BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Artificial intelligence adoption: productivity effects and supporting policies

by Luigi Bellomarini, Fabio Bertolotti, Luca Citino, Maria Giulia Cassinis, Francesco D'Amuri, Silvia Del Prete, Sara Formai, Litterio Mirenda, Massimiliano Rigon and Anna Russo Russo

June 2026

Number 1009

BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Artificial intelligence adoption: productivity effects and supporting policies

by Luigi Bellomarini, Fabio Bertolotti, Luca Citino, Maria Giulia Cassinis, Francesco D'Amuri, Silvia Del Prete, Sara Formai, Litterio Mirenda, Massimiliano Rigon and Anna Russo Russo

Number 1009 – June 2026

The series Occasional Papers *presents studies and documents on issues pertaining to the institutional tasks of Banca d'Italia and the Eurosystem. The* Occasional Papers *appear alongside the* Working Papers *series which are specifically aimed at providing original contributions to economic research.*

The Occasional Papers *include studies conducted within Banca d'Italia, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong.*

The series is available online at www.bancaditalia.it .

ISSN 1972-6643 (online)

Designed by the Printing and Publishing Division of Banca d'Italia

ARTIFICIAL INTELLIGENCE ADOPTION: PRODUCTIVITY EFFECTS AND SUPPORTING POLICIES

by Luigi Bellomarini*, Fabio Bertolotti*, Luca Citino*, Maria Giulia Cassinis*, Francesco D'Amuri*, Silvia Del Prete*, Sara Formai*, Litterio Mirenda*, Massimiliano Rigon* and Anna Russo Russo*

Abstract

In Italy, the share of firms adopting artificial intelligence technologies is growing but remains below the European average. Long-run estimates suggest that the diffusion of this technology could raise productivity by 0.2 – 1.1 percentage points per year over the next decade, depending on the speed and depth of adoption. In the short run, however, no significant effects on firm-level productivity are apparent yet, despite documented gains at the level of individual tasks: this outcome is consistent with the literature, in which aggregate benefits only materialize after substantial organizational adjustments. The paper identifies the main barriers to adoption and the conditions that justify public intervention. Drawing on an analysis of the policies adopted in more advanced countries, it highlights the need for a coherent strategy that, rather than relying on poorly targeted subsidies, supports firms through the adoption process, fosters the supply of applications by encouraging the development of specialized providers, and invests in enabling factors: regulatory certainty, data sharing, and ease of access to computing infrastructure.

JEL Classification: O33, O47, D24, O38.

Keywords: artificial intelligence, technology adoption, productivity, firm performance, industrial policy.

DOI: 10.32057/0.QEF.2026.1009EN

* Banca d'Italia.

1. Introduction and summary[1]

According to the results of the Invind survey conducted by the Bank of Italy on firms with at least 20 employees, the share of firms using AI tools, after doubling to 27 per cent in 2025, rose further, reaching 32 per cent at the beginning of 2026; intensive use of the technology remains more limited (5 per cent). At present, AI is mainly used to optimise existing processes rather than to develop new products or services.

In the medium term, the productivity effects of AI could be significant: simulations based on calibrated macroeconomic models point, for Italy, to gains of between 0.2 and 1.1 percentage points per year over a ten-year horizon, depending on the assumptions made about the speed and depth of adoption. In the short term, by contrast, the estimates do not yet reveal any systematic effect on the productivity of the Italian firms that have adopted AI. This is consistent with the fact that, in the early stages of adoption of a new technology, integration and reorganisation costs tend to materialise before the benefits. It may also reflect the limited time span over which the phenomenon has so far been observed. The experience of ICT shows that sizeable productivity gains require the technology to be adopted in depth and production processes and organisational practices to be redesigned.

The paper identifies the main barriers to adoption and the conditions that may justify public intervention. Firms with weaker organisational structures may struggle to gauge the gains, identify the most suitable applications and acquire the necessary capital and skills. Moreover, part of the benefits may extend beyond the individual firm – along supply chains, through the diffusion of knowledge and skills, or through network effects, whereby the advantages depend on aggregate adoption rates. Where such externalities and complementarities are present, firms internalise only part of the overall benefits, so that adoption may fall short of the desirable level. Public intervention may therefore be warranted where it removes informational and organisational obstacles, builds skills and narrows the gap between the private and social returns to the technology. These mechanisms can apply to other investments too, but they are especially relevant for AI: the technology is new and many firms still know little about its potential and possible uses. In addition, demand that is fragmented – made up of small firms and tentative adoptions – may be too thin to make it worthwhile for suppliers to broaden their range of AI solutions, and the resulting scarcity of solutions in turn reduces the value of adopting, further depressing demand. Public policy can provide the initial impetus needed to break these vicious circles and foster wider diffusion.

The effectiveness of support measures depends on their overall coherence. Surveys indicate that the shortage of skills is the single most important constraint, but firms report many others: notably, insufficient technological and organisational readiness, poor data integration and regulatory uncertainty.

The analysis of the policies adopted in the most advanced countries also suggests the need for a coherent strategy that – rather than relying on poorly targeted subsidies – accompanies firms in adoption through dedicated structures, fosters the supply of applications by supporting the development of specialised providers, and invests in the enabling factors: regulatory certainty, data sharing and ease of access to computing centres.

2. Adoption rates

[1] We thank Giacomo Caserta for his excellent support work and Federico Cingano, Paolo Libri, Francesco Lozupone, Fabiano Schivardi, Roberto Torrini, Giuseppe Zingrillo for their valuable comments on previous versions of the text.

According to the results of the Invind survey conducted by the Bank of Italy on firms with at least 20 employees, the share of firms using AI tools, after doubling to 27 per cent in 2025, rose further, reaching 32 per cent at the beginning of 2026.[2] Adoption is, as expected, more widespread among larger firms and in services. The data make it possible to distinguish the intensity of adoption, the business functions involved and the types of tools used. The share of firms reporting that AI is intensively integrated into their business processes remains limited (5 per cent).[3]

AI is used most frequently in commercial activities, followed by the production of goods and services and the handling of administrative obligations. Among the firms that use generative AI applications (about 30 per cent), the large majority report using them for text generation, and just over half also turn to other applications, such as chatbots for interacting with customers or employees, AI agents, or tools for generating computer code.

Furthermore, on comparable data for 2025 covering firms with 10 or more employees, the adoption rate in Italy is four points below the EU average and almost ten points below that of Germany.[4]

3. Evidence on the effects of AI adoption: short term

Micro-econometric evidence – causal in nature but confined to individual tasks, such as coding or professional writing – suggests that the effects of generative AI are tangible and economically significant.[5] However, the activity of a firm derives from the combination of multiple tasks, whose efficiency gains may, individually, have a limited impact on the aggregate.[6]

In the (limiting) case of perfect complementarity between the different tasks (e.g. a Leontief-type technology), even if AI were to sharply increase productivity in one of them, the aggregate gain would be nil. Even with less extreme technologies, the aggregate impact may remain limited if the tasks that benefit from even a large efficiency gain contribute little to overall value added.

So far, the empirical evidence on the effects of AI adoption on firm-level productivity has been inconclusive.[7] According to a recent study based on 6,000 interviews with company executives in the United States, the United Kingdom, Germany and Australia, over 80 per cent of firms report the

[2] See the box "Artificial intelligence: adoption and effects on firms", Annual Report for 2025, Banca d'Italia.
[3] The same survey, conducted in 2025 and also administered to German and Spanish firms, showed that the share of intensive use of GenAI was similar across the three countries (below 4 per cent) and that the differences in adoption rates, larger in Germany and Spain, were attributable to experimental or limited uses.
[4] See Eurostat (2026).
[5] For writing and the production of textual content, Noy and Zhang (2023) show a reduction in the average completion time of around 40 per cent, accompanied by an increase in output quality of about 18 per cent. For customer-service tasks, a study within a US software firm documents a productivity increase of about 14 per cent on average; the dynamic estimates indicate an immediate increase in the first month, a further slight rise in the second and a subsequent stabilisation of the effect (Brynjolfsson et al., 2025). For programming tasks, an experiment finds very high productivity increases, measured by the number of lines of code produced, with rises of around 55 per cent (Gambacorta et al., 2024). Even in complex professional activities, such as consulting, access to AI tools can reduce execution times and increase output: in a study conducted with consultants, users on average complete more tasks and more quickly, with times about 25 per cent lower. In some contexts, the benefits also manifest themselves on the demand side, through an increase in sales and in the ability to attract users (Fang et al., 2025).
[6] See Gans and Goldfarb (2026), Jones (2026), Kremer (1993).
[7] On the one hand, it is difficult to measure the actual degree of integration of the technology into the production process. A contribution to the information usually available in survey data has come from the ESCB surveys cited above, which made it possible to clarify that high adoption rates can coexist with limited "intensive" use of AI. On the other hand, the estimate is complicated by the fact that the firms that adopt AI are often selected among those most likely to benefit from it (more dynamic, more digitalised and endowed with complementary assets in terms of human capital, data, managerial practices).

absence of significant effects on employment and productivity.[8] Estimates for US manufacturing suggest that, at least in the case of the adoption of industrial AI systems[9], the limited short-term effects may be due to a "J-curve" dynamic, in which integration and reorganisation costs precede the benefits of the technology over the longer term (McElheran et al. 2026). There is nonetheless no shortage of analyses that find positive effects (Aldasoro et al., 2026; Ropele and Tagliabracci, 2026).

An econometric analysis exploiting Invind data over the period 2022-26 compares Italian firms that adopt AI with others that have similar characteristics but do not use it. The approach is a staggered-adoption difference-in-differences design, which exploits the fact that firms adopted AI in different years: 2024, 2025 or 2026. For each cohort of adopters, the control group is made up of firms that had not yet taken up AI in the same period. The estimates are obtained on a balanced panel of about 900 firms, matched by sector, size class, geographical area and propensity to invest in advanced technologies as of 2022[10].

The estimates do not identify any systematic effect of AI adoption on turnover per employee, on employment or on investment. The results should nonetheless be read with caution: firms on more favourable growth paths may adopt AI earlier than others, and the absence of measured effects may simply reflect the short period observed so far.

In line with this interpretation, most of the AI-using firms surveyed in the same Invind survey report that adoption has so far had no effect on labour productivity (70 per cent). Expectations for the next three years are more upbeat, however: half of the firms anticipate a positive impact on productivity, against 35 per cent that expect no change.

The experience of information and communication technologies (ICT) can help in interpreting the current estimates of AI's effects on productivity. In the 1980s and early 1990s, the rapid rise in ICT investment did not translate into an immediate acceleration of aggregate productivity, giving rise to the so-called Solow paradox, which held that *"You can see the computer age everywhere but in the productivity statistics"*.

Subsequent studies clarified that the apparent paradox reflected the need for organisational complementarities and intangible investments that took time to mature.[11] A significant part of the

[8] See Yotzov et al. (2026). The McKinsey survey of 1,750 large firms also shows still limited effects of AI adoption: only 36 per cent of the firms that adopt these technologies report a positive impact on EBIT (Singla et al., 2025).

[9] Industrial AI applications are artificial-intelligence solutions applied to industrial processes to monitor, predict and optimise operations, quality and maintenance (often using sensor and machine data).

[10] The estimator produces an average treatment effect for each (cohort, period) pair, aggregated into an average estimate and an event-study profile. The covariates are incorporated with a doubly robust method; inference is based on a wild bootstrap.

[11] At the microeconomic level, the evidence has shown that ICT was associated with significant firm-level productivity gains, especially in the medium term. Brynjolfsson and Hitt (2000) document a positive relationship between IT capital and business performance, with stronger effects in the long run, consistent with the hypothesis of complementary investments in organisational capital. Similarly, Bresnahan et al. (2002) show that ICT generates high returns when combined with the reorganisation of work and greater decentralisation of decision-making, highlighting strong complementarities between technology, organisation and skills. Later evidence indicates that differences in managerial practices explain a significant part of the heterogeneity in the returns to ICT across firms and countries (Bloom et al., 2012). At the macroeconomic level, the acceleration of productivity in the United States between the mid-1990s and the early 2000s has been attributed in large part to ICT, both through capital deepening and through the increase in productivity in the ICT-producing sector (Basu et al., 2004; Jorgenson et al., 2008). However, this contribution was not immediate and emerged only after a phase of accumulation and reorganisation. Subsequently, the slowdown in aggregate productivity reopened the debate on the nature and duration of the effects of the digital revolutions (Gordon, 2012). Brynjolfsson et al. (2021) show that "general purpose" technologies such as AI require intangible complementary investments (processes, skills, organisation) that initially hold back or mask productivity gains in the statistics. When

productivity growth gap between the United States and Europe has been attributed to the different ability to adopt and exploit ICT technologies.[12] Schivardi and Schmitz (2020)[13] document that differences in the adoption and effectiveness of ICT explain a substantial share of the productivity slowdown in Southern Europe relative to Germany and the United States in the years 1995–2008. This evidence underscores the crucial role of organisational and managerial complementarities in turning technological adoption into productivity growth.

4. Possible long-run aggregate effects

In estimating long-run aggregate effects, the most widely followed approach models AI as a new wave of automation within a *task-based* framework: AI increases efficiency in some tasks, but the aggregate impact depends on their actual diffusion beyond specific domains. The overall benefits can be represented as the product of four factors: (i) the share of tasks exposed to AI; (ii) the share of those tasks for which adoption is economically worthwhile; (iii) the lower cost or greater efficiency for each task in the event of adoption; (iv) the weight of labour in the activities exposed to AI.

Starting from different assumptions about the size of these factors, Acemoglu (2025) and Aghion and Bunel (2024) reach very different conclusions regarding the impact of AI on annual TFP growth: 0.07 and 0.68 percentage points respectively (Table 1). It is important to stress that half of the difference between the estimates derives from the assumptions about the share of tasks exposed to AI[14] (Column 1). The remaining part, instead, depends on the share of those tasks for which adoption is economically worthwhile (which affects demand, Column 2) and the lower cost or greater efficiency for each task in the event of adoption (factors attributable to the supply side, Column 3). These last two elements can be influenced by policy.

Table 1: The decomposition of the determinants of annual TFP growth in Acemoglu (2025) and Aghion and Bunel (2024)

	(1)	(2)	(3)	(4)	(5)=(1*2*3*4*100)/10
	Over a 10-year horizon				
Study	Share of exposed tasks	Share of exposed tasks for which adoption is worthwhile	Saving in the event of adoption	Weight of labour in exposed activities	Annual TFP growth (p.p.)
Acemoglu (2025)	0.199	0.23	0.27	0.57	0.07
Aghion and Bunel (2024)	0.600	0.50	0.40	0.57	0.68

these intangibles "mature" and are exploited, the benefits emerge, and productivity can accelerate: this is the "Productivity J-curve".

[12] Jorgenson et al. (2008) show that the acceleration of US productivity was driven in large part by investment and the intensive use of ICT, whereas in Europe the impact was weaker.

[13] The authors calibrate the model using firm-level evidence and show that it can explain 35 per cent of Italy's productivity gap, 47 per cent of Spain's and 81 per cent of Portugal's relative to Germany over the period 1995–2008. Counterfactual exercises indicate that subsidies for ICT adoption or for education are not sufficient to reduce this gap: only policies that act directly on managerial inefficiencies are effective.

[14] The contributions of the individual factors are computed from the logarithmic decomposition, whereby the logarithmic difference between the two estimates equals the sum of the logarithmic variations of the individual factors.

Extending Acemoglu's (2025) approach, a recent OECD paper (Filippucci et al., 2025) estimates the gains from AI adoption for each sector of the economy and then aggregates them with a general equilibrium model built on Baqaee and Farhi (2024).

This approach allows for sectoral differences in exposure to AI, making countries with different production structures comparable. It also captures spillovers along the input-output network – a productivity gain in one sector raises output and lowers prices further down the production chain – and the way in which aggregate benefits depend on demand and on the reallocation of labour and capital across sectors.[15]

For the G7 countries, the authors estimate that AI adoption raises labour productivity by between 0.2 and 1.3 percentage points per year (Table 2). The differences across countries are sizeable and depend on the sectoral structure and, above all, on the pace of AI diffusion. For Italy, the increase in annual labour productivity growth would be 0.19 percentage points under slow adoption (comparable to that of electricity) and could reach 0.89 points under rapid and widespread adoption (comparable to that of mobile phones).

Table 2: Expected productivity gains from the adoption of artificial intelligence

[15] The mechanism is as follows: the increase in productivity reduces marginal costs; assuming constant mark-ups, this translates into a reduction in the prices of the goods produced. If these goods are used as intermediate inputs by other sectors, the decrease in their price lowers the production costs of downstream sectors. Since the composition of inputs is governed by the elasticity of substitution, downstream sectors react by increasing the demand for the goods that have become relatively cheaper, thus amplifying the initial effect. In this context it is important to distinguish between the size and the centrality of a sector. Central sectors – those that supply inputs to many other branches – generate greater aggregate propagation of the shock, since the price reduction spreads along multiple links of the production network. By contrast, shocks in downstream sectors, closer to final demand, tend to have more contained aggregate effects: the productivity gains are reflected mainly in lower final prices for consumers, without activating the same multiplier effect on the costs of other sectors. Productivity increases in central sectors can maximise spillovers and aggregate effects, whereas interventions on downstream sectors produce direct benefits that do not propagate to other sectors. Aggregate TFP is then converted into labour-productivity growth by applying a multiplier (1.5) that incorporates the capital-deepening effect. A multiplier equal to 1.5 is consistent with standard growth models with a Cobb-Douglas production function and capital and labour shares equal to 1/3 and 2/3 respectively. Moreover, it coincides with the historical ratio between labour-productivity growth and TFP (total factor productivity) growth over the last five decades in the United States (Bergeaud et al., 2016).

Scenario	Exposure given AI capabilities*	AI adoption pace**	AI's predicted contribution to annual labour productivity growth over the next decade (in p.p.)						
			USA	GBR	DEU	CAN	FRA	ITA	JPN
Slow adoption	Baseline	Slow (as electricity)	0.41	0.39	0.34	0.35	0.26	0.19	0.16
Medium adoption and expanded AI capabilities	Expanded	Medium (as computers & internet)	0.99	0.97	0.86	0.86	0.72	0.57	0.51
Rapid adoption and expanded AI capabilities	Expanded	Rapid (as mobile phones)	1.28	1.27	1.16	1.13	1.05	0.89	0.82

*Exposure to AI is measured as the weighted share of tasks in which AI can substantially reduce the time required for their completion, constructed as outlined in Annex A. Baseline exposure refers to the median estimate of task-level exposure in Eloundou et al. (2024). High exposure refers to the upper-end estimate of task-level exposure in Eloundou et al. (2024), which makes more optimistic assumption about the integration of AI via the development of complementary software (see Figure 4). AI exposure can vary across countries due to differences in the occupational structure within sectors and the sectoral composition of the economy.
**The pace of AI adoption is benchmarked to that of previous technologies (see Figure 6).

Source: Filippucci et al. (2025)

Projections for Italy

To obtain more detailed estimates and to simulate additional scenarios, we use a model of sectoral shock transmission that differs from the OECD's in two respects: it features an elastic labour supply, which can amplify the transmission of shocks, and it relies on more recent and more detailed input-output tables (Bertolotti et al., 2026).[16]

Annual productivity growth is higher than the OECD's estimate under the intermediate and rapid adoption scenarios (Table 3); a slight positive effect on employment also emerges (about one tenth of a percentage point in all three scenarios). Overall, the results confirm that rapid adoption of the technology could have a very substantial impact on long-run productivity growth.

[16] The presence of an elastic labour supply adds a macro channel that has a significant impact. Sectoral shocks change not only productivity "at constant factors", but also – through their effect on productivity – the labour input. This tends to amplify the effects of shocks relative to the case of an inelastic supply: a fall in productivity in "key" sectors can reduce the real wage and hence the labour input, further depressing output; and vice versa for positive shocks.

Table 3: ***Macroeconomic effects of AI adoption*** *(annual change over a ten-year horizon, in percentage points)*

	Adoption		
	Slow	Medium	Rapid
Labour productivity	0.2	0.7	1.1

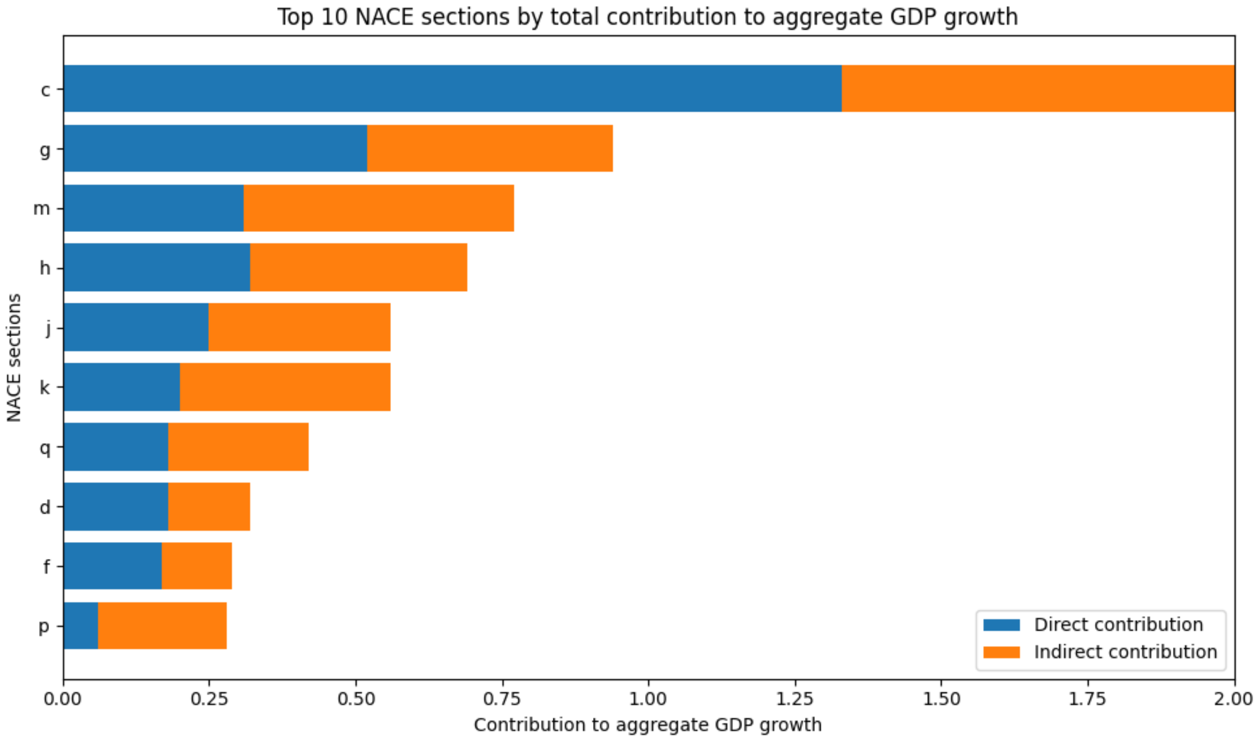
Source: Bertolotti et al. (2026).

The model makes it possible to decompose each sector's contribution to value-added growth (Figure 1) into a direct component (the productivity gain within the sector itself) and an indirect one (reflecting the effects transmitted through inter-sectoral linkages). A sector's contribution to overall GDP growth depends on its size, its exposure to AI and its position in the production network: more upstream and more central sectors tend to generate larger indirect effects.

Over a ten-year horizon, and in the intermediate adoption scenario, the largest contribution to value-added growth comes from manufacturing (2 percentage points), followed by trade (1 percentage point) and professional activities (0.8 percentage points). For professional activities, which occupy a central position in production networks by serving and connecting different supply chains, the indirect contribution is the larger of the two.

The estimates are subject to wide margins of uncertainty. On the one hand, the impact could prove even larger: more than past innovations, AI can act directly on research and development – including research aimed at improving AI itself – accelerating innovation and hence productivity. On the other hand, several considerations counsel caution. First, although it allows the import of intermediate inputs, the model does not fully capture possible productivity improvements in foreign sectors that are more exposed to AI, causing a possible overestimation of domestic value-added growth, in particular in some tradeable services. Second, the model assumes constant profit margins. This assumption implies a full pass-through of productivity gains to prices, whereas in the presence of market power a larger share of the benefits could be retained by existing firms in the form of higher profits, attenuating the propagation effects along supply chains. Finally, the amplification channel linked to endogenous labour supply, although quantitatively limited by the calibration of a labour supply as only weakly responsive to real wages, assumes a significant capacity for labour to be reallocated across sectors. This mechanism may be even weaker in the Italian case, where structural rigidities of the labour market, skills mismatch and limited geographical mobility can constrain workers' movement across sectors (Dalla Zuanna et al, 2024).

Figure 1: Contributions to GDP growth *(ten-year horizon, percentage points)*



Source: Bertolotti et al. (2026); Intermediate scenario. Key: C = Manufacturing; G = Wholesale and retail trade, repair of motor vehicles and motorcycles; M = Professional, scientific and technical activities; H = Transport and storage; J = Information and communication services; K = Financial and insurance activities; Q = Human health and social work; D = Electricity, gas, steam and air conditioning supply; F = Construction; P = Education.

5. Policy interventions to support the integration of AI into business processes

What justifies public intervention?

Artificial intelligence can deliver substantial productivity gains for firms. If these benefits were fully perceived and fully appropriable, firms would have an incentive to adopt the technology on their own, up to the level that is also optimal for the economy as a whole.

In practice, this may not happen. On the one hand, some firms may find it hard to assess the benefits of adoption, to identify the most suitable uses and to acquire the necessary capital or skills. On the other, part of the benefits may extend beyond the individual firm – for example along supply chains, through the diffusion of knowledge and skills, or through network effects whereby the gains from adoption depend on aggregate adoption rates. Where such externalities and complementarities are present, firms' decisions reflect only part of the overall benefits.

Adoption may then fall short of the level that would be desirable for the economy as a whole. Public intervention may therefore be justified where it helps remove informational and organisational obstacles, foster the diffusion of skills and close the gap between the private and social returns to the technology.

In the adoption of new technologies, "strategic complementarities" are particularly relevant: the benefit a firm derives from adopting AI increases as more other firms adopt it too. The literature offers several examples:

- "Vertical" complementarities along the supply chain: the adoption of new technologies by upstream producers in the production chain can reduce the prices of intermediate goods and hence the costs of downstream producers, increasing profitability for everyone; policy can steer towards the high-adoption equilibrium.[17]
- "Horizontal" complementarities among adopters (network effects): the benefit of adoption depends on how many others adopt. In the presence of fixed costs and uncertainty, firms may rationally adopt a "*wait-and-see*" strategy, generating inefficient delays or multiple equilibria linked to reaching a critical mass.[18] The presence of network effects is more marked when adoption requires common standards and infrastructure or the sharing of data, which require the development of vertical solutions. The "*wait-and-see*" strategy may also emerge in relation to the expected evolution of the quality of the technology (Bertolotti and Lanteri, 2024).
- Complementarities in the adoption of different technologies: the adoption of a single technology may have a limited return if it is not accompanied by complementary investments (digital infrastructure, skills, data, software). In such contexts, low-adoption traps and structural *path dependence* may emerge, requiring broader coordination or a strong temporary push to move the economy onto a high-diffusion path. [19]

The common implication is the possible presence of multiple equilibria and *path dependence*: a low-adoption equilibrium that is self-sustaining because it depresses the private return on adoption; a high-adoption equilibrium, in which rapid diffusion of the technology strengthens the private return and the incentive for firms to adopt it. Policy can "select" among these long-run equilibria through interventions that are either temporary, aimed at solving problems of *path dependence*, or structural, in the case of the presence of multiple long-run equilibria.

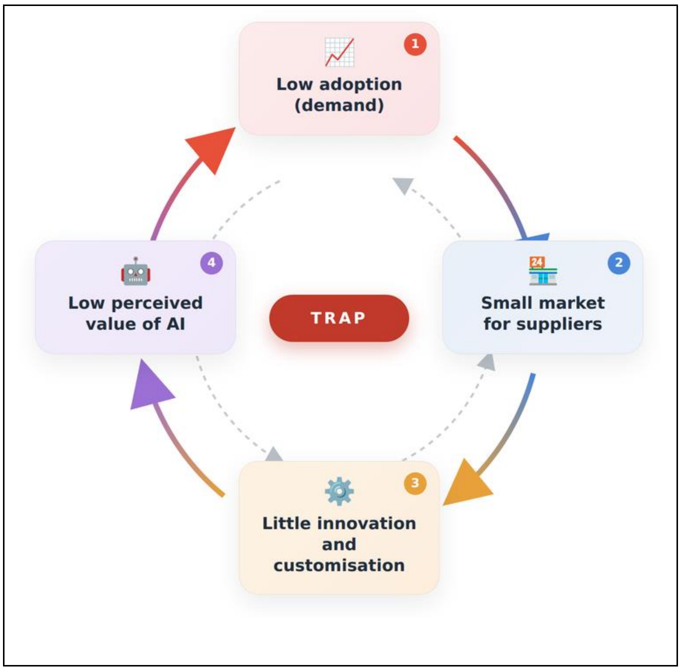
Figure 2 Demand-supply coordination

[17] The central mechanism consists of a macroeconomic complementarity: when producers adopt "modern" techniques, their marginal costs decrease, reducing input prices for downstream customers (other firms) and increasing the profitability of adoption for other firms as well, through inter-firm production linkages. Therefore, if many producers adopt AI, aggregate productivity and profitability increase for other firms too, further reinforcing adoption; if instead few adopt, modern technologies are not sufficiently profitable and the economy may coordinate on a low-adoption equilibrium. In practice, there may exist multiple equilibria with high or low adoption and productivity. Distortions interact non-linearly with these complementarities, potentially pushing the economy towards the "bad" equilibrium. Reforms or subsidies can allow coordination on the "good" equilibrium. See Buera et al. (2021).

[18] The current benefit of using the technology increases with the number of adopters, so that the benefit of adoption today depends on the expected path of future adoption. In the presence of a fixed cost of adoption and uncertainty/heterogeneity, agents have an option value in waiting for others to adopt first ("wait-and-see"), producing gradual diffusion and, if complementarities are strong, the presence (or absence) of a critical mass of adopters can lead to multiple adoption paths. See Alvarez et al. (2026). The relevance of these mechanisms is confirmed, on Italian data, by the analysis of Cullen et al. (2025), which shows how informing firms about the adoption rates of similar firms changes expectations and, through these, adoption plans. The presence of multiple adoption equilibria and inefficiently slow diffusion can also emerge in relation to the evolution of the quality of the technology, in particular when it depends endogenously on the innovation choices of the producers of that technology (Bertolotti and Lanteri, 2024).

[19] In this case the complementarity is explicit between the adopted technologies: growth depends on the adoption of a set of complementary frontier technologies, and the return on adopting one technology increases when the others are also adopted, generating path dependence. The market power of the suppliers of these technologies can depress adoption. Policy therefore has two roles: (a) correcting distortions on the supply side (which can be difficult if the suppliers are foreign; see Bertolotti et al. (2025)), and (b) acting as a tool for equilibrium selection (choosing a high-adoption development path). This is the basis of the logic of the "temporary big push": incentives concentrated in the initial phase can permanently move the economy onto a superior path when complementarities create traps. See Alvarez, Buera and Trachter (2026).

Coordination failures among potential adopters can compress the demand for AI solutions and also affect innovation incentives on the supply side. A higher adoption rate widens the expected market for producers, increasing the returns on investment aimed at improving the quality of the solutions. At the same time, higher-performing technologies strengthen firms' incentives to adopt them, making pre-existing solutions obsolete more quickly (Figure 2). As shown by Bertolotti and Lanteri (2024), policies supporting adoption can therefore also stimulate innovation by producers, through the expansion of the potential market. However, in the presence of strong market power, part of the benefits of demand subsidies may be absorbed by higher prices and mark-ups, to the advantage of incumbent suppliers.



A further obstacle to diffusion lies in the market's ability to translate general-purpose technologies into applications suited to firms' operational needs. The heterogeneity of production processes and the limited standardisation of data within supply chains make it harder to develop vertical, replicable solutions that are also within reach of smaller firms.[20] This may result in a "missing middle" between upstream technological supply and downstream application demand: the market remains polarised between generalist tools and tailor-made implementations, accessible only to larger firms.[21] This coordination failure between demand and supply points to the need for policies that do not merely encourage adoption but also support the supply of scalable applications.

Policy should nonetheless remain limited in scope, without substituting for the market in picking the winning AI solutions. Its role is to stimulate the demand for and supply of solutions in the short term and, over the longer term, to create and sustain conditions conducive to coordination, experimentation, interoperability, data sharing and regulatory certainty. As noted above, moreover, market power on the supply side bears on the optimal design of policy: subsidies and procurement risk translating into higher prices and mark-ups, transferring rents to incumbent suppliers. Interventions should therefore be designed to preserve the contestability of markets – for example through competitive procurement, open and interoperable standards, support for new entrants and shared infrastructure.[22]

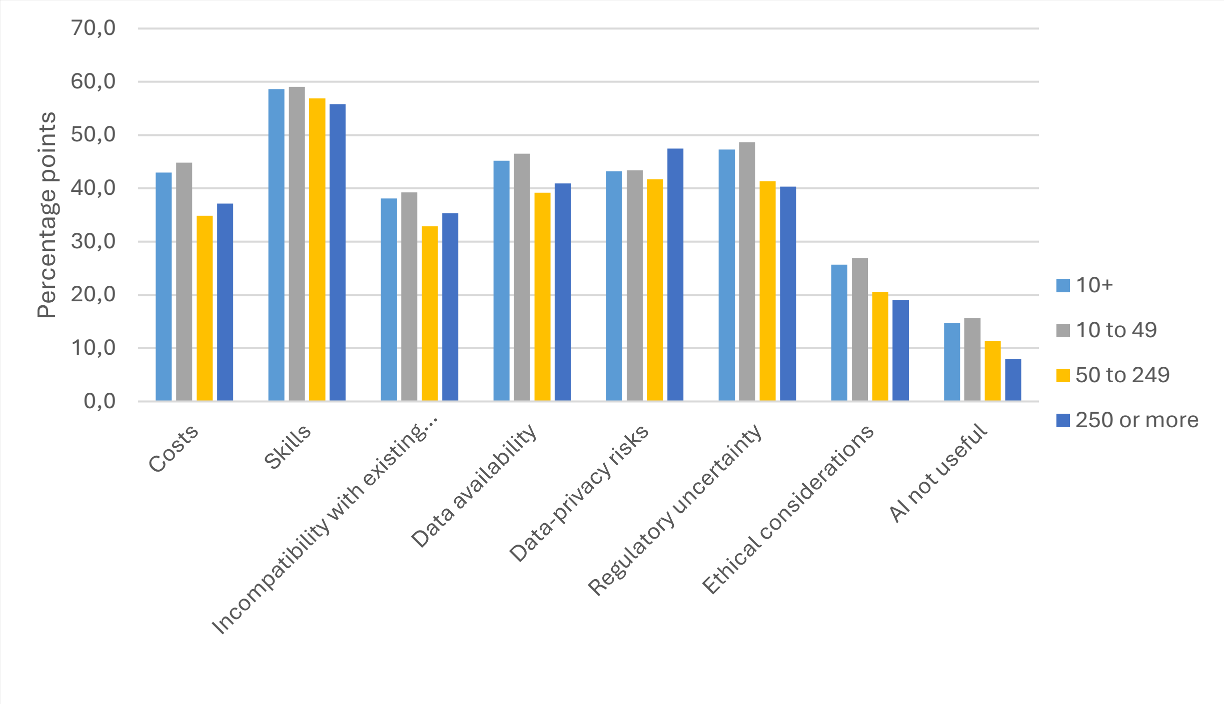
Business constraints on adoption

Eurostat surveys make it possible to gather information on the reasons for non-adoption by Italian firms with at least 10 employees, by firm size class (Figure 3). In 2025, about 10 per cent of firms

[20] In the absence of common standards for the collection and sharing of sectoral data, technology suppliers face high development and integration costs for each application context, with limited returns to scale.
[21] SMEs are not able to fill this gap on their own, lacking the financial resources and the internal skills needed for proprietary development, and being often excluded from credit markets for investments with high intangible content. See OECD (2021).
[22] Bertolotti et al. (2025) study optimal subsidies for technological investment/adoption in the presence of market-size externalities but also of market power of capital-goods producers, explicitly analysing the trade-off between rent capture and dynamic gains. The paper shows how the optimal subsidy should internalise the dynamic spillover on innovation, taking into account mark-ups and market power, since demand-side subsidies may otherwise be partly captured as rents.

reported that they had not adopted artificial intelligence even though they had considered the possibility. The share of firms reporting that AI is not useful for their production processes is residual. The main reason for the non-adoption of AI across all size classes is the shortage of skills. However, adoption is not held back by a single obstacle, but rather by a set of factors that reflect limits in firms' technological and organisational readiness, in addition to uncertainty about the regulatory framework and the risks associated with adoption.

Figure 3: Reasons for the non-use of AI among Italian firms that considered adoption (*First half of 2025, by size class expressed in terms of number of employees*)



Note: For each size class, the bars show the incidence of the various reasons for the non-adoption of AI among the firms that considered using it. Source: Eurostat.

Policies to foster adoption

This evidence confirms that policies to support AI adoption cannot rely on isolated measures but require a coherent set of complementary actions – the approach taken by the countries furthest ahead in diffusing the technology. Table 4 sets out an assessment grid that scores the degree of policy maturity across different areas, comparing Singapore – at the forefront of AI policy – and some Nordic countries, which lead on adoption, with the main EU countries (see also Appendix A, "National AI strategies: an international comparison"). A further important point is that firms need to be able to count on stable and predictable policies: there is ample evidence that Italian small and medium-sized enterprises require long lead times to take up innovation programmes or incentives.[23]

Table 4: Comparison of policies across countries

[23] See for example: Comitato scientifico per la valutazione dell'impatto economico degli interventi del Piano Transizione 4.0, Gli incentivi in investimenti 4.0: una valutazione dell'impatto della misura, interim report, November 2024; Banca d'Italia, L'economia dell'Emilia-Romagna. Rapporto annuale, box "Il competence center BI-REX", in Economie regionali, No. 8, June 2025, p. 60.

Dimension	DK	FI	SG	DE	ES	FR	IT
Demand stimulus							
Cost and economic-risk reduction							
Information and adoption support							
Supply development							
Vertical developers							
Enabling factors							
Human capital and managerial skills							
Data and interoperability							
Computing infrastructure							
AI compliance and governance							
Total score (max 21)	**19**	**18**	**21**	**18**	**18**	**21**	**13**
Green (3) — Advanced policy: operational programme, significant funding, defined governance, implementation under way							
Yellow (2) — Policy in place: programme launched, objectives defined, partial implementation or dependent on regional level							
Red (1) — Initial policy: intervention in planning, exclusively sub-national, or with structural gaps in the implementation chain							

Note: Table produced with the assistance of artificial intelligence. Sources: OECD (2025) Progress in Implementing the EU Coordinated Plan on AI — country notes; official national strategies; EuroHPC JU (2024-2025). SG=Singapore.

Policies to foster demand

Increasing information on the opportunities and on the returns on investment

Many firms, especially smaller ones, lack the skills or resources needed to assess the opportunities that AI offers. The uncertainty concerns not only the potential economic returns but also how to integrate solutions into production and organisational processes, and how the technological frontier will evolve – all of which complicates adoption decisions.

In several countries this problem is addressed through tools that accompany adoption, such as technology advisory services, application demonstrators, *testbeds*[24] and knowledge-transfer programmes.

Table 5: Policy priorities to foster the adoption of artificial intelligence in Italy
Stimulating demand for AI applications Strengthen and rationalise the services that accompany adoption (Digital Innovation Hubs, Competence Centres). Introduce selective economic support (*grants/vouchers*) for the purchase of vertical AI applications and funding for pilot projects and *proof-of-concept*.

[24] A testbed is a controlled environment, physical or virtual, used to experiment with, test and validate new technologies, software or processes under realistic conditions before their official release.

Strengthening the supply side and the innovation ecosystem Rationalise and specialise technology-transfer infrastructure, strengthening the link between start-ups, research centres and the production system. Use public procurement to create initial demand and make it worthwhile for suppliers to expand their offering of AI solutions and to generate replicable demonstrative use cases.
Interventions on enabling factors Facilitate firms' access to advanced computing infrastructure through shared-use models, computing credits and technical accompaniment services. Promote interoperability standards and develop sectoral *data spaces* to foster the secure sharing of data and the development of scalable applications. Introduce regulatory experimentation tools (*sandboxes* and *living labs*) for highly innovative AI applications and promote coordination and clarity in the regulatory framework. Strengthen workforce *upskilling* and *reskilling* programmes and managerial training initiatives on AI adoption, while at the same time fostering the attraction of qualified talent.

Similar lines of intervention are also set out in the Italian strategy for artificial intelligence, which points to the role of Digital Innovation Hubs, Competence Centres and other technology-transfer bodies. The breadth of this network is a strength in terms of geographical coverage. Compared with similar European initiatives, however, funding is limited and unstable[25], and interventions tend to be fragmented across numerous scattered initiatives, lacking a shared strategy (Andini et al., 2025).

Reducing the costs and the economic risk associated with adoption

Besides informational barriers, AI adoption can be held back by fixed implementation costs that precede uncertain benefits. In these conditions firms may rationally adopt wait-and-see strategies, deferring investment until uncertainty about the available technologies, market standards or regulatory environment recedes.

Subsidies for pilot projects are a direct way of lowering this barrier, reducing the share of the cost borne by the firm in the exploratory phase. Temporary support can also serve a coordinating function, helping adoption to get under way.

Their effectiveness nonetheless depends on their design. Generic subsidies or tax credits for digitalisation tend to have a broad but shallow impact. More selective instruments, targeted at projects with high innovative content or at specific technologies, can deliver more transformative results,

[25] The cumulative funding of the Competence Centres over the period 2019-25 amounted to 186 million euros, compared with annual public revenues of the German Fraunhofer Institute alone of 2.2 billion and of the Catapult centres in the United Kingdom of 320 million pounds in 2023.

while also sending clearer demand signals to service providers and spurring the development of specialised applications. As already happens in part, subsidies can be channelled through Competence Centres and technology-transfer bodies, which then combine the technical appraisal of projects with support during implementation; this is one of the salient features of the partnership models described in the Box: *AI Singapore's 100 Experiments programme*.

Box: AI Singapore's "100 Experiments" programme

Singapore is one of the countries most active in developing forms of support for the adoption of AI by firms (see Appendix A: National AI strategies: an international comparison). Among the international initiatives most frequently cited in the debate on policies for the diffusion of artificial intelligence is the "100 Experiments" programme promoted by AI Singapore, a national platform supported by the government in collaboration with the National University of Singapore. The programme is part of a broader digital transformation framework that also includes the *Go Digital* platform, designed to support firms, in particular SMEs, in the progressive adoption of advanced digital technologies, including AI.

The programme is structured as a public-private co-innovation mechanism, oriented towards the rapid development of applied AI solutions. Firms submit specific *use cases*, typically well delimited and with measurable impacts. Once selected, the projects are developed by teams of engineers, data scientists and researchers specialised in AI, with public financial support covering a significant share of the costs. The aim is to deliver, in a relatively short time (normally six months), working *proof-of-concept* solutions, able to demonstrate the technical and economic feasibility of the proposed solutions. At the end of the trial, firms can decide whether to adopt the developed solution.

This approach reduces the risk associated with the early phases of adoption and generates replicable demonstration cases. The programme is a policy intervention that stimulates demand and supply in the AI market at the same time: as more firms take part, demand signals become clearer and more consistent, reducing uncertainty for developers, start-ups and technology suppliers. This coordination effect helps to widen the expected size of the market, encouraging R&D investment, improvements in the quality of solutions and, ultimately, the strengthening of the entire national innovation ecosystem.

Policies to foster supply

Strengthening the supply of applications, developing the "missing middle", technology transfer

A dynamic ecosystem of start-ups and scale-ups, specialised in artificial intelligence, is crucial both as a source of innovative solutions and as a channel for diffusing the technology into the production system, by tailoring general-purpose models and tools to the specific industry contexts and organizational requirements of firms.[26]

[26] The emerging applications involve various areas. For example, AI-assisted software-development tools allow organizations to build tailor-made internal applications and to automate administrative and management processes, significantly reducing operational costs and execution times. In parallel, intelligent-agent systems and advanced document-management solutions are transforming the automation of complex workflows, enhancing productivity in information-intensive sectors such as finance, professional services, and public administration. A further strand concerns the development of domain-specific models trained on sectoral data, with applications in healthcare services, advanced

In several European countries, the development of highly specialised AI applications is supported by a coordinated mix of public policies, including targeted funding, innovation infrastructures, and

manufacturing and knowledge-intensive technical services. Finally, the integration of AI and robotics ("physical AI") opens up significant prospects for the automation of production and logistics processes.

dedicated support programmes for firms.[27] These measures are designed to accompany all phases of the innovation cycle, especially the most crucial transition from research and technological development to commercial deployment and market adoption.[28]

Support for firms does not end at the early stages of innovation, but can continue along the firm's growth path, by providing access to computing capacity, shared databases, common development platforms, and specialised skills that are often scarce or costly to obtain on the market. This kind of support lowers barriers to entry, accelerates innovation, and facilitates the emergence of a broader ecosystem of specialised AI applications.

In Italy, a number of initiatives have been launched to promote *Venture Capital* (VC)[29] investments and strengthen technology transfer, although their scale remains relatively limited. Among the most successful experiences in the latter area, one may recall the activity of the Italian Institute of Technology (IIT), a private-law foundation funded mainly with public resources and explicitly mandated to promote the industrial use of research. In recent years the Institute has promoted advanced projects in the fields of humanoid robotics[30] and of innovative materials and nanomaterials, with potential applications in the aerospace, automotive, biomedical and energy sectors.

Beyond a handful of centres of excellence, however, Italy's capacity to translate scientific achievements into commercially viable technologies remains constrained. While the country maintains a solid scientific presence in artificial intelligence research, its performance in technological commercialisation is considerably weaker. In 2022, the number of highly cited AI publications produced by researchers based in Italy was slightly more than half that recorded in Germany, whereas the number of AI-related patent applications was approximately twenty times lower. This gap highlights the persistent difficulties in transforming scientific excellence into innovation outcomes and industrial competitiveness.

Public demand and pre-commercial procurement

In several countries the public administration adopts AI not only to provide public services more efficiently but also to stimulate the development of new markets and applications that can subsequently diffuse throughout the private sector.[31]

A particularly effective but often underappreciated instrument in this regard is *Pre-Commercial Procurement* (PCP). Through PCP programmes, public authorities support research activities undertaken by private firms to produce innovative solutions that are not yet available on the market. In doing so, governments help bridge the gap between research and commercialisation, sharing the risks of innovation with firms and fostering the emergence of new technological capabilities and market opportunities (see the Box *Pre-Commercial Procurement as an innovation policy*).

Box: Pre-Commercial Procurement as an innovation policy

PCP[32] is an innovation-policy tool through which public administrations can purchase research and development (R&D) services to meet specific public needs for which the market does not yet offer

[32] The regulatory framework of PCP was defined by the European Commission in 2007 within Communication COM(2007) 799 final, Pre-commercial Procurement: Driving innovation to ensure sustainable high quality public services in Europe, 14 December 2007. In Italy, the regime of pre-commercial procurement was introduced by Article 158 of Legislative Decree No. 50/2016. On the interpretative aspects, see ANAC, resolution No. 46 of 26 February 2014.

solutions. The economic rationale of PCP is to correct market failures that hold back innovation in areas of collective interest. In the absence of structured public demand willing to share the risk, private operators tend to under-invest in technologies aimed at collective challenges marked by high uncertainty and diffuse benefits, such as health, mobility and environmental sustainability.

Compared with other innovative procurement tools, PCP is distinctive in being confined to the pre-commercial phase and in its model for sharing risks and benefits. In particular, the research results are not reserved to the contracting authority, which acquires only non-exclusive rights of use, while intellectual property rights remain with the suppliers; and the contracting authority co-finances the R&D activities, covering only part of the costs. This arrangement keeps the tool from being classified as State aid.

PCP is supported at the operational level by the European Union's framework programmes for research and innovation, which provide specific forms of co-financing for networks of contracting authorities engaged in the joint purchase of R&D services. In this context, PCP is conceived as a privileged tool for fostering transnational cooperation, the sharing of costs and the emergence of European markets for innovative solutions. The European Commission has recently highlighted the role of public procurement in the field of AI, not only to improve public services, but also to develop a European market for innovative solutions; in particular, PCP is identified as the most suitable tool for stimulating the growth of start-ups and SMEs.[33] In 2021 the European Commission published an analysis[34] of the EU co-financed ICT PCPs in the context of the FP7, CIP and Horizon 2020 programmes, which found significant long-term impacts on contracting authorities and firms some years after the conclusion of the PCPs.[35] Among the projects most relevant in terms of impact

[28] The support tools combine research grants, joint public-private investment, funds dedicated to advanced technologies and instruments to reduce the risk of the most uncertain investments. Alongside funding, accompaniment programmes for innovative firms are activated, offering both commercial and technical support. Often these programmes are flanked by test spaces that make it possible to test solutions in settings close to real ones. A central aspect is the link with universities and research centres, which provide advanced skills and foster the transfer of scientific results to the production world. This crucial connection makes the transformation of research into new firms and applications with high innovative content more effective.

[29] On the financial side, public and public-private tools operate to support the growth of technology start-ups. In particular, CDP Venture Capital manages a set of funds that support the creation and growth of deep-tech firms and the valorisation of research results. Examples are the National Innovation Fund, the AI Tech Fund, the Deep Tech Fund and the National Technology Transfer Fund.

[30] Generative Bionics is a spin-off firm operating in the field of the advanced design of robotic and bionic components, combining generative-modelling techniques, artificial intelligence and new materials to develop high-performance solutions in industrial and biomedical applications. Rehab Technologies is a joint IIT–INAIL laboratory dedicated to the development of robotic solutions and intelligent devices for the rehabilitation and reintegration into work of people with disabilities or injuries. Activities include the development of exoskeletons and robotic prostheses with high technological content, integrated with advanced control systems and machine-learning algorithms.

[31] In Spain, for example, pilot projects and living labs in the public administration allow start-ups and technology suppliers to test solutions on real processes; in Denmark a dedicated task force promotes the use of AI in public services and the scalability of the solutions developed.

[32] The regulatory framework of PCP was defined by the European Commission in 2007 within Communication COM(2007) 799 final, Pre-commercial Procurement: Driving innovation to ensure sustainable high quality public services in Europe, 14 December 2007. In Italy, the regime of pre-commercial procurement was introduced by Article 158 of Legislative Decree No. 50/2016. On the interpretative aspects, see ANAC, resolution No. 46 of 26 February 2014.

[33] See StepUp StartUps Consortium (2025). The report nevertheless highlights that the procedural complexity of PCP can be an obstacle for startups and SMEs.

[34] See European Commission (2021).

[35] About 50 per cent of the companies are generating revenues from commercialisation, 24 per cent of the participating start-ups obtained equity investments and 18 per cent concluded commercialisation partnerships. 71.5 per cent of the value of the contracts was awarded directly to SMEs. 19 per cent of the procurements were awarded to consortia of companies and SMEs and 33.1 per cent on a cross-border basis.

and strategic value are AI4Cities[36], THALEA[37] and PRACE-3IP. In particular, the latter, launched in 2013 with a budget of 9 million euros, had the objective of developing solutions to increase the energy efficiency of high-performance computing (HPC) systems. It is also a transnational initiative, in which the Italian consortium Cineca took part as contracting authority, managing the tender on behalf of the entire European consortium.

Figure A summarises the participations of various European countries in the twenty-six PCPs analysed by the European Commission in 2021. The figure shows active participation by Italy.

Italy launched a structured commitment to PCP starting in 2013.[38] In 2015 the Agency for Digital Italy (AgID) was designated as the implementing body and central purchasing body for PCP at national level, charged with analysing the needs collected and grouping them into homogeneous thematic areas, and with preparing coherent and scalable procedures. On these foundations the Smarter Italy programme was built, jointly promoted by several central administrations and implemented by AgID[39], which represents the main operational framework for innovative procurement in Italy in the context of the most recent European programming cycles. The programme has launched interventions in several strategic sectors.

Experience at European level shows that, while PCP is an effective tool for stimulating advanced innovation, it has some structural weaknesses that affect its take-up and impact. Procedural complexity and risk management remain significant barriers[40], to the point that in settings such as Italy the support of specialised central bodies like AgID has often been needed to guide the administrations; over time, however, a stable commitment and growing resources can gradually improve the administrations' own ability to manage these initiatives. Moreover, as a pre-commercial tool PCP entails a discontinuity with the market that can weaken the incentive to take part, especially for SMEs.

Figure A: Number of PCPs by country

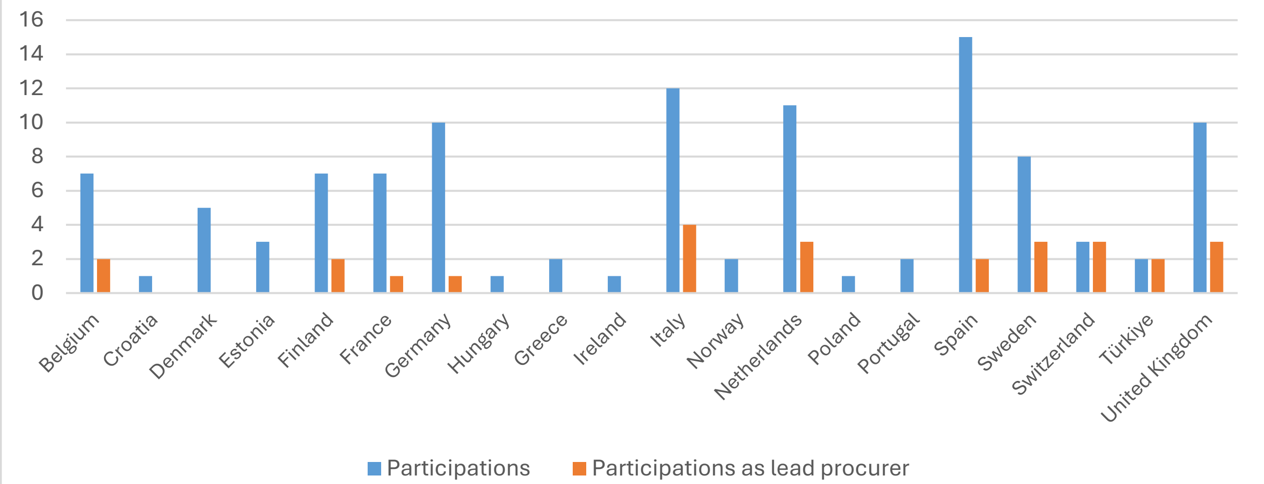
[36] The AI4Cities project represents one of the most advanced cases to date of a European PCP that includes AI as an enabling technology: the project aims to exploit artificial intelligence to implement the climate action plans of six European cities seeking energy and mobility solutions oriented towards carbon neutrality. The Buyer Group, made up of Helsinki, Amsterdam, Copenhagen, Paris, Stavanger and Tallinn, with the contribution of the European Union, made available to the selected suppliers a total budget of 4.6 million euros for the entire duration of the PCP (2020-22). The 41 suppliers selected for Phase 1 each received up to 40,000 euros to further develop their AI-based solutions. The proposals ranged from the optimisation of traffic flows with real-time AI to the management of energy demand in buildings using thermal storage, the management of urban cycling with intelligent systems, and the optimisation of last-mile logistics.

[37] THALEA (Telemonitoring and Telemedicine for Hospitals Assisted by ICT for Life saving comorbid patients in Europe) was coordinated by the university hospital of Aachen (Germany). The project represents one of the most significant cases of the use of PCP in the healthcare field at the European level. The initiative developed telemedicine solutions for the monitoring of intensive-care patients, enabling the real-time analysis of clinical data and remote support to specialists in the management of critical situations. The project was subsequently followed by THALEA II, which used a Public Procurement of Innovative Solutions (PPI) instrument to accompany the solution towards the commercialisation phase, completing the PCP–PPI cycle.-

[38] The first structured initiative dates back to a call launched in March 2013 by MIUR, in agreement with MISE, addressed to local administrations for the collection of innovation needs. The call gathered 42 expressions of interest, of which 30 directly within MIUR's remit, for an estimated value of about 90 million euros, funded mainly through European structural funds.

[39] The Smarter Italy programme is promoted by MIMIT, MUR and the Department for Digital Transformation of the Presidency of the Council of Ministers and is implemented by AgID. The first initiatives were launched in the 2014–2020 programming cycle.

[40] See Morisson and Pattinson (2019).



Note: Considering the 26 ICT-solution PCPs co-financed by the European Union and analysed by the European Commission in 2021, the chart reports, for each country, the number of PCPs in which one or more national administrations participate as procurer, highlighting the number of PCPs in which the country plays the role of lead procurer.

Alongside direct public demand, mandatory digital standards can also play an important part in fostering the adoption of technologies. A telling example in Italy, though not related to AI, is electronic invoicing, which required firms to make a significant leap in digitalising processes and structuring data; introducing specific cybersecurity standards for suppliers to the public administration could work in the same direction.

Interventions on enabling factors

Data sharing and interoperability

The most advanced AI applications require the sharing of domain- and process-specific data that are typically locked in silos and dispersed along production chains. This limits the scope for developing scalable solutions for whole supply chains or sectors.

In many European countries, national strategies have been introduced to foster the availability of public datasets and the secure sharing of data among firms and institutions.[41] In Italy, the National Digital Data Platform – provided by the Digital Administration Code and among the key interventions of the NRRP – is a potentially important infrastructure for improving the interoperability and accessibility of public information bases, creating the conditions for data-driven services and AI applications. The Italian AI strategy, moreover, makes the use of data an essential pillar for supporting the diffusion of the technology. Nonetheless, beyond the strategic guidelines, operational initiatives are still being consolidated. The objective should be to foster forms of secure data sharing among firms, within supply chains and districts, promoting common standards and technical interoperability.[42]

---

[41] Denmark represents one of the most advanced cases, thanks to systematic open-data policies, the creation of national language archives and the development of public platforms. In Finland, the Data Spaces Alliance Finland has involved more than 100 actors in 30 data spaces covering 15 sectors.

[42] Initiatives such as the German Catena-X, in the automotive sector, show the possibility of creating federated data spaces in which firms share information while retaining sovereignty over it and adopting common standards, enabling traceability, quality and sustainability applications along the supply chain.

Regulatory and compliance certainty

A further factor that can slow the diffusion of AI is uncertainty about the regulatory framework and compliance obligations. The rapid evolution of the technology, together with the gradual definition of rules on liability, data protection and risk management, can lead firms to adopt wait-and-see strategies.

In several countries, regulatory experimentation tools have been introduced, such as the so-called *regulatory sandboxes*, which allow artificial-intelligence-based applications to be tested in controlled settings, while fostering, at the same time, institutional learning and the definition of shared operating practices.[43] Moreover, the Italian strategy for AI highlights the need to adopt *sandboxes* to test regulation, but this type of initiative is not yet fully under way.

Developing human capital and skills

Adopting AI requires not only advanced technical skills but also managerial and organisational capabilities. For this reason, many countries have launched programmes that work on several levels: basic and higher education, reskilling of the workforce and the attraction of talent.[44]

In Italy, despite the fairly widespread availability of basic digital skills, some structural weaknesses persist. International indicators point to a relatively small share of STEM graduates compared with the main advanced economies and to a shortage of ICT specialists in the labour market. Added to this are weaknesses in the quality of managerial practices, which the empirical literature links to a lower ability to adopt and exploit advanced technologies (Bloom et al., 2012; Schivardi and Torrini, 2011; Schivardi and Schmitz, 2020).

Computing infrastructure: from basic research to artificial intelligence applications

Among the factors that can foster the adoption of AI by firms, high-performance computing infrastructure (*High Performance Computing*, HPC) plays a central role, enabling advanced data processing and the training of AI models on a large scale.

Italy is comparatively well placed in supercomputing, thanks to internationally significant infrastructure such as the HPC6 supercomputer owned by Eni (see Appendix B: *Eni-HPC6*) and the Leonardo supercomputer at the public consortium Cineca (see Appendix B: *Leonardo*). Eni's HPC6 is used in advanced simulation projects for energy applications and is embedded in an ecosystem that involves universities, research centres and start-ups through dedicated initiatives. Leonardo, by contrast, is a public infrastructure oriented mainly towards scientific research (particle physics, nuclear fusion, artificial intelligence and machine learning).

This endowment is an important precondition for the development of AI, but it is not in itself enough to sustain the technology's diffusion across the production sector. Public supercomputing systems such as Leonardo, at Cineca in Bologna,have historically been designed and used mainly for scientific

[43] Spain, for example, has launched pilot programmes to accompany the development of high-risk systems in compliance with the requirements of the AI Act, while Denmark has set up sandboxes for firms and public organisations to test applications in compliance with data-protection regulations.

[44] In Estonia, the AI Leap programme introduces basic artificial-intelligence skills into school curricula. In Finland, the Finnish Center for Artificial Intelligence (FCAI) links universities, research centres and firms and promotes advanced training programmes, also with the explicit aim of attracting international students and researchers. The Finnish AI 1000 programme, instead, provides training aimed at management. In France, the AI Booster France 2030 programme promotes upskilling activities for management.

research by universities and research centres, with limited involvement of firms.[45] It is in response to these limits that, in the current context, the European initiative in support of the *AI Factories* is situated. The *AI Factory* IT4LIA (*Italy for Artificial Intelligence*) – an evolution of the Leonardo supercomputer and based on the *one-stop-shop* model – aims precisely to simplify access to computing resources, large datasets and advanced services for industrial applications, with a particular focus on four specialist areas: agri-food, manufacturing, cybersecurity and earth studies. The main challenge is therefore to transform an advanced infrastructure endowment into an ecosystem that is genuinely accessible and usable by firms, especially smaller ones.

[45] In 2024, only 5 per cent of the computing power of the Leonardo supercomputer was used for contracts and calls for tender on industrial projects. For details, see Cineca, Cineca HPC Report 2024-25, p. 16.

References

Acemoglu, D. (2025). *The simple macroeconomics of AI*. Economic Policy, 40(121).

Aghion, P., & Bunel, S. (2024). *AI and growth: Where do we stand?* Policy Note.

Alvarez, F. E., Argente, D., Lippi, F., Mendez-Chacon, E., & Van Patten, D. (2026). *Strategic complementarities in a dynamic model of technology adoption: P2P digital payments*. (CEPR Discussion Paper No. DP21211). Centre for Economic Policy Research.

Alvarez, F. E., Buera, F. J., & Trachter, N. (2026). *Technology adoption and optimal policy* (NBER Working Paper No. 35133). National Bureau of Economic Research.

Aldasoro, I., Gambacorta, L., Pal, R., Revoltella, D., Weiss, C., & Wolski, M. (2026). *AI adoption, productivity and employment: Evidence from European firms* (BIS Working Papers No. 1325). Bank for International Settlements.

Andini, M., Bertolotti, F., Citino, L., D'Amuri, F., Linarello, A., & Mattei, G. (2025). *Ricerca, innovazione e trasferimento tecnologico in Italia*. Questioni di Economia e Finanza 954. Banca d'Italia.

Banca d'Italia. (2025). *L'economia dell'Emilia-Romagna. Rapporto annuale* (Economie regionali, No. 8, June 2025). Banca d'Italia.

Baqaee, D. R., & Farhi, E. (2024). Networks, barriers, and trade. *Econometrica, 92*(2), 505–541.

Basu, S., Fernald, J. G., Oulton, N., & Srinivasan, S. (2004). *The case of the missing productivity growth, or does information technology explain why productivity accelerated in the United States but not in the United Kingdom?* NBER Macroeconomics Annual, 18, 9–82.

Bergeaud, A., Cette, G., & Lecat, R. (2016). *Productivity trends in advanced countries between 1890 and 2012*. Review of Income and Wealth*, 62*(3), 420–444.

Bertolotti, F., & Lanteri, A. (2024). *Capital replacement and innovation dynamics*. (CEPR Discussion Paper No. DP18869). Centre for Economic Policy Research.

Bertolotti, F., Lanteri, A., & Yoon, H. (2025). *Optimal subsidies for capital replacement and the green transition*. (Mimeo).

Bertolotti, F., Linarello, A., & Zoi, P. (2026). *Shock propagation and economic policies in the Italian production network*. Questioni di Economia e Finanza, Banca d'Italia, forthcoming.

Bloom, N., Sadun, R., & Van Reenen, J. (2012). *Americans do IT better: US multinationals and the productivity miracle*. American Economic Review*, 102*(1), 167–201.

Bresnahan, T. F., Brynjolfsson, E., & Hitt, L. M. (2002). *Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence*. Quarterly Journal of Economics*, 117*(1), 339–376.

Brynjolfsson, E., & Hitt, L. M. (2000). *Beyond computation: Information technology, organizational transformation and business performance*. Journal of Economic Perspectives*, 14*(4), 23–48.

Brynjolfsson, E., Rock, D., & Syverson, C. (2021). *The productivity J-curve: How intangibles complement general purpose technologies*. American Economic Journal: Macroeconomics, *13*(1), 333–372.

Brynjolfsson, E., Li, D., & Raymond, L. (2025). *Generative AI at work*. The Quarterly Journal of Economics, *140*(2), 889–942.

Buera, F. J., Hopenhayn, H., Shin, Y., & Trachter, N. (2021). *Big push in distorted economies*. (NBER Working Paper No. 28561). National Bureau of Economic Research.

Cineca (2026). *Bilancio d'esercizio 2025*.

Cineca (2025). *Cineca HPC Report 2024-25*.

Comitato scientifico per la valutazione dell'impatto economico degli interventi del Piano Transizione 4.0. (2024). *Gli incentivi in investimenti 4.0: Una valutazione dell'impatto della misura*. Ministero dell'Economia e delle Finanze, Banca d'Italia & Ministero delle Imprese e del Made in Italy.

Cullen, Z. B., Faia, E., Guglielminetti, E., Perez-Truglia, R., & Rondinelli, C. (2025). *The innovation race: Experimental evidence on advanced technologies* (NBER Working Paper No. 34532; revised February 2026). National Bureau of Economic Research.

Dalla Zuanna, A., Dottori, D., Gentili, E. & Lattanzio, S. (2024). *An assessment of occupational exposure to artificial intelligence in Italy*. Questioni di Economia e Finanza (Occasional Papers), 878, Banca d'Italia.

European Commission. (2021). *Innovation procurement: The power of the public purse – EU funded projects in the ICT domain*. Publications Office of the European Union.

Eurostat. (2026). *Artificial intelligence by size class of enterprise* (Dataset). Eurostat Database.

Fang, L., Yuan. Z., Zhang, K., Donati, D., & Sarvary, M. (2025). *Generative AI and firm productivity: Field experiments in online retail*. Columbia Business School Research Paper No. 5584850.

Filippucci, F., Gal, P., Laengle, K., & Schief, M. (2025). *Macroeconomic productivity gains from artificial intelligence in G7 economies* (OECD Artificial Intelligence Papers, No. 41). OECD Publishing.

Fonteneau, F., Mollins, J., Marchi, S., Russo, L., Gentaz, A., Daoud, M., & André, A.-A. (2025). *Advancing the measurement of investments in artificial intelligence* (OECD Artificial Intelligence Papers No. 47). OECD Publishing.

Gambacorta, L., Qiu, H., Shan, S., & Rees, D. M. (2024). *Generative AI and labour productivity: A field experiment on coding* (BIS Working Papers No. 1208). Bank for International Settlements.

Gans, J. S., & Goldfarb, A. (2026). *O-ring automation* (NBER Working Paper No. 34639). National Bureau of Economic Research.

Gordon, R. J. (2012). *Is U.S. economic growth over? Faltering innovation confronts the six headwinds* (NBER Working Paper No. 18315). National Bureau of Economic Research.

Government of Singapore. (2023). *National AI Strategy 2.0: AI for the public good, for Singapore and the world*. Government of Singapore.

ISTAT. (2025). *Imprese e ICT – Anno 2025*. ISTAT.

Jones, C. I. (2026). *A.I. and our economic future* (NBER Working Paper No. 34779). National Bureau of Economic Research.

Jorgenson, D. W., Ho, M. S., & Stiroh, K. J. (2008). *A retrospective look at the U.S. productivity growth resurgence*. Journal of Economic Perspectives, *22*(1), 3–24.

Kremer, M. (1993). *The O-ring theory of economic development.* The Quarterly Journal of Economics, 108(3), 551–575.

McElheran, K., Yang, M.-J., Kroff, Z., & Brynjolfsson, E. (2026). *The adoption of industrial AI in America.* AEA Papers and Proceedings, 116, 20–25.

Morisson, A., & Pattinson, M. (2019). *Industry 4.0* (Policy Brief). Lille: Interreg Europe Policy Learning Platform.

Noy, S., & Zhang, W. (2023). *Experimental evidence on the productivity effects of generative artificial intelligence*. Science, 381(6654), 187–192.

OECD. (2021). *The Digital Transformation of SMEs*. OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris.

OECD. (2025). *OECD input-output tables* (Dataset).

OECD. (2025). *Progress in implementing the European Union Coordinated Plan on Artificial Intelligence (Volume 1): Member States' Actions*. OECD Publishing, Paris.

Ropele, T., & Tagliabracci, A. (2026). *The economic impact of artificial intelligence: Evidence from Italian firms*. Questioni di Economia e Finanza (Occasional Papers), 1005, Banca d'Italia.

Schivardi, F., & Torrini, R. (2011). *Structural change and human capital in Italy's productive system*. Giornale degli Economisti, 70(3).

Schivardi, F., & Schmitz, T. (2020). *The IT revolution and Southern Europe's two lost decades.* Journal of the European Economic Association, 18(5), 2441–2486.

Singla, A., Sukharevsky, A., Yee, L., Chui, M., & Hall, B. (2025). *The state of AI: How organizations are rewiring to capture value*. QuantumBlack AI by McKinsey.

StepUp StartUps Consortium. (2025). *Public sector services and the AI opportunity*. European Union.

Strand Partners. (2025). *Unlocking Singapore's AI potential 2025*. Report prepared for Amazon Web Services (AWS).

Yotzov, I., Barrero, J. M., Bloom, N., Bunn, P., Davis, S. J., Foster, K. M., Jalca, A., Meyer, B. H., Mizen, P., Navarrete, M. A., Smietanka, P., Thwaites, G., & Wang, B. Z. (2026). *Firm data on AI* (NBER Working Paper No. 34836). National Bureau of Economic Research.

Appendix

A. National AI strategies: an international comparison

In recent years the global adoption of AI in firms has grown at a sustained pace, but with marked differences across countries. According to the Eurostat survey on the use of ICT in firms, in 2025 20 per cent of European firms with at least 10 employees reported using at least one AI technology, with national values ranging between 42 per cent in Denmark and 5 per cent in Romania (Figure A1).

Quantifying public investment in AI is difficult because there is no standardised and comparable data across countries.[46] Based on estimates produced by the OECD, Table A1 offers an international comparison of total public investment made in 2023, the last year available, both in absolute terms and as a ratio to GDP for the same year. Only in a few small countries AI spending exceeds 0.5 per cent of GDP.

Figure A1: Firms with at least 10 employees using AI technologies

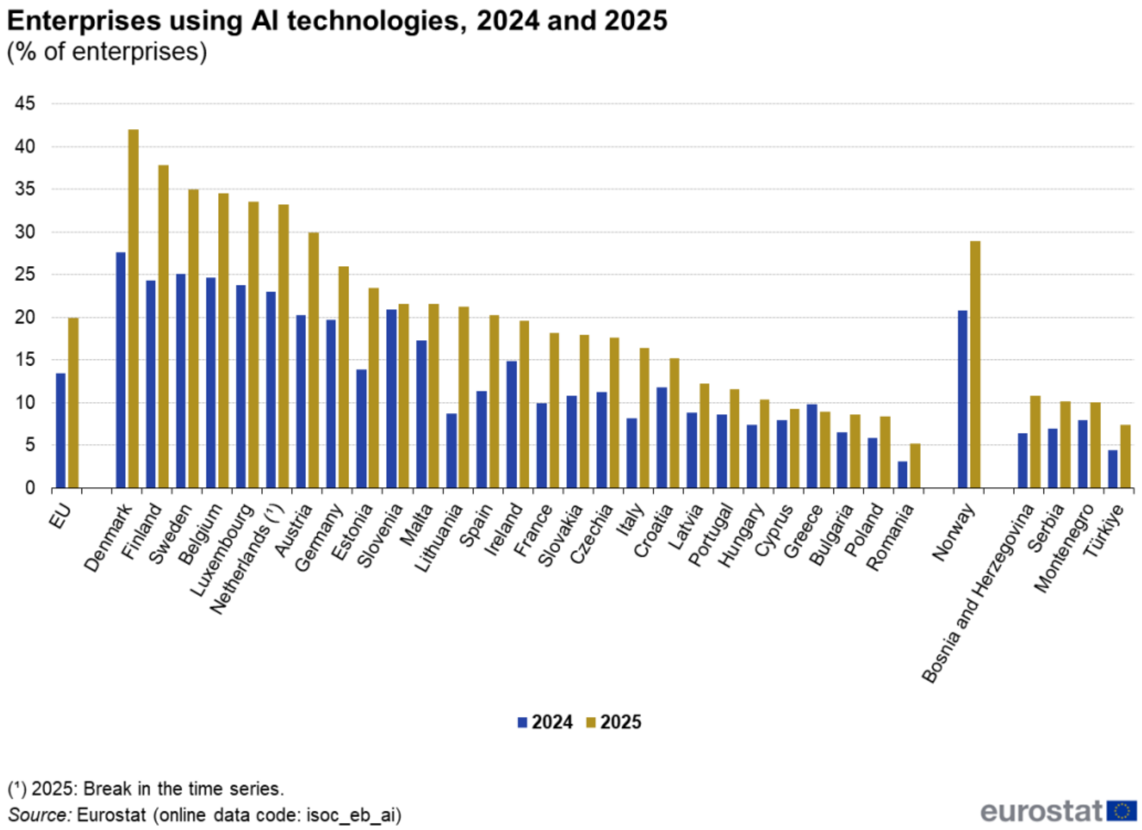


Table A1: International comparison of AI investment

[46] Some figures reflect actual expenditure, while others represent non-binding commitments, budget allocations or multi-year policy plans. Moreover, the data on AI investment often mix different areas: in some cases they include only research and development, while in others they encompass broader uses, including defence.

	Public investment in AI 2023 (€ million)	Investment/GDP
Austria	2,166.8	0.46%
Belgium	3,188.95	0.56%
Bulgaria	105.54	0.11%
Canada	6,460.67	0.32%
Cyprus	134.11	0.42%
Croatia	410.46	0.52%
Czech Republic	438.67	0.14%
Denmark	2,201.49	0.59%
Estonia	352.5	0.94%
Finland	1,789.63	0.65%
France	8,401.43	0.30%
Germany	18,891.77	0.45%
Greece	1,098.94	0.49%
Hungary	696.84	0.35%
Ireland	1,794.35	0.34%
Italy	5,235.3	0.25%
Latvia	167.71	0.42%
Lithuania	631.67	0.87%
Luxembourg	64.61	0.08%
Malta	67.94	0.32%
Netherlands	6,601.33	0.63%
Poland	5,886.32	0.78%
Portugal	942.08	0.35%
Romania	2,031.29	0.63%
Slovakia	421.17	0.34%
Slovenia	10.46	0.02%
Spain	3,047.11	0.20%
Sweden	2,244.74	0.42%
UK	6,221.00	0.20%
US	55,288.79	0.22%

Note: Total public investment in AI in 2023 was estimated by the OECD through an experimental methodology[47] (Measuring AI investment); the annual nominal GDP for 2023 used in the report was obtained from Eurostat data (Gross domestic product at market prices) for EU Member States, and from World Bank data (World Bank Group - GDP) for the others. The GDP of the latter, originally expressed in USD, was converted into EUR using the 2023 average exchange rate provided by Exchange-rates.org

What follows is a brief, non-exhaustive review of the policy tools used to support the diffusion of AI among firms in a selection of countries: the main European economies, the two Scandinavian countries leading the European adoption ranking, and some non-EU countries that stand out in the global AI landscape.

Denmark

[47] See Fonteneau et al. (2025).

Within the EU, Denmark has the highest level of AI adoption among firms against the backdrop of a highly digitalised production system[48] and a strongly coordinated governance framework.

The Danish approach to AI is based on four main initiatives, in line with the guiding principles identified by the 2024 national strategy.[49] The first pillar is to foster a large-scale, transformative use of AI within the public administration. To this end, the Digital Artificial Intelligence Taskforce was established[50], tasked with removing organisational, technical and legal obstacles and promoting the large-scale reuse of AI solutions in the public sector. A second pillar is the strengthening of the research ecosystem, including the creation of the Centre for Artificial Intelligence in Society, a new research centre intended to steer the country towards a responsible use of AI. The third pillar is the development of a platform for safe and transparent Danish language models, as a foundation for the AI solutions that domestic firms will adopt.[51] A final strategic direction is the sharing of high-quality public data collections to facilitate the development of AI applications.

Particular attention is paid to supporting SMEs with tools for digitalisation[52] and supporting programmes. The Digital Innovation Hub AI-Boost offers assessment, advisory and test-before-invest services aimed at SMEs and public organisations that want to adopt AI. In parallel, the Export and Investment Fund (EIFO) of Denmark supports access to credit for digitalisation and AI-application projects in SMEs. In addition, since 2024 regulatory sandboxes have been progressively activated to facilitate compliance with the GDPR and the European AI Act in the development of AI solutions.

The policy framework is completed by numerous sectoral projects led by public organisations, aimed at the development and implementation of AI solutions in priority areas, including health, agriculture and environmental sustainability.[53]

Finland

Finland was one of the first European countries to adopt a national strategy on AI, as early as 2017. In 2020 the government launched the Artificial Intelligence 4.0 programme, focused on the diffusion of AI in industrial firms, in particular in SMEs, within the framework of the digital and green transition. The government set out an integrated approach aimed first at strengthening firms' competitiveness through the widespread use of intelligent technologies, while also promoting the extensive, cross-cutting use of data across all sectors. Particular attention is paid to lowering barriers to adoption for SMEs and to strengthening human capital, both by building advanced skills and by attracting international talent. Public support to SMEs is based on a broad ecosystem of skills, platforms and partnerships rather than on direct subsidies. The Finnish Center for Artificial Intelligence acts as a national skills hub, connecting universities, research centres and firms and fostering

[48] Among EU member states, in 2025 Denmark ranked second after Finland in the share of small and medium-sized enterprises achieving at least a basic level of digitalisations: 92.45 per cent of SMEs with at least 10 employees. See Eurostat 2025*, Digital Intensity by size class of enterprise*.

[49] The strategy prioritises an ethical and responsible use of the technology, aimed at the well-being of citizens, the functioning of the public sector and the competitiveness of Danish firms. See *Strategic Approach to Artificial Intelligence*, December 2024. The OECD estimates an annual budget of more than 4.4 billion euros. See The OECD.AI Policy Navigator, *Overarching National AI Strategy*, December 2025.

[50] One of the objectives of the initiative is to release at least 50 million working hours within the public administration by 2035. See Task Force for Artificial Intelligence, *More time for what truly matters: vision for the roll-out and use of artificial intelligence in the public sector*, June 2025.

[51] See University of Copenhagen, *Ministry of Digital Affairs grants a total of 30.7 million DKK to ambitious Danish language model project*, December 2024. The figure corresponds to about 4 million euros.

[52] The SMV:Digital programme, in operation since 2018, offers SMEs grants for consultancy, technological investment and robotics experimentation and supported over 7,000 digital-transformation projects from 2018 to 2025.

[53] Some examples of AI applications are: in the public administration, the automation of bureaucratic procedures, the analysis of demographic data, virtual assistants for citizens; in healthcare: assisted diagnostics, analysis of epidemiological data (CAI-X, RAIT); in agriculture: optimisation of crops, efficient use of fertilisers and water, predictive systems for harvests; for the environment: emissions monitoring, management of natural resources, predictive systems for flood risk.

technology transfer to the production system. Finland has also invested systematically in computing infrastructure, in order to make firms, start-ups and research centres able to develop, test and scale AI-based solutions: the LUMI supercomputer, operational since 2022 and among the most powerful in Europe, represents the core of this ecosystem.[54]

The strategy is also characterised by broad support for large-scale public and private investment and by the ambition to use AI as a lever for modernising the public sector. This is coupled with a strong emphasis on collaboration between public and private actors and on the creation of new models of cooperation among research, firms and institutions.

Germany

The German strategy for AI developed in continuity with the broader Industry 4.0[55] programme which, starting in 2011, focused on the digitalisation of manufacturing processes, the interoperability of systems and on technology transfer. The adopted approach is based on the creation of shared infrastructure, the development of skills and the definition of common standards and reference architectures, rather than on direct financial incentives to firms. The national strategy for AI was developed within this context, with an initial endowment of 3 billion euros, later raised to 5 billion. The strategy is structured along areas of intervention that include talent, research, technology transfer and applications, job market, regulation and society[56]. The 2020 update also integrated environmental-sustainability priorities and strengthened the orientation towards European and international cooperation.

A distinctive feature of the German approach is the focus on technology transfer. The diffusion of AI within the production system has drawn on a network of pre-existing infrastructures. The Plattform Industrie 4.0[57] plays a coordinating role in the definition of standards, reference architectures and use cases that facilitate the integration of AI into existing production systems. In parallel, the network of Fraunhofer Institutes and the German Research Centre for Artificial Intelligence act as intermediaries between research and firms, developing applied solutions and accompanying firms in the reorganisation of processes preceding automation.

Germany has complemented this ecosystem with support tools geared more directly towards the adoption of AI solutions in SMEs. The Mittelstand-Digital[58] programme, aimed at providing guidance, demonstration and operational support services, has since 2024 placed greater emphasis on AI technologies. In addition, targeted programmes such as KI4KMU and Generative AI for SMEs, co-finance application initiatives led by SMEs in various production areas. The AI Studios also offer accessible learning paths and practical demonstrators to workers and firms.[59]

Alongside the initiatives aimed at fostering technology transfer, additional measures target enabling factors, such as computing capacity, data and regulation. Within the European network of AI Factories, Germany hosts HammerHAI and the JUPITER AI Factory, intended to provide firms and research centres with advanced

---

[54] The Finnish government has further strengthened this asset with significant financial commitments, including a contribution of up to 250 million euros for the upgrade of HPC infrastructures and the development of the future LUMI AI Factory, in collaboration with the EuroHPC initiative. See Finnish Government, Ministry of Education and Culture, *New supercomputer to be located in Kajaani – Finland gains stronger role in AI research*, December 2024.
[55] See Plattform Industrie 4.0, *What is Platform Industrie 4.0?*
[56] See Bundesregierung, *Strategie Künstliche Intelligenz der Bundesregierung*, 2018; Bundesregierung, *Artificial Intelligence Strategy of the German Federal Government*, 2020; OECD, *OECD Artificial Intelligence Review of Germany*, 2024.
[57] See Plattform Industrie 4.0, *What is the Platform Industrie 4.0?*
[58] See Bundesministerium für Wirtschaft und Klimaschutz, *Mittelstand-Digital* and *Accompanying and Ex-post Evaluation of the Funding Priority "Mittelstand-Digital"*.
[59] The project was financed with about 4 million euros. See Fraunhofer, *Opening of AI Studios Stuttgart: Hands-on workshop experiences*, February 2024.

infrastructure and services for the development of AI applications.[60] In parallel, with the overarching objective of strengthening digital sovereignty, the National Data Centre Strategy[61] of 2026 set the goal of doubling the overall capacity of data centres by 2030 and quadrupling the capacity dedicated to HPC and AI. The Nationale Datenstrategie[62], updated in 2023, brought within a unified framework several initiatives aimed at enhancing the availability, quality and reuse of data, also through the creation of sectoral data spaces. In the manufacturing sector, Manufacturing-X[63] represents the main example of this approach; the programme has an endowment of 150 million euros and is aimed at facilitating the federated sharing of data and supporting advanced digital applications along supply chains.

Spain

The Spanish strategy for AI, the Estrategia Nacional de Inteligencia Artificial (ENIA), was first launched in 2020 and then updated in 2024 to define the operational priorities for the two-year period 2024-2025 with a dedicated budget of 1.5 billion euros.[64] The Spanish approach for AI stands out for its tight integration with measures aimed at spreading basic digitalisation, with particular attention to SMEs.

In this context, one of the main vehicles for the diffusion of AI among firms is the Kit Digital programme, initially conceived to support the basic digitalisation of SMEs through *vouchers* for purchasing technological solutions. By progressively extending the catalogue of eligible technologies to AI applications, the programme has become a support mechanism that links the early phases of digital transformation with the adoption of more advanced technologies.

To complement this initiative, the Kit Consulting programme is aimed at supporting SMEs in accessing specialist advisory services on digital transformation projects.[65] Similarly, the Next Tech Fund aims to mobilise capital in support of start-ups and technology firms.

Special attention is paid also to regulation. In 2025 Spain launched a regulatory sandbox for high-risk AI systems, constituting one of the first operational examples in Europe.[66]

Finally, the framework is completed by investment in infrastructure and strategic projects, including the strengthening of supercomputing capacity[67] and the development of national language models in Spanish and in the co-official languages, aligned with the transparency and accountability standards provided for by the

---

[60] HammerHAI is the first German AI Factory, coordinated by the High-Performance Computing Center of the University of Stuttgart, with an overall budget of about 85 million euros. The project objectives include the installation of a new supercomputer optimised for AI, expected to become operational in 2026, while already offering access to AI computing capacity, inference services on language models and technical support to SMEs and researchers. The JUPITER AI Factory (JAIF) was established in March 2025 and is linked to Europe's first exascale supercomputer at the Forschungszentrum Jülich, offering SMEs and researchers advanced computing capacity. See EuroHPC Joint Undertaking, 'AI Factories – Germany'.

[61] Bundesregierung, "*Rechenzentrumsstrategie*", 2026

[62] Bundesministerium des Innern und für Heimat, "*Nationale Datenstrategie*", 2023.

[63] Plattform Industrie 4.0, "*Manufacturing-X*".

[64] At the time of writing, no new overall AI strategy for the subsequent period appears to have been published. In the meantime the government has announced the development of a new digital-transformation framework for the public administration for the period 2026-2030, and has allocated 40 million euros to support the adoption of AI in SMEs. See, respectively, Ministerio para la Transformación Digital y de la Función Pública, press release of 17 September 2025 and press release of 17 March 2026, available on digital.gob.es.

[65] Although these programmes are not specifically dedicated to AI, they had a significant impact due to the breadth of the target audience involved and their ability to lower access barriers such as initial costs and lack of in-house skills. In three years, Kit Digital has involved 860,000 firms, disbursing more than 3.4 billion euros.

[66] The first call led to the selection of 12 high-risk AI systems. See Ministerio para la Transformación Digital y de la Función Pública, *Government launches EU's first test environment to ensure accountability for AI systems*, April 2025.

[67] The strategy allocates 90 million euros to the upgrade of the MareNostrum supercomputer, alongside the introduction of services dedicated to supporting industry access . See La Moncloa, *The Government of Spain approves the Artificial Intelligence Strategy 2024*, May 2024.

European regulatory framework and freely usable by firms and the public administration for the development of trustworthy AI applications.[68]

France

French policy on artificial intelligence is integrated into the France 2030 investment plan, oriented towards strengthening technological sovereignty and industrial competitiveness. The strategy combines support for frontier research with the diffusion of technologies on the application side, identifying the development of supercomputers, data centres and national cloud infrastructure as central priorities. A distinctive element of the French model is its strong emphasis on infrastructure and technological autonomy. In 2025 the government announced a plan to mobilise 109 billion euros of investment[69], largely private, for the development of AI, with particular attention to the construction of data centres and advanced computational capacity. This intervention reflects a strategy oriented towards strengthening the entire technological chain, from hardware to models, and positioning France as a European hub for AI, with the support of large industrial groups. On the research and innovation ecosystem front, the plan established nine AI Clusters[70], interdisciplinary poles connecting start-ups, universities, research institutions and industry for the development of strategic areas, including generative AI and the responsible governance of AI.

To foster the diffusion of AI among firms, and SMEs in particular, France has introduced targeted programmes. The IA Booster programme, managed by Bpifrance, supports firms along the whole path of technology integration, from assessing use cases to pilot trials, with grants of up to 80 per cent of consultancy costs.[71] In 2025, Osez l'IA was launched as a national initiative combining local awareness-raising efforts, AI skills development through a dedicated digital training platform, and practical support for implementation, including subsidised diagnostics and a catalogue of ready-to-use solutions.

United States

The United States' AI strategy differs sharply from European approaches, as the role of the State is predominantly that of an enabler and coordinator rather than a direct actor in the diffusion of the technology. The country currently represents the main global AI hub, thanks to an ecosystem characterised by a unique concentration of venture capital, large technology firms, digital infrastructure and centres of excellence in research. The US government's approach combines substantial public funding for research[72] and for the domestic production of specialised semiconductors with very light-touch regulation.[73]

---

[68] The ALIA family of models was released in 2025, after verification by the Spanish Agency for the Supervision of Artificial Intelligence. See European Commission, Open Source Observatory (OSOR), *Spanish Government promotes open access to its ALIA AI models*, April 2025.
[69] The exact time horizon was not specified. See Présidence de la République française, *Faire de la France une puissance de l'IA*, Élysée, 11 February 2025.
[70] See Inria, *AI Programme*, February 2026.
[71] See Présidence de la République française, *Lancement des clusters IA*, Élysée, 21 mai 2024.
[72] The 2025 budget dedicated to AI research and development in the defence sector amounted to about 3.5 billion dollars. See Federal Budget IQ, *Federal AI and IT Research and Development Spending Analysis*, January 2025. Between 2013 and 2023 public spending on AI-related contracts amounted to a total of 5.23 billion dollars, of which 75 per cent attributable to the Department of Defense. See *Stanford Artificial Intelligence Index Report 2025*.
[73] In January 2025, the new Trump administration revoked the 2023 Biden executive order on AI (Safe, Secure, and Trustworthy Development and Use of AI, EO 14110) and signed EO 14179 (Removing Barriers to American Leadership in Artificial Intelligence), which explicitly reorients federal policy towards deregulation and the 'global dominance' of the United States in AI. In July of the same year, the White House published the AI Action Plan, structured around three pillars: deregulation and acceleration of private innovation, the building of national computing infrastructure, and the promotion of American leadership on AI in geopolitical terms. At the end of 2025, a further executive order (Ensuring a

A key element of the US strategy is investment in critical technological infrastructure. This includes the CHIPS and Science Act, which aims to strengthen domestic semiconductor production and foster the development of an advanced industrial ecosystem, crucial also for training AI models and developing next-generation data centres.

Direct support policies for firms are less structured and less centralised. To foster the transformation of research into marketable products and services, the National Science Foundation, through the SBIR and STTR programmes, funds AI-based projects of small technology firms.[74] In addition, the AI for Main Street Act and the AI-WISE Act are under discussion in Congress; these bills, approved by the House in January 2026, would entrust the Small Business Administration with the task of providing direct assistance to small firms in adopting AI, by strengthening training and advisory services through the national network of Small Business Development Centers.

China

The National Plan for the New Generation of Artificial Intelligence, outlined in 2017, identifies objectives and strategic priorities for building a complete and integrated ecosystem in which technological innovation, industry and governance proceed in a coordinated manner. Among the strategic assets are frontier research, both in foundation models and in applications, for which Chinese spending was estimated at between 1.7 and 5.7 billion dollars[75] as early as 2018, as well as the expansion of domestic computing capacity through the creation of dedicated infrastructure.

Announced in 2024 and formalised with an operational plan in August 2025, the AI plus initiative is aimed at spreading AI throughout the Chinese economy and society, targeting adoption rates of next-generation smart terminals and AI agents above 70 per cent by 2027 and 90 per cent by 2030. In support of these objectives, in 2025 the National AI Industry Investment Fund was announced, a fund of about 8.2 billion dollars[76], which provides for various tools to support firms: free or subsidised computing resources, early access to AI models and funding for large research projects, with the aim of incentivising firms to experiment and innovate. In the initial phase, resources are intended to fill critical gaps in the AI ecosystem, with priority given to chip-design companies and semiconductor manufacturers[77], to fund the creation of infrastructure and the diffusion of enabling technologies in order to expand operational capacity and reduce dependence on foreign platforms. Subsequently, the focus shifts towards applications and commercialisation, making capital available for the growth of firms developing AI solutions. The fund identifies several priority sectors: semiconductors, autonomous-driving systems and healthcare. Other strategic sectors include smart manufacturing, financial services, technologies for agriculture and educational platforms.

United Kingdom

The United Kingdom has one of the largest domestic AI markets in the world, benefiting from strong private investment in technologies and start-ups. The adoption of AI in firms is supported by policies historically oriented towards experimentation and relatively light-touch regulation.

National Policy Framework for Artificial Intelligence) extended the deregulatory approach also to state regulations on AI, with the aim of creating a single 'minimally burdensome' federal framework.

[74] See America's Seed Fund.

[75] Although it is difficult to verify such estimates precisely, some studies suggest that actual spending was closer to the upper limit of the range and that it increased further in subsequent years. See Ashwin Acharya and Zachary Arnold, *Chinese Public AI R&D Spending: Provisional Findings*, 2019

[76] China Daily, *China sets up 60 billion yuan investment fund to accelerate AI innovations*.

[77] Entrepreneur loop, *China's 60 Billion Yuan AI Investment Fund Signals Global Tech Ambitions*, February 2026.

The UK Compute Roadmap, published in 2025, provides for a commitment of up to 2 billion pounds by 2030 to build a public ecosystem of computing capacity.[78] Alongside infrastructure, a second strand of intervention concerns access to data and information resources. This includes initiatives such as the National Data Library, which aims to make strategic public datasets more usable and accessible, strengthening the conditions for developing data-based applications.

With respect to firm-level adoption, the United Kingdom's approach integrates AI within a broader agenda of digitalisation and skills development: the Flexible AI Upskilling Fund, piloted in 2024, subsidised up to 50 per cent of training costs for SMEs in the professional-services sector[79]; BridgeAI, launched in 2023 with an endowment of about 100 million pounds, supports the adoption of AI in sectors that are still relatively less digitalised but high-growth, such as agri-food, construction, the creative industries and transport and logistics. The programme combines grants, technical mentoring, challenge-led collaborations and matchmaking activities between SMEs and suppliers through periodic calls.[80]

Singapore

Singapore has established itself as one of the most dynamic countries in the AI landscape, thanks to significant private and public investment, a solid initial level of business digitalisation and a broad policy portfolio, favoured by centralised governance, high fiscal and administrative capacity and an innovation-oriented regulatory approach. The National AI Strategy 2.0 (NAIS 2.0), launched in December 2023, planned investment over the following five years in high-performance computing resources, talent development, and AI applications for scientific research and industrial growth[81] (Government of Singapore, 2023). The National AI Research and Development Plan (NAIRD) is the tool aimed at strengthening public research for the period 2025-2030.[82]

The Productivity Solutions Grant (PSG), launched in 2018 and repeatedly renewed, is the main vehicle of direct subsidy for the adoption of certified digital and AI solutions.[83] In parallel, the AI Trailblazers initiative, launched in 2023, offers SMEs technical support and access to advanced AI tools to accompany firms in the rapid development of concrete use cases and to lower entry barriers. To reduce the initial investment risk in the most complex and innovative application cases, firms can join the AI Singapore 100 Experiments programme, which has already supported the development of over 300 pilot projects[84]. In addition, the government has launched programmes in partnership with the main global hyperscalers[85], through which firms

[78] The plan allocates over 1 billion pounds to a twentyfold expansion of the AI Research Resource and up to 750 million pounds for a new national supercomputer in Edinburgh. The government has also launched the *AI Growth Zones* to attract private investment in AI-enabled data centres. See Department for Science, Innovation & Technology, UK Compute Roadmap, July 2025.

[79] See Department for Science, Innovation & Technology, *AI Upskilling Fund*, August 2024.

[80] See Innovate UK, BridgeAI.

[81] NAIS 2.0 provides for an overall investment of more than one billion Singapore dollars. See Ministry of Digital Development and Information, *Artificial Intelligence (AI) initiatives launched to uplift Singapore's economic potential*.

[82] See Ministry of Digital Development and Information, *Singapore Invests Over S$1 billion in National AI Research and Development Plan to Strengthen AI Research Capabilities and Our Position as Global AI Hub*. NAIRD funding is part of the substantial investment planned for the 2026-2030 period under the Research, Innovation and Enterprise plan (RIE), the public-funding plan for R&D, which also includes a specific programme for the semiconductor sector. See NRF Singapore, Research, Innovation and Enterprise 2030.

[83] The PSG covers up to 50 per cent of eligible costs, including the purchase of pre-approved software, hardware components and consultancy services linked to implementation, with a maximum ceiling per firm over a multi-year period. See Enterprise Singapore, *Productivity Solutions Grant*.

[84] Participating organisations propose concrete use cases and are supported in development by dedicated teams of engineers and researchers over project cycles of three or six months, respectively for proof-of-concept or minimum-viable-product, receiving funding. See AI Singapore, *100 Experiments*.

[85] This is the case of the Google Cloud and DISG AI Cloud Takeoff programme, the Microsoft and DISG Agentic AI Accelerator and the AWS and DISG AI Springboard.

benefit from resources and skills at reduced costs. With the broader aim of incentivising the digitalisation of SMEs, in 2017 Singapore created the SMEs Go Digital platform, which integrates different tools, such as sectoral roadmaps and access to advisory services and pre-approved digital solutions[86], often co-financed through the PSG. Within the Smart Nation 2.0 programme, launched in 2024, the government intends to act actively as an early adopter of AI, leveraging the diffusion of the technology in the public administration as a form of strategic procurement oriented towards innovation.

To address a structural shortage of both specialist and widespread AI skills, Singapore has also launched initiatives to strengthen domestic training, attract international talent and reskill the workforce. In this framework, the TechSkills Accelerator programme supports the acquisition of digital and AI skills by ICT professionals and workers in transition, including through training and placement paths into technological roles. The most recent initiatives of the National AI Impact Programme aim to spread AI-use skills among non-ICT workers as well, with the aim of training 100,000 non-tech "AI bilingual" professionals by 2029.[87]

[86] See SMEs Go Digital Programme.
[87] See The Straits Times, *Singapore to train 100,000 AI-savvy workers by 2029*, 2026

B. Supercomputing infrastructure and access policies

Eni-HPC6

A) The characteristics of the infrastructure

Since 2013, Eni has operated, at Ferrera Erbognone (PV), the Green Data Center (GDC), a highly energy-efficient facility dedicated to corporate data systems and high-performance computing, home of the HPC6 supercomputer.[88] Built on a modular, scalable design, the GDC offers ample space and power capacity for high-performance computing infrastructure, together with high energy efficiency and strong operational resilience.[89]

HPC6 is an advanced Eni supercomputer, among the first in the world, designed with technology partners and integrated into the GDC with dedicated infrastructure and proprietary software.[90] At full capacity it uses up to about 10 MW IT of electrical power and reaches a peak computational capacity of about 606 PFlops (606 million billion operations per second; 477 PFlops sustained over time), ranking sixth in the Top500 list of November 2025 and first among the systems intended for industrial use.

Eni's high-performance computing infrastructure is used for the study of energy applications and for advanced simulation projects. Although designed mainly for other areas of use, HPC6 is also able to support AI and machine learning applications, thanks to the combination of about 14,000 AMD Instinct MI250X GPUs[91], a low-latency interconnection network and large-scale storage. One of its uses will be to support the expertise Eni has developed in integrating and developing AI models to optimise its various business areas, including applications to improve workplace safety and the training of proprietary Large Language Models tailored for the energy sector.

B) Applications

Eni's HPC infrastructure is used both for internal activities and for experimental open-innovation initiatives, making computing resources available to start-ups, innovative SMEs, universities and research centres. Among the open-innovation initiatives, HPC Call4Innovators (June 2025), in collaboration with AMD, Hewlett Packard Enterprise and the Cineca Consortium, with the support of Plug and Play[92], collected 99 applications from 20 countries (about 60 per cent from Europe, 30 per cent from the United States) and selected 10 projects, almost half of them Italian, which will have direct access to the computational resources of HPC6. In addition,

---

[88] The GDC is powered partly by a 1 MW photovoltaic plant and partly by the adjacent Enipower power station; an innovative natural-air free-ventilation cooling system (so-called "free-cooling") regulates the temperature, avoiding the use of air conditioners for more than 90 per cent of the year. The HPC6 supercomputer is also equipped with a direct-liquid cooling system that allows the dispersion of 96 per cent of the heat produced by the machine. The GDC hosts the management-processing and scientific-simulation systems, including the HPC6 supercomputer (2024), which marks the most recent phase of a path of development of corporate supercomputing capacity that began in 2013 and had been preceded by HPC4 (2018) and HPC5 (2020), with repeated investments by Eni.

[89] The GDC was built according to criteria in line with the standards for the highest level of operational resilience for a data centre.

[90] HPC6 is an infrastructure designed in-house with the technological contribution of Hewlett Packard Enterprise (HPE), Advanced Micro Devices (AMD) and Cray.

[91] The AMD Instinct MI250X series of GPUs was introduced in 2021. Characterised by a large amount of integrated memory, they constitute a high-end technology in HPC computing, although lacking the optimisations for AI computing introduced in subsequent AMD generations.

[92] Plug and Play, founded in California in 2006, is one of the largest open-innovation platforms in the world, active in more than 60 cities (about 30 countries): it connects start-ups, investors, large companies, governments and universities. It manages over 125 start-up accelerators and is one of the most active venture capital firms in the world.

Eni has more than 70 active collaborations with universities and research centres around the world.[93] These are flanked by other open-innovation initiatives, such as Joule, a school of entrepreneurship, the corporate venture capital Eni Next and the corporate venture builder Eniverse. The main areas of application of the HPC infrastructure include geophysical analyses and three-dimensional subsurface modelling, magnetic confinement fusion[94], studies on the behaviour of CO_2 in storage processes, research on innovative materials, atmospheric simulations and the development of artificial intelligence algorithms.

C) Future developments

In its 2025-28 strategic plans, Eni identifies data centres, powered by low-emission energy, as a potential area of development to meet the growing demand linked to AI and digital services, drawing on its own energy and technological expertise. In the 2026–30 strategy, technology, including high-performance computing, plays a central role as an enabling lever of growth. As part of the partnership between Italy and the United Arab Emirates, in 2025 Eni launched collaborations with some Emirati companies[95] to develop large-scale data centres in Italy with overall IT capacity of 1 GW. In this area, the first project under study is the one located at Ferrera Erbognone near the GDC: it is planned to develop, in two phases, an AI Data Center Campus[96] of 500 MW IT (almost the capacity installed in Italy in 2024[97]). Finally, during 2024, Eniquantic was established, a company set up by Eni and the start-up ITQuanta, for the design and development of a quantum computer.

Leonardo

A) The characteristics of the infrastructure

The public Consortium Cineca is headquartered at the Bologna Tecnopolo, which hosts the Italian supercomputer Leonardo.[98] The system can handle workloads linked both to traditional computing and, in part, to AI applications.[99] The supercomputer is currently equipped with about 14,000 NVIDIA A100 GPUs (a model produced by the leading company in the sector, but no longer part of the latest generation[100]), with highly

[93] Among these are the International Foundation Big Data and Artificial Intelligence for Human Development, IFAB, and the National Research Centre in HPC, Big Data and Quantum Computing, ICSC.
[94] Regarding magnetic-confinement fusion, HPC6 makes it possible to simulate the behaviour of plasma in order to improve the efficiency and stability of the fusion process, as well as for the study of materials.
[95] In February 2025 Eni signed letters of intent with G42, a leading global AI group based in Dubai, and Mgx, a fund dedicated to investments in AI and advanced technologies; while in July 2025 it signed a joint venture with Khazna Data Centers, a global leader in hyperscale digital infrastructure.
[96] Data-centre campuses are a set of several data-centre buildings, with redundancy systems and power supplies that are independent of one another, located within the same industrial complex.
[97] According to the Data Center Observatory of the Politecnico di Milano, in 2024 the data centres located in Italy reached an energy capacity of 513 MW (considering only the energy consumed by the data halls of the infrastructures), of which 62 per cent in Lombardy (318 MW in 2024) and in particular in Milan, which contributes 238 MW (still far from London, 1,065 MW, and Frankfurt, 867 MW).
[98] The Leonardo supercomputer, designed to approach the exascale threshold (one billion billion operations per second), is based on the BullSequana XH2000 architecture. The HPC system is divided into two modules: the Booster, dedicated to workloads accelerated with graphics units, and the Data Centric, designed for traditional computing and the management of large volumes of data. The system has more than 100 petabytes of disk space and more than 5 petabytes of flash memory, with high-speed internal networks and optimised software for data analysis and artificial-intelligence applications. The overall power exceeds 240 petaflops, while the electrical consumption at full load is about 9 megawatts (equivalent to the power installed in 3,000 houses).
[99] Other systems complete Cineca's technological perimeter: GAIA for cloud services, MARCOPOLO for critical applications such as weather forecasting, PITAGORA for the international nuclear-fusion community and MEGARIDE, being installed in Naples, dedicated to cybersecurity. Together, these systems offer a continuum of resources, ranging from cloud to supercomputing, available to universities, research centres and firms. For more details, see Cineca, *Cineca HPC Report 2024-25*.
[100] The NVIDIA A100 model was introduced in 2020 and is being phased out of production, although it is still supported by the manufacturer and widely used in many systems.

optimised interconnections for parallel computing[101] and with a storage system suitable for managing large volumes of heterogeneous data.[102] The main mission of the Consortium is to support the national and European scientific community in research activity. Cineca is also fully integrated into the network of European initiatives managed by *EuroHPC Joint Undertaking* (*EuroHPC JU*), a European Union organisation that coordinates and co-finances the development of HPC infrastructure in Europe.

From its very start-up phase (November 2022),[103] the system had to cope with a growing European demand for computing power for model training.[104] A technological *upgrade*, under development, will allow it to increase its processing capacity to support advanced AI technology applications.

According to the latest financial statements of the Cineca Consortium,[105] the total production value amounted to €160 million in 2025. The major share of revenues derives from services provided to consortium members, which generated approximately €95 million, compared with €13 million from other customers. These revenues are complemented by national funding, notably ministerial contributions from the Ordinary Financing Fund for supercomputing, amounting to €13 million. European resources and projects financed under the National Recovery and Resilience Plan (NRRP) contributed €14.4 million for EU-funded initiatives, while national projects accounted for €5.9 million. In addition, capital grants linked to the Tecnopolo amounted to €7.3 million. The composition is completed by other revenues for activities for private parties and other income, including specialist consultancy and the sale of energy-efficiency certificates. According to the latest available financial statements, at the end of last year Cineca's HPC Department, which manages the Leonardo supercomputer, employed about 160 people, mainly based in Bologna.[106]

Access to computing resources takes place mainly through competitive calls, based on an evaluation process by independent experts, who analyse the proposals according to technical-scientific criteria to ensure their quality and feasibility. At the national level, calls dedicated to Italian researchers are active, while at the European level resources are allocated through initiatives coordinated by the EuroHPC JU. Alongside these procedures, framework agreements with universities and research bodies make it possible to reserve computing capacity for activities not easily eligible for competitive calls. In a few cases, firms can also sign private agreements with Cineca, in order to use the computing resources for research and development purposes or for *proof-of-concept* projects.

According to the latest Cineca report on the HPC infrastructure[107], the majority of computational resources in 2024 were allocated through European calls, which absorbed almost 40 per cent of the total, followed by national ones, with just over 20 per cent. Direct agreements, including those reserved for the EUROfusion consortium,[108], accounted for almost 30 per cent, while, in the remaining part, about 5 per cent was allocated to industrial projects. Analysing the distribution of resources by scientific domain, in 2024 the largest share

---

[101] The intra-node and inter-node interconnections are made respectively by NVIDIA NVLink 3.0 and NVIDIA InfiniBand HDR100 technology, technologies of excellence and at the cutting edge until a few years ago.

[102] Multi-tier and multiprotocol storage.

[103] On 30 November 2022, just one week after the inauguration of the Leonardo supercomputer at Cineca, OpenAI released the first version of ChatGPT. The Leonardo system, configured with NVIDIA accelerators, was therefore the pre-exascale model that supported the first European response to the demand for computing on NVIDIA accelerators for the training of large generative-AI applications.

[104] The system, thanks to its configuration based on NVIDIA accelerators, made AI readiness a central and growing dimension of the infrastructure and became the reference platform for families of national models: Italia LLM (developed by the start-up iGenius with Cineca), Minerva (Sapienza), Velvet (Almawave SpA) and LLaVAMORE (University of Modena and Reggio Emilia), all trained or scaled with the GPU power of Leonardo. At the European level, calls on artificial intelligence issued by the EuroHPC Joint Undertaking are worth noting, including the Large AI Grand Challenge project, which allocated computational resources (2 million GPU-hours) to two European companies (Lingua Custodia and Unbabel, French and Portuguese respectively).

[105] For details, see Cineca, *Bilancio d'esercizio 2025*.

[106] The HPC Department has operational offices, with staffs located also in the hubs of Rome, Milan, Naples and Palermo; Cineca employs more than 1,000 people overall.

[107] See Cineca, *Cineca HPC Report 2024-25*.

[108] This is a European consortium for research on energy and nuclear fusion.

was allocated to initiatives linked toparticle physics (21.9 per cent), to nuclear fusion (14.3), to AI and Machine Learning (14.2), as well as to condensed-matter physics (10).[109]

B) Applications

Although Cineca's primary mission is to support scientific research, collaboration with businesses and public administrations also constitutes an important component of its activities, contributing to the transfer of advanced technologies to the wider economy. These collaborations focus in particular on applications that rely on high-performance computing (HPC) and artificial intelligence, supporting the development and deployment of innovative solutions across a range of sectors. In the energy sector, Cineca collaborates with Eni SpA for simulations and analyses linked to the energy transition, in an integrated manner with the computing capacity available to the company (the HPC5 and HPC6 ecosystems). In pharmaceuticals, it collaborates with Dompé to accelerate the discovery of new drugs through large-scale computing platforms. In manufacturing, it develops Digital Twin models and solutions to optimise production processes. Digital culture also benefits from projects based on image recognition and the automation of cataloguing workflows with AI techniques. Among the most relevant collaborations with public administrations are: *a)* the Digital Twin of Bologna, the digital model of the city that made it possible to simulate the energy behaviour of 24,000 buildings; *b)* the transition to the ICON weather models for ItaliaMeteo and ARPAE, with improvements in forecasts compared with the previous COSMO model.[110]

C) Future developments

The first intervention to enhance the infrastructure dedicated to artificial intelligence applications involves the introduction of LISA (*Leonardo Improved Supercomputing Archit*ecture). This is a new partition of the supercomputer, designed specifically for AI applications and equipped with over 1,000 NVIDIA H100 series GPUs.[111] The overall infrastructure will also be integrated with systems to support cloud services and data storage, in order to offer a computational *continuum*, that is, a system in which computing, cloud and data interact in a coordinated way. In a medium-term horizon, the overall infrastructure is expected to exceed 20,000 GPUs.

The potential for artificial intelligence will be strengthened by the progressive implementation of the IT4LIA project – *Italy for Artificial Intelligence*, which was selected among the first European AI Factories within the initiative promoted by the EuroHPC JU. At the core of the project is the creation of an optimised supercomputerfor this technology. Cineca, in a consortium with Austria and Slovenia, will host the facility. Once fully operational, IT4LIA will be among the first AI Factories in the world, and a leader in Europe in terms of computing capacity dedicated to artificial intelligence.

IT4LIA - AI-Factory benefits from a total investment of about €430 million, with an equal contribution at the national[112] and European levels.

The acquisition of the new optimised supercomputer for artificial intelligence applications was the subject of a European tender launched by the EuroHPC JU. The tender for the creation of the new supercomputer, with

---

[109] Confirming the relevance of the infrastructure, in 2024 the publications citing Cineca reached 24,000, with an H-index of 16, a high value with reference to the overall publications, and growing compared with the previous year.

[110] The Digital Twin of Bologna is developed in collaboration with local public bodies (the Municipality of Bologna and the "Innovazione Urbana" foundation) and with the University of Bologna, whose aim is to support urban planning and energy-efficiency policies.

[111] The NVIDIA H100 series was launched in 2022 and brought about a major architectural and performance leap compared with the previous A100 model, especially in support for AI computing. Although it can no longer be considered a frontier model, it still represents a high-end technology and a standard in many exascale computing systems.

[112] Co-financing at national level is supported by a wide range of institutions, including the Ministry of University and Research, the National Cybersecurity Agency (ACN), the Emilia-Romagna Region, the Cineca Consortium, the National Institute for Nuclear Physics (INFN), the ItaliaMeteo Agency, the Foundation for AI and the Bruno Kessler Foundation. Other Italian institutions and bodies also collaborate in the initiative, such as the National Research Centre in High-Performance Computing, Big Data and Quantum Computing (National Centre ICSC).

an estimated value of €290 million, was published on 6 October 2025 and was won by E4 Computer Engineering (in partnership with Dell Technologies) in April 2026, with progressive entry into production expected during the current year.

Looking ahead, with the IT4LIA project, Cineca aims to broaden its base of market revenues – especially in the energy, pharmaceutical, mobility and digital-manufacturing sectors – while at the same time preserving competitive and free access for basic research.[113] Economic sustainability will also depend on the ability to turn a growing part of the projects into high-value professional services, while the strengthening of energy efficiency should help to contain costs.

As part of the path towards exascale[114] in Europe, Leonardo's successor for general scientific computing is expected to enter operation in 2028. The development trajectory also includes the integration of two quantum systems at the Bologna Tecnopolo: IQM Radiance and Pasqal Orion Beta.

[113] Leonardo will benefit from the possibility of offloading massive training workloads onto the new optimised systems, freeing up computing capacity for scientific and industrial projects already in production, and improving waiting times and the quality of services for the entire scientific community.
[114] Computing power of at least 10^18 floating-point operations per second.