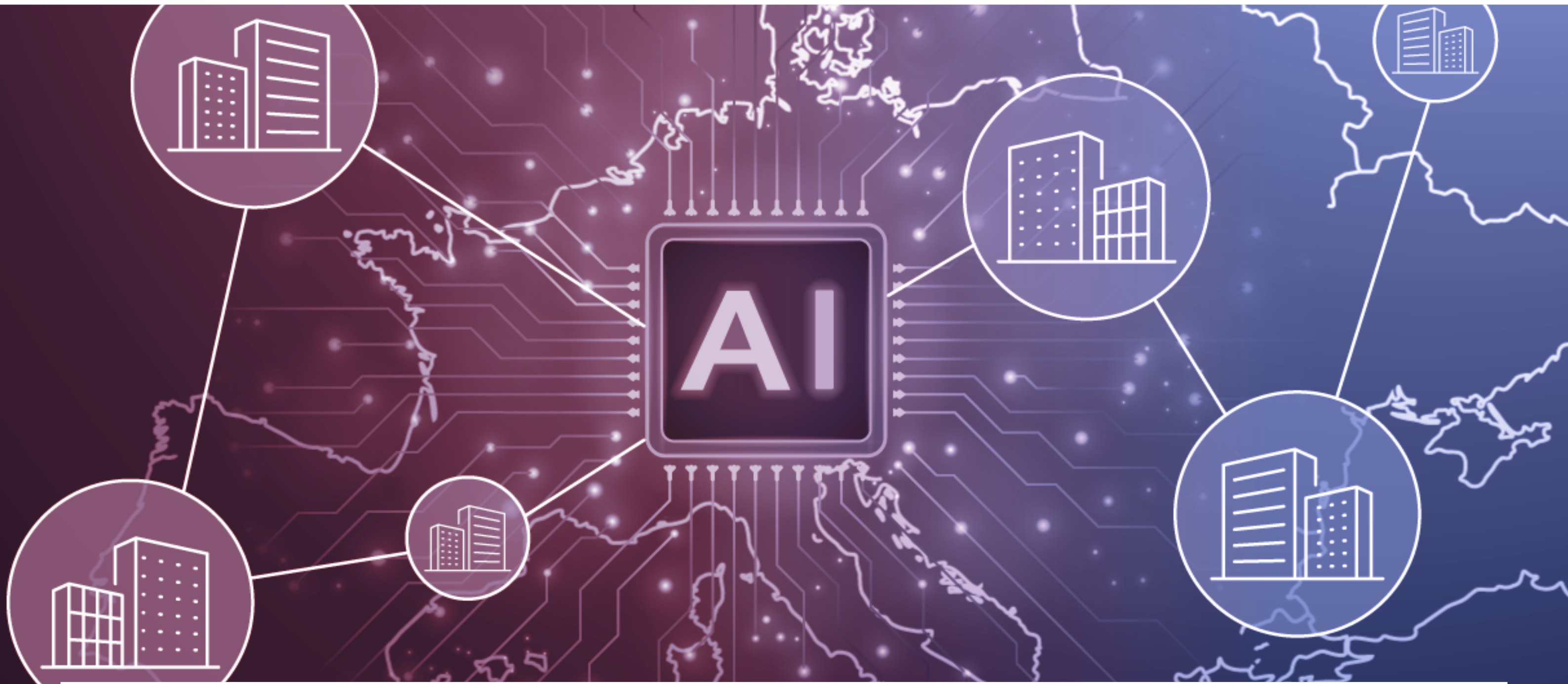
LISER
Luxembourg Institute of
Socio-Economic Research

POLICY BRIEF ISSUE 2026-03



AI adoption by firms in Luxembourg and neighbouring countries

Which firms adopt AI, when and for what

Julio Garbers[1], Christina Gathmann[1,2,3,4,5], Terry Gregory[1,6]

[1] Luxembourg Institute of Socio-Economic Research (LISER), [2] CEPR, [3] IAB, [4] CESifo, [5] University of Luxembourg, [6] ZEW

Corresponding author:
Julio Garbers
julio.garbers@liser.lu

Policymakers lack reliable measures of which European firms actually use artificial intelligence (AI). Most existing indicators capture only potential AI exposure based on industry composition or have only very specific samples of large firms or firms in specific sectors. This policy brief presents new evidence from over 3 million firm websites in Belgium, France, Germany, and Luxembourg between 2016 and 2024. AI adoption has grown twelvefold, reaching 12% of firms, with Luxembourg leading at 23%. However, roughly 9 percentage points of Luxembourg's advantage stem from its large financial sector—its sector-adjusted rate of 14.3% is comparable to Germany's 14.8%. Across all countries, workforce skills are the strongest predictor of AI adoption, with particularly large potential relevance for sectors where such skills are less prevalent. Closing the skills gap—particularly for SMEs in non-tech industries—is key to broadening AI adoption across Europe.

Artificial Intelligence (AI) has seen rapid advances that have begun to diffuse into the European economy. Traditional and social media are full of stories around AI and predictions of what the developments might or might not imply for the future of jobs, the firms' productivity or the labour market as a whole. Yet, little is known how much AI is actually adopted, by whom and for what. Policymakers, but also the public more broadly, face a critical gap in understanding who adopts AI, where and how it diffuses and what barriers hinder its adoption and implementation. This policy brief presents new evidence on firms' adoption of AI between 2016 and 2024 based on 3 million firm websites in Belgium, France, Germany, and Luxembourg.

Key findings

AI adoption accelerates

Across all countries, the share of firms using any AI grew from 1% in 2016 to 12% in 2024 (Figure 1). Growth was slow but steady until 2022 and accelerated with the release of generative AI after 2022. Firms in Luxembourg have been early adopters of AI. In 2024, 23% of firms in Luxembourg use AI in some form, which is nearly double the average for Belgium, France, Germany and Luxembourg—and ahead of Germany (16%), France (10%), and Belgium (8%).

Knowledge-intensive service industries lead AI adoption

The use of AI varies a lot across sectors. AI adoption is particularly high in the financial and insurance industry where prediction tasks (e.g., risk assessments) are important. Adoption is also high in the ICT sector where AI tools are typically developed, tested and implemented. In both sectors, almost 40% of firms in Luxembourg report using AI. Adoption is much lower in sectors like health, construction, real estate or manufacturing where AI use in Luxembourg is still below 10%. Looking across countries, shows that Luxembourg has higher adoption rates than Belgium, France and Germany in several service industries like banking and insurance, accommodation and food, but also art and entertainment. Luxembourg has lower adoption rates in the health sector, but also real estate. Across most sectors, Luxembourg and Germany consistently show higher adoption rates than France and Belgium.

Data and methods

Data

We analyse website content from over 3 million firms in Belgium, France, Germany, and Luxembourg between 2016 and 2024. Website texts are collected by ISTARI.ai from Common Crawl archives and linked to the Orbis firm registry (Bureau van Dijk) for firm characteristics and to Revelio Labs for workforce skill profiles derived from LinkedIn. A firm is identified by its website domain and matched to the Orbis business register; local establishment records (i.e. a local operating unit of a firm that is not a separate legal entity), unincorporated solo self-employed businesses, and public-sector entities are excluded. On average, 6 pages per firm per year are available, providing a rich textual basis for analysing the use of AI in firms.

AI classification

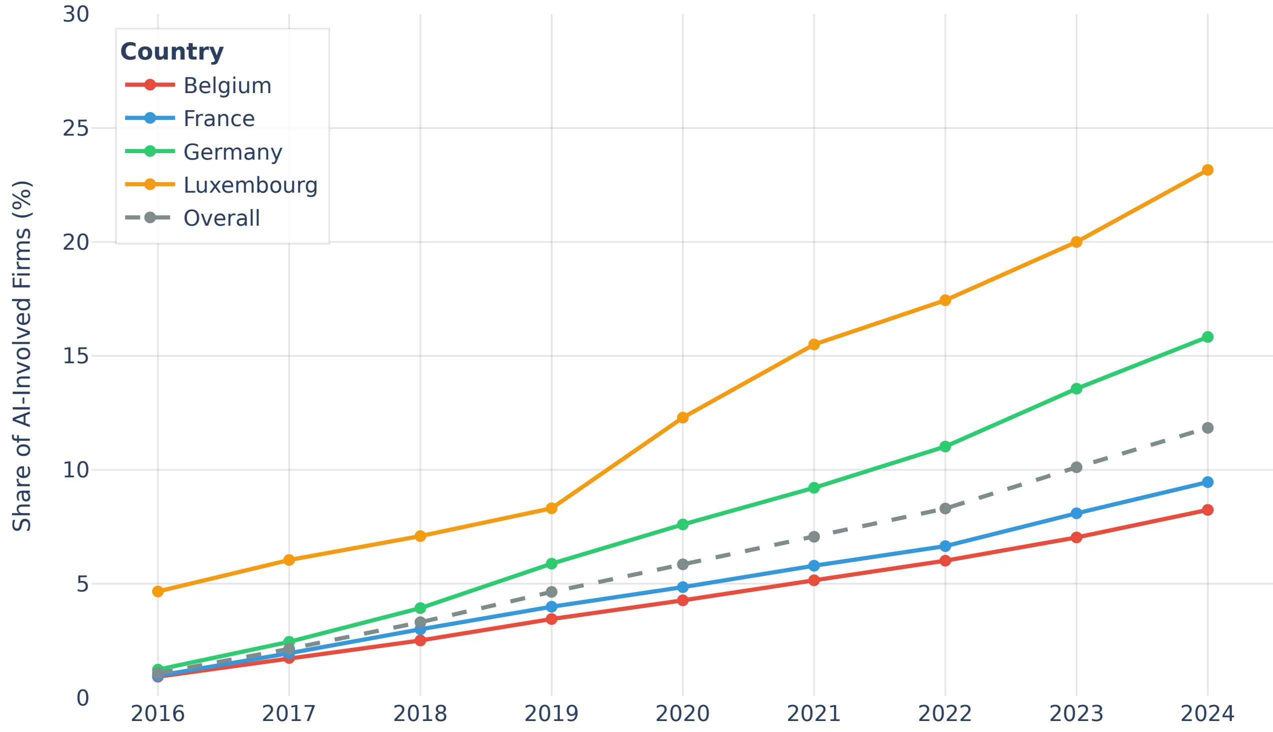
Existing AI measures typically capture potential exposure—where AI is likely to affect industries or occupations—rather than where firms are actually using AI. We take a different approach: a large language model (Magistral, developed by Mistral AI) analyses each firm's website text and classifies whether the firm uses AI, based on the European Commission's official definition of artificial intelligence. The method captures realised AI adoption—what firms publicly signal they do—rather than potential exposure. Validation against human-coded assessments confirms 94% accuracy, and results correlate strongly (r = 0.94) with official Eurostat statistics. As with any web-based approach, the method does not cover firms without an online presence.

AI roles and technology types

Using the same LLM-based approach, we also classify each firm's role in the AI ecosystem—for example, whether it develops core AI technology, builds AI-powered applications, or adopts AI in its operations. The six role categories are inspired by the classification system of Luxinnovation. We further identify the type of AI technology each firm uses (e.g., generative AI, predictive analytics, image recognition) across nine categories adapted and extended from Eurostat. Neither classification is mutually exclusive: a firm can hold multiple roles and deploy several AI technologies at the same time.

Figure 1—Cumulative AI adoption by country, 2016–2024.

Luxembourg leads with 23% of firms using AI by 2024, nearly double the four-country average.



Note: cumulative AI adoption by country from 2016 to 2024. Luxembourg leads at 23%, followed by Germany at 16%, France at 10%, and Belgium at 8%.
Source: Authors' calculations based on ISTARI.ai/Common Crawl website data linked to Orbis Europe.

Actual Sector-adjusted

A natural question is whether Luxembourg's overall high adoption rate simply reflects its large financial sector, where AI adoption is particularly high. More broadly, if industries have different adoption rates and countries differ in their sectoral structure, cross-country differences in adoption rates will reflect their sectoral structure. To answer this, we compute a sector-adjusted AI adoption rate for each country by imposing a common sectoral structure, defined as the pooled, firm-weighted distribution of sectors across all countries. We then apply each country's sector-specific adoption rates (Panel A of Figure 2) to this standardised structure and calculate the resulting average adoption rate. The results in Panel B of Figure 2 show that about 9 percentage points of Luxembourg's lead in AI adoption are explained by its sectoral mix—particularly its over-representation in finance (31.5% of firms vs. 5.9% in the pooled sample). However, even after this adjustment, Luxembourg's sector-adjusted rate (14.3%) remains

Luxembourg
Highest adoption in finance (43%) and among the leaders in most sectors—diverse AI ecosystem bridging research and deployment

Germany
Strong in AI application development, reflecting its industrial base; leads in ICT (43%)

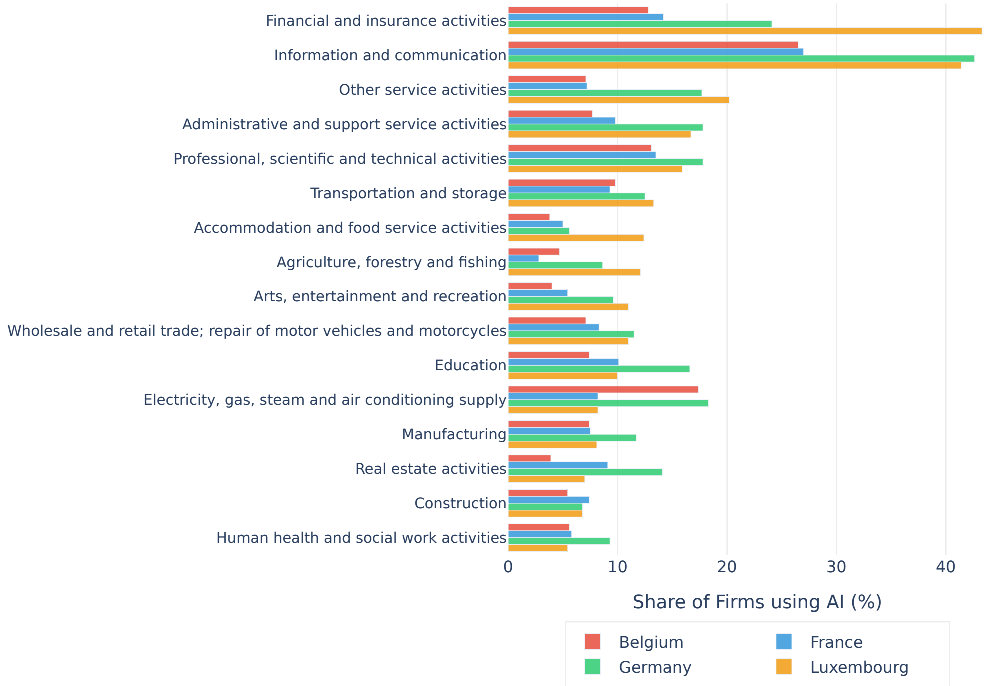
France
Emphasis on core AI technology development and research

Belgium
Consistent growth across sectors but lower overall levels

Figure 2—AI Use by sector and sector-adjusted AI adoption (2024).

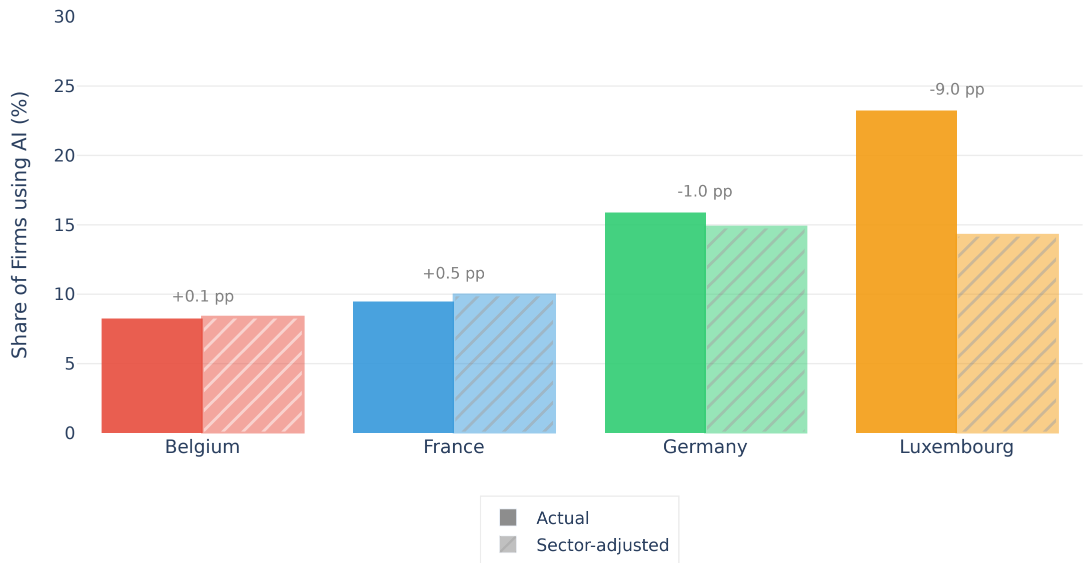
A. AI adoption by sector and country (2024)

Financial services and ICT lead across all countries.



B. Actual vs. sector-adjusted AI adoption (2024)

Luxembourg's rate drops from 23% to 14% after adjustment, comparable to Germany's 15%.



Note: Panel A shows sector-specific AI adoption rates by NACE sector by country, with sectors ranked by the share of firms using AI in Luxembourg. Panel B compares actual and sector-adjusted adoption rates. About 9 percentage points of Luxembourg's lead are compositional; its adjusted rate of 14.3% matches Germany's 14.8%
Source: Authors' calculations based on ISTARI.ai/Common Crawl website data linked to Orbis Europe.

on par with Germany (14.8%) and well above France (10.0%) and Belgium (8.4%). These patterns imply that Luxembourg firms are more active in AI in several of their respective sectors, not just benefiting from being in AI-intensive industries.

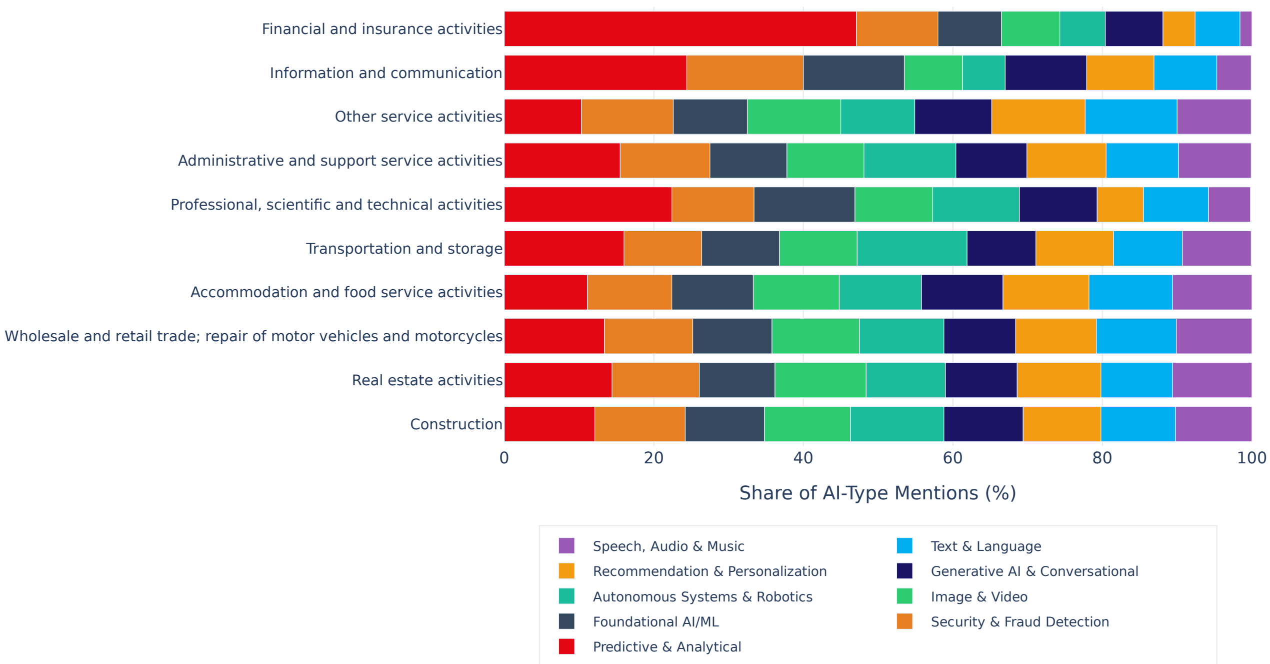
Types of AI firms use

Beyond overall adoption rates, an important question is what AI tools firms actually implement and for what. We distinguish between analytical tools for text or language, predictive and analytical tools, recommender systems, but also autonomous systems and robotics, for example. Figure 3 shows the type of AI used in Luxembourg in 2024 by broad sector. The categories are not mutually exclusive, so firms could be active in multiple activities at the same time. The financial sector stands out: nearly half of all AI-type mentions relate to Predictive & Analytical AI (47%), reflecting the sector's reliance on risk modelling and algorithmic decision-making. ICT and professional services also lean heavily toward Predictive & Analytical tools (24% and 22%) as well as Foundational AI and machine learning (14% each). In contrast, most other sectors seem to use different AI tools evenly, each accounting for around 10–12%—suggesting that firms are experimenting with a broad set of AI applications, rather than concentrating investment and expertise in a single AI technology.

The specific AI technologies firms implement have evolved rapidly over time. Our data show that the use of Generative AI has grown more than tenfold (+17pp), while Predictive Analytics has expanded by +37.5 pp. Traditional text analysis, in turn, declined, suggesting its gradual replacement by more advanced AI-driven approaches. This pattern indicates a qualitative shift in AI use over time, with firms moving away from earlier, task-specific applications toward more general-purpose and data-intensive technologies. In particular, the rapid expansion of generative and predictive AI appears to be replacing traditional text-based tools.

Figure 3—AI technology types by sector in Luxembourg (2024).

Financial services is dominated by Predictive and Analytical AI at 47%. Most other sectors show an even distribution across all nine technology types.



Note: Horizontal bars are ordered by the share of firms using AI in Luxembourg (descending). Financial services is dominated by Predictive & Analytical AI (47%). Most other sectors show an even distribution across all nine technology types (~10–12% each). For each sector, shares are normalised so that AI technology types sum to 100%. Sectors with fewer than 30 AI-using firms are excluded.

Source: Authors' calculations based on ISTARI.ai/Common Crawl website data linked to Orbis Europe.

AI ecosystem undergoes transformation

It is not only important to know how many firms use AI at all, but also understand in what roles firms work with AI. Are they acting as a developer of AI tools, do they support it with research or invest in the development of AI technologies? We have classified the roles of firms into a number of different categories: whether the firm develops AI tools ('core technology provider'), whether they provide data infrastructure, whether they develop applications and specific solutions, are an adopter and user of AI tools or whether they help finance or act as incubator for AI innovations. Figure 4 shows how the different roles have evolved in Luxembourg since 2016.

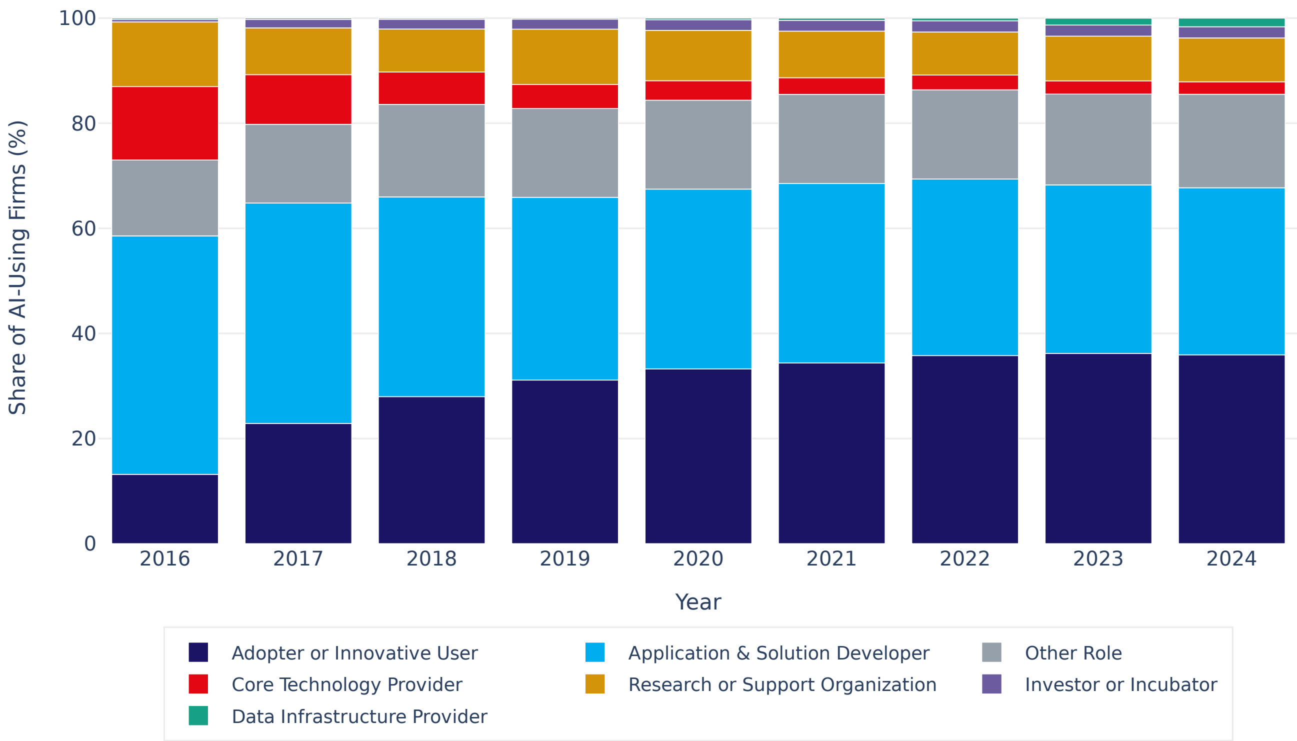
In 2024, if firms in Luxembourg engage with AI, they are mostly implementing existing AI tools or develop novel AI applications and solutions. Only a small share of firms in Luxembourg engage in development of core AI technology or data infrastructure. A major shift is underway in how firms engage with AI. Early on, the development of core AI technology and specific applied AI solutions was important. By 2024, 'Adopters and Innovative Users'—firms integrating AI into operations without developing AI tools themselves—have become the largest group.

Specialised skills as the critical enabler

The strong growth in AI adoption, together with large differences across sectors and among firms in the same sector across countries, raises the question of what determines whether a firm engages with AI or not. Our analyses show that workforce skills emerge as the most powerful predictor of AI adoption—across all sectors and firm types. Based on workforce skill profiles derived from LinkedIn data provided by Revelio Labs, a data-driven selection process identified 613 skills (out of 2,709 distinct skills) that are systematically associated with AI adoption and distinguish adopting firms from non-adopters. Among these selected skills, prevalence and predictive importance are not the same: some skills

Figure 4—Relative composition of AI ecosystem roles, 2016–2024.

Adopters grew from 13% to 36%, while Application Developers fell from 45% to 32% and Core Technology Providers shrank from 14% to 2%.



Note: Shares are normalised to 100% per year. Categories are not mutually exclusive—firms may hold multiple roles.

Source: Authors' calculations based on ISTARI.ai/Common Crawl website data linked to Orbis Europe.

are common among AI adopters, while others—though less frequent—are particularly strong predictors of adoption. While the specific skill combinations required for AI adoption naturally vary by sector and types of use, we provide a first overview of the workforce skills that matter for the economy as a whole.

- Data skills form the foundation: 41% of the selected skills are data-related skills. Big Data, SQL, and Data Analysis are especially widespread among adopting firms.
- AI skills prove to be crucial: Only 3% of the selected skills are AI-specific skills, but they have the highest predictive power. Machine Learning alone is almost twice as important for predicting adoption as Big Data.
- Combination of Data and AI important: Firms with strong data foundations and specialised AI expertise show the highest adoption rates.

Additional analyses indicate that AI adoption is also strongly related to firm size, consistent with the idea that larger firms are better able to build up data capabilities, acquire specialised AI expertise, and develop the organisational capacity required to integrate AI into existing processes, while smaller firms are more likely to face binding constraints.

From a policy perspective, this implies that widely discussed skill shortages—particularly in data- and AI-related domains—may directly limit firms' ability to adopt and effectively use AI technologies, especially among smaller firms. Addressing these constraints is therefore central to enabling a broader and more inclusive diffusion of AI across the Luxembourg economy.

Policy implications

Our findings indicate five priorities for Luxembourg policymakers.

1. **Support AI adoption and broaden it beyond the financial sector**

- Compared to its neighbours, Luxembourg is an advanced AI adopter. Yet, adoption is heavily concentrated in the financial sector where more than 40% of firms use AI—the highest share observed in any country or sector we analyse.
- This represents both a strength and a concentration of aggregate AI adoption in the financial sector, despite comparatively high adoption rates across many other sectors. Sectors like construction (6.8%), manufacturing (8.1%), and real estate (7.0%) lag behind.
- Policies should have an eye on enabling AI adoption in lagging sectors, for example by leveraging expertise from fintech and ICT and adapting it to the needs of more traditional industries.

2. **Skills policy is AI policy**

- Workforce skills are a central determinant of AI adoption and diffusion. Policies should therefore support upskilling and reskilling efforts, particularly in sectors such as manufacturing, construction, and real estate, where AI adoption remains comparatively low.
- Training programmes should prioritise core data and AI-related skills—including Machine Learning, Python, SQL, and Big Data—which are most strongly associated with firm-level AI adoption.
- Programme design should reflect the complementarity of skills: firms combining strong data foundations with specialised AI expertise show the highest adoption rates.

3. **Target SME adoption barriers**

- AI adoption increases strongly with firm size, consistent with larger firms being better able to build data capabilities, acquire specialised AI skills, and cover implementation costs. Policy support should therefore explicitly target capacity constraints faced by SMEs.
- Expand hands-on AI advisory services and targeted support programmes for SMEs to lower informational, organisational, and skill-related barriers to adoption.
- Promote shared AI platforms, data infrastructure, and access to external expertise to reduce fixed costs and enable smaller firms to experiment with and deploy AI technologies.

4. **Leverage Luxembourg's position in the Greater Region**

   – The results reveal complementary AI strengths across neighbouring countries—Luxembourg in financial services, Germany in industrial AI, and France in research and core AI development—suggesting scope for beneficial cross-border cooperation.

   – Foster cross-border collaboration and talent mobility to facilitate knowledge spillovers, skill matching, and access to specialised expertise that may be scarce domestically.

5. **Monitor and evaluate AI diffusion to inform policy**

   – Track firm-level AI adoption and associated skill needs in near real-time, using indicators that capture realised AI use rather than potential exposure.

   – Complement adoption monitoring with regular assessments of how AI use affects workforce skill demand and other firm-level outcomes.

   – Use this evidence to evaluate policy instruments and adapt support measures as AI technologies and types of use evolve.

References

Garbers, J. & Gregory, T. (2026). 'The Diffusion of Artificial Intelligence Across Firms: Evidence from Europe.' IZA Discussion Paper, No. 18434.

Feimi, N., Gathmann, C., Gregory, T., & Marguerit, D. (2025). 'Skill Demand in the Age of AI: Evidence from Europe.' *Unpublished Manuscript*.

High-Level Expert Group on Artificial Intelligence (2019). 'Ethics Guidelines for Trustworthy AI.' European Commission.

The authors

Julio Garbers is Research Associate in the Labour Market Department at LISER. His research focuses on migration, discrimination, policy evaluation, and labour economics. He holds a PhD in Economics from the University of Luxembourg (ACROSS Doctoral Training Unit).

Email: julio.garbers@liser.lu

Christina Gathmann is Director of the Labour Market Department at LISER, affiliated with CEPR, IZA@LISER, IAB, CESifo and the University of Luxembourg. Her research focuses on human capital, labour market consequences of digital transformation, immigration and integration, and policy evaluation. She holds a PhD from the University of Chicago and previously worked at Stanford University, Hoover Institution, the University of Mannheim and Heidelberg University.

Email: christina.gathmann@liser.lu

Terry Gregory is Research Associate and Senior Researcher at LISER and ZEW–Leibniz Centre for European Economic Research, Mannheim, affiliated with IZA@LISER. His research focuses on the consequences of automation and digitalisation for firms and workers, policy evaluation, and data science. He holds a PhD from the Univerity of Regensburg, has published in leading economics journals such as the JEEA and JPubE, and has advised the OECD, the European Commission, and the German Bundestag.

Email: terry.gregory@liser.lu

Acknowlegment

Supported by the Luxembourg National Research Fund (FNR) under the ACROSS Doctoral Training Unit (grant no. PRIDE19/14302992) and the LISER Innovation call grant.

Luxembourg
National
Research Fund

Publisher: LISER
Series: Policy Brief
e-ISSN: 2716-7437

To cite this brief: Garbers, J., Gathmann, C., Gregory, T. (2026, Mar). AI adoption by firms in Luxembourg and neighbouring countries: Which firms adopt AI, when and for what. LISER Policy Brief; 2026-03, 11p.