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Between Productivity and Uncertainty

AI Diffusion, Inflation and the ECB Monetary Policy



Economic Governance and EMU Scrutiny Unit (EGOV)
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Abstract

This paper analyses how artificial intelligence may affect euro area inflation dynamics and ECB monetary policy. It argues that AI is likely to be mildly disinflationary over the medium term, while its speed of diffusion and its effects on the natural rate of interest (R^*), monetary transmission and inflation diagnostics remain uncertain. The ECB should expand its existing toolkit by incorporating AI specific indicators, probabilistic scenario analysis, and explicit communication of structural uncertainty.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
BIS	Bank for International Settlements
ECB	European Central Bank
HICP	Harmonised Index of Consumer Prices
IMF	International Monetary Fund
R*	Natural rate of interest
SAFE	Survey on the Access to Finance of Enterprises
TFP	Total factor productivity

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EXECUTIVE SUMMARY

This paper analyses the implications of artificial intelligence (AI) for inflation dynamics and ECB monetary policy. It treats **AI not as a standard technology shock, but as a macro critical transition that increases uncertainty** by potentially altering production functions, labour demand, investment, relative prices, financial conditions and the information set available to central banks. As of mid-2026, AI is diffusing through the euro area, but its aggregate footprint in realised inflation, potential growth and the natural rate of interest remains modest. **A further source of uncertainty concerns the speed and breadth of diffusion**: slow adoption would delay macroeconomic effects, while rapid diffusion could make them more abrupt and harder to (identify and diagnose). The paper reaches three conclusions.

- **AI is likely to be mildly disinflationary for the euro area over the next five to ten years, and the effect is expected to be small, delayed and state contingent.** Productivity gains and lower unit labour costs should place downward pressure on prices, especially in services and task intensive activities. During the transition, however, this may be offset by complementary investment in software, data, skills, compute infrastructure – including data centres, and organisational capital, as well as by AI related energy demand. The net effect depends on the balance between productivity gains, investment demand, energy bottlenecks, wage responses, market power and the pace at which adoption spreads beyond frontier firms.

- **AI is likely to place stronger upward pressure on the US natural rate of interest than on the euro area natural rate.** Europe can benefit from AI adoption, but frontier AI production, upstream capital expenditure, hyperscale cloud infrastructure and the associated financial returns remain concentrated mainly outside the euro area. Producer economies are therefore more likely to experience stronger AI related investment cycles, while user economies may capture productivity gains with a smaller domestic demand impulse. For the ECB, the relevant question is whether future adoption and complementary investment become strong enough to change the balance between desired saving and desired investment.

- **AI may change monetary policy transmission.** If AI substitutes for labour in some occupations, wage indicators may become less informative about the degree of labour market slack. If algorithmic pricing increases market power, faster repricing need not imply stronger competitive pass through. Moreover, If AI-intensive firms rely increasingly on market-based finance, retained earnings and equity valuations rather than bank lending, the traditional bank lending channel may become less representative of AI related investment. Euro area financial conditions may also become more sensitive to global AI valuation cycles, especially those originating in US technology markets.

Overall, the ECB does not need a new monetary policy framework. What is needed is an incremental extension of the existing toolkit. AI specific variables should become a standing part of the projection process, including diffusion speed, the split between labour and capital augmenting effects, AI-related investment, imported versus domestically generated AI capability, energy demand feedback and financing conditions. Scenario analysis should play a central role. Gradual, moderate and rapid diffusion paths generate different policy problems and should be monitored through observable indicators. Where possible, these scenarios should be given explicit probabilistic content, to facilitate communication of the ECB assessment of risks changes over time. This approach calls for monitoring a recurring AI state vector: significant firm level AI use, employee level use, digital and intangible investment, AI related patenting, data centre and electricity demand, occupational exposure, wages in AI intensive sectors, sectoral productivity, margins, and financial sector exposure to AI related assets.

1. INTRODUCTION

The use of artificial intelligence (AI) is gradually spreading through the euro area, but, as of mid-2026, its macroeconomic effects on inflation and growth remain modest and hard to detect (Lane, 2026). This does not mean that future effects will be small. The IMF has rightly characterised AI as a "macro-critical transition" rather than a standard technology shock (Barhoumi et al., 2026). The distinction is important. Macroeconomic models typically represent the economy as a stable system hit by shocks. AI is different: it is not just a shock to an otherwise invariant structure, but a source of far-ranging structural change. It will alter the way firms produce, how labour and capital are used, and will have very heterogeneous effects across sectors. It may also substantially change the information on which economic actors, including central banks, base their decisions (Brunnermeier, 2026).

A further source of uncertainty concerns the speed and breadth of diffusion. The macroeconomic effects of AI depend not only on what the technology is ultimately capable of doing, but also on how quickly it is adopted by firms, workers and public institutions, and on whether adoption remains concentrated among frontier firms or spreads across the broader economy. Slow diffusion would imply that productivity, employment and price effects appear only gradually and may remain difficult to distinguish from other macroeconomic developments. Rapid diffusion, by contrast, could generate more abrupt changes in productivity, labour demand, investment, energy use and market structure, while also making traditional indicators of slack less reliable. For this reason, the macroeconomic effects of AI adoption and diffusion are surrounded by exceptional uncertainty.

In this paper, we will focus our discussion on three related topics:

- the effect of AI adoption on euro area inflation dynamics via its impact on aggregate supply and aggregate demand;
- the effect of AI on how the central bank interprets and responds to macroeconomic developments;
- the effect of AI on the transmission mechanism of monetary policy.

Our assessment is that the available evidence is too limited to identify a single dominant effect. The monetary policy implications of AI should therefore be analysed through multiple scenarios rather than a single baseline narrative. Gradual, moderate, and rapid diffusion scenarios generate different policy problems. In a gradual diffusion scenario, the main challenge is to detect changes in productivity, costs, and pricing behaviour before they become visible in aggregate data. In a moderate diffusion scenario, the ECB must assess the balance between supply side disinflation and demand side pressures from investment and income growth. In a rapid diffusion scenario, monetary policy may face larger shifts in potential output, sectoral reallocation, energy demand, and financial market expectations. The ECB already has many of the tools needed to address an AI transition: scenario conditioned projections, density forecasting based on machine learning, text mining of alternative data, and an R* estimation framework that reports a range rather than a point estimate. What is still missing is a more explicit probabilistic framework attached to different AI scenarios, together with AI specific indicators capable of tracking the transition in real time. These indicators should capture the speed of diffusion, the split between labour augmenting and capital augmenting effects, the scale of AI related investment, the geographical location and ownership of AI-related activity (EU-based AI firms vs. non-EU-based AI firms), and AI linked energy demand. Such additions would help the ECB distinguish temporary relative price movements from persistent changes in underlying inflation pressure, while preserving the medium-term orientation of its monetary policy strategy.

2. AI ADOPTION AND EURO AREA INFLATION DYNAMICS

AI affects inflation dynamics through its effects on aggregate supply and aggregate demand.

2.1. The Supply Side

The use of AI will change the cost of producing goods and services. A simple way to think about it is that firms now have access to a new input—call it machine intelligence—that can perform tasks that previously required human labour. As the quality adjusted price of machine intelligence falls, firms can reorganise production, using it either to complement workers and make them more productive or to substitute for tasks previously performed by human labour. In both cases, the cost of production will fall.

As the use of AI spreads, it will set in motion general equilibrium forces that dampen the cost savings just discussed. How these forces play out depends on the specific nature of AI as an input. If machine intelligence is mostly complementary to human labour, adoption can strengthen labour demand, leading to upward pressure on wages, partly offsetting the initial decline in production costs.[1] If machine intelligence instead mostly substitutes for human labour, demand for it will rise more sharply. Given limits to the capacity to produce AI services, this will tend to push up their price and raise the price of upstream inputs needed to produce them. Making reliable forecasts about these forces is hard, given that there is still considerable disagreement among technology experts and economists about whether AI will be mostly a labour augmenting form of technical advance or mostly a labour-saving form (Autor, 2024; Acemoglu, 2025).

Demand for AI services may also create inflationary pressures in sectors that do not themselves experience substantial AI-related productivity gains. Providing and expanding AI capacity requires electricity, advanced chips, data centres, grid connections and other infrastructure. Until supply adjusts, higher demand for these inputs may raise energy, construction and equipment costs.
Let us briefly focus on electricity, a channel the ECB has explicitly flagged as a source of inflationary pressure (Lane, 2026). Until energy supply capacity catches up with AI related demand, electricity and fuel prices may face upward pressure. ECB economists put a number on this channel: in a scenario where AI driven data centre electricity demand is met entirely through natural gas, euro area gas prices could rise by roughly 9% by 2026, with AI data centres responsible for about 2 percentage points of that increase (Burian & Stalla Bourdillon, 2025; Lane, 2026). A parallel IMF estimate puts the equivalent US electricity price effect at 8.6% by 2030 (Bogmans et al., 2025).

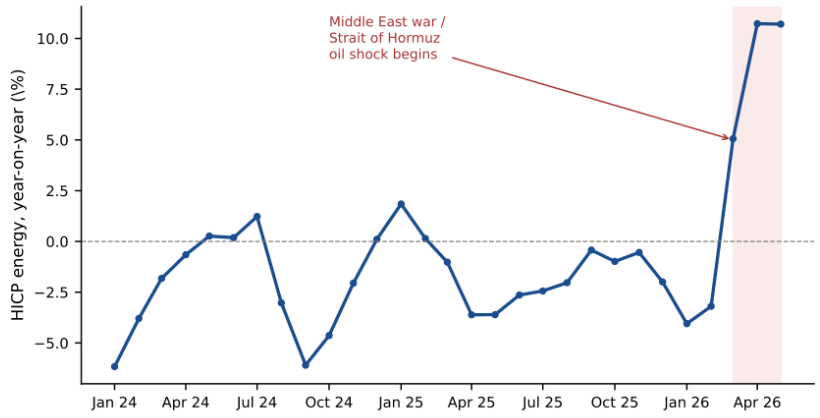
These pressures may delay or partly offset the cost reductions associated with AI adoption, but they do not eliminate the underlying productivity gain. An important timing asymmetry follows: investment and input-cost pressures may materialise before productivity gains become visible in aggregate data, while those gains will differ across sectors. AI may therefore generate short-run inflationary pressures even if its eventual effect on production costs is disinflationary.

Two measurement issues may further complicate the assessment of AI's inflation effects in real time. First, AI-enabled services may generate substantial quality-adjusted price reductions that are only imperfectly captured in inflation statistics. For example, routine legal assistance may become available at a fraction of its previous cost while being delivered in a different form. The second issue concerns unit labour costs, which measure the labour cost of producing one unit of output and are commonly used to assess whether wage developments are generating cost pressures that may feed into prices. In sectors where AI is primarily labour saving, a firm may significantly reduce its use of labour as it

[1] This is the way in which a TFP shock typically plays out in macroeconomic models with Cobb Douglas production and sticky wages.

substitutes towards AI services. Unit labour costs may then fall by more than the firm's marginal cost, because part of the decline reflects a reduction in labour's share of production rather than a fall in the cost of producing an additional unit of output.[2] In particular, lower expenditure on labour may be partly offset by higher expenditure on other inputs required to deploy AI, including computing services and energy As AI becomes a more important input into production, unit labour costs may therefore become a less reliable indicator of underlying cost pressures.

Figure 1: Euro area HICP energy inflation, year on year, 2024 2026



Note: The shaded period marks the onset of the Middle East war and the closure of the Strait of Hormuz, the confirmed driver of the spike (Arce et al. (2026)); it is not evidence of the AI energy demand channel. Source: author's calculations from FRED series ENRGY0EZ19M086NEST (source: Eurostat).

Recent euro area energy developments illustrate the importance of distinguishing AI-related pressures from unrelated shocks. HICP energy inflation rose from 3.1% in February 2026 to 10.9% in May (Figure 1), but the ECB attributed the increase to the renewed war in the Middle East and the closure of the Strait of Hormuz rather than to AI-related electricity demand (Arce et al., 2026). The scale of the AI-energy channel estimated above is too small to account for this increase.

Independent survey evidence points in the same direction. Consensus Economics (2026) tracks a monthly panel of professional forecasters for the euro area. Between the March and June 2026 survey vintages—the period in which the Middle East war escalated—the consensus forecast for 2026 shifted sharply in a stagflationary direction: expected GDP growth fell from 1.19% to 0.59%, expected gross fixed capital formation growth fell from 2.16% to 1.39%, headline consumer price inflation rose from 2.06% to 2.94%, core HICP inflation (i.e. excluding energy and food) rose from 2.08% to 2.38%, and the expected ten year German government bond yield rose from 2.80% to 3.03% (Table 1). A supply side AI narrative, disinflationary and growth supportive, would not produce this pattern; an adverse oil supply shock would, and does.

[2] For a cost minimising firm with constant returns to scale and competitive input markets, unit labour costs are equal to $WL/Y = s_L MC$ where s_L is labour's cost share and MC is marginal cost. Hence, a reduction in s_L can drive down unit labour costs over and above the reduction in marginal cost that matter for prices. As production becomes more AI intensive, changes in unit labour costs may consequently reflect changes in input composition as well as changes in the marginal cost relevant for pricing.

Table 1: Consensus Economics survey revisions for 2026, before and after the energy shock

2026 forecast (Consensus mean)	March 2026	June 2026	Change
GDP growth (%)	1.19	0.59	-0.60 pp
Gross fixed capital formation growth (%)	2.16	1.39	-0.77 pp
Headline consumer price inflation (%)	2.06	2.94	+0.88 pp
Core HICP inflation (%)	2.08	2.38	+0.30 pp
10 year German government bond yield (%)	2.80	3.03	+0.23 pp

Source: Consensus Economics

2.2. The Demand Side

On the demand side, it is useful to distinguish effects on consumer spending, business investment, and the external sector. The effect on household demand depends partly on how the gains from AI are distributed. Labour-augmenting AI may support wages and employment, strengthening consumption, whereas labour-saving AI may shift a larger share of the gains towards capital owners and generate a weaker consumption response.

Among studies emphasising the potential for job displacement, a 2024 IMF study estimates that almost 40% of global employment is exposed to AI, rising to roughly 60% in advanced economies where cognitive task intensive occupations predominate. In this perspective, the euro area's services heavy, cognitive intensive labour market would be more exposed than average. Early evidence hints at potentially more benign effects on employment. Firm level evidence finds that AI adoption by EU firms has so far produced roughly a 4% productivity increase through capital deepening, with no detectable adverse effect on employment (Aldasoro et al., 2026; Ferrando et al., 2026; Lane, 2026).

On consumer spending side, as for supply side effects, there are differences between short run and medium run effects. A standard argument is that when consumers anticipate future productivity improvements in the economy, they expect future income increases and this can generate a consumption boom before the supply side gains materialise. The ECB's own analysis argues that this channel is likely to be weak in practice: households cannot know the size, timing, or persistence of AI driven income gains with precision, and the more realistic behavioural response, gradual learning about the income effects of AI combined with habit formation in consumption, diminishes the upfront inflationary effect (Lane, 2026). The strength of this channel nevertheless depends on how quickly households revise expectations about AI-related income gains, which remain highly uncertain.

A specific form of the anticipation channel may operate through financial markets. Optimistic expectations on future earnings are contributing to the sustained increase in technology stock valuations, which contribute to consumer spending through a wealth effect. The same channel may also operate in the euro area: US equities account for around one-third of euro-area households' direct and indirect equity holdings, and their holdings of US high tech equities amount to around €400 billion (ECB, 2026).

Turning to business investment, integrating AI into production requires substantial upfront capital expenditure on compute infrastructure, data centres, software, and organisational restructuring. This investment is itself a demand side impulse, and its scale and timing matter for the near-term inflation outlook independently of any eventual supply side payoff. The scale of this investment impulse is likely

to differ across economies; Section 2.4 examines why it may currently be smaller in the euro area than in the United States.

The third one is an open economy mechanism. If higher productivity materialises predominantly in AI producing regions rather than in AI using ones, the standard prediction is that AI using regions such as the euro area should see lower domestic investment and higher domestic savings, generating a larger current account surplus and net financial outflows (Lane, 2026). However, the geographic concentration of AI also has implications for competitiveness. The Draghi report attributed roughly 70% of the EU's per capita GDP gap with the United States to lower productivity growth of in the European information and communications technology sectors (ICT) (Draghi, 2024; Lane, 2026). AI could reinforce this gap if firm-level adoption in the euro area continues to lag behind the United States. The challenge is not exclusively transatlantic: China is already a major producer of AI technologies and is investing heavily in their development and deployment. Europe therefore faces a competitiveness challenge relative to both the United States and China, although the nature of the gap differs across the two economies.

2.3. Under what conditions is AI inflationary versus disinflationary?

The inflation effects of AI are likely to vary over time. As discussed above, investment demand and capacity constraints may precede economy wide productivity gains, making the transition temporarily inflationary even if AI eventually lowers production costs. Relative price changes at either stage should be distinguished from persistent aggregate inflation. The overall effect depends on the speed, depth and composition of AI diffusion, and on the relative response of productive capacity and nominal demand. AI is more likely to be disinflationary when productivity gains spread beyond frontier firms and outpace the associated increase in nominal demand, input supply adjusts without major bottlenecks, and lower marginal costs are passed through to prices rather than absorbed into higher markups. This would be particularly relevant in services, where much of euro area inflation persistence has historically been concentrated.

AI is more likely to be inflationary during the transition when investment demand expands faster than productive capacity; energy, compute, construction or skilled labour constraints bind; wages rise in anticipation of productivity gains that have not yet materialised; or cost shocks propagate into margins, wages and inflation expectations. A rapid increase in consumption based on expected future income could reinforce these pressures, although uncertainty about the size and distribution of AI related gains makes a large anticipatory consumption boom less likely. The distinction between labour augmenting and labour substituting AI does not by itself determine the sign of the inflation effect. Labour augmentation may raise both productive capacity and household income, while labour substitution may increase productive capacity but weaken consumption by shifting income away from workers.

In each case, the outcome depends on the relative responses of productive capacity and nominal demand. Available estimates illustrate the uncertainty rather than establish a single central effect. Acemoglu (2025) provides a comparatively conservative estimate, placing cumulative Total Factor Productivity (TFP)[3] gains from current generation AI at no more than 0.66% over ten years and at approximately 0.53% when differences between easier and harder to automate tasks are incorporated. ECB staff scenarios imply larger, but still moderate, effects: approximately 0.2 percentage points of additional annual TFP growth under slow diffusion and 0.3–0.4 percentage points under faster diffusion (Lane, 2026). The above estimates are more moderate than some early assessments. Goldman Sachs (2023) estimated that widespread generative AI adoption could raise global GDP by around 7% over a

[3] TFP measures how efficiently labour and capital are combined to produce economic output.Strictly speaking, TFP also captures factors not directly explained by labour and capital, such as technology, management and institutions.

decade and increase annual productivity growth by 1.5 percentage points, while McKinsey Global Institute (2023) estimated that generative AI could add 0.1–0.6 percentage points to annual productivity growth through 2040, rising to 0.5–3.4 percentage points when combined with other automation technologies. These figures are not directly comparable, as they measure different concepts including GDP and TFP, over different horizons and under different assumptions about adoption and diffusion.

Taken together, the estimates imply a wide range of possible productivity outcomes rather than a precise inflation forecast. The IMF's April 2026 "runaway diffusion" scenario illustrates a qualitatively different case, based on much faster and more extensive AI adoption. Rapid, economy-wide automation expands productive capacity, while labour displacement weakens household consumption, making the net inflation effect ambiguous and reducing the information content of traditional slack indicators (Barhoumi et al., 2026). This exercise considers a hypothetical case of rapid and transformative AI adoption to assess its macroeconomic consequences, rather than as a forecast of the likely path of AI diffusion. Given the still limited integration of AI within firms, the scenario is therefore more relevant for stress testing and scenario analysis than for the central forecast.

On balance, our central assessment is that AI will exert modest disinflationary pressure in the euro area over the next five to ten years, as productivity gains and lower unit costs gradually broaden across firms and sectors. Confidence in this directional assessment is low, however, because the timing of the supply and demand effects is uncertain. In particular, the transition could be inflationary if investment demand and capacity pressures materialise before economy-wide productivity gains. The effect should therefore be treated as modest, delayed and highly state-contingent, rather than as a near-term offset to realised inflation. The practical implication is that the ECB should not look through realised inflation on the assumption that an AI productivity dividend is imminent. AI related supply gains should enter the policy assessment as they become visible in the breadth of firm level integration, sectoral productivity, marginal costs and final prices. Transitional inflation risks should similarly be assessed through investment, wages, margins and capacity bottlenecks. If AI were to materially alter the medium-term inflation outlook, an appropriate ECB response should limit its effect on persistent inflation. Part of the longer run adjustment would therefore appear in interest rates, output and relative prices rather than in a permanently different inflation rate.

Table 2 summarises the demand and supply effects of AI, their impact on inflation and the conditions and indicators to monitor.

Table 2: The supply and demand effect of AI and their impact on inflation.

Channel	Main mechanism	Impact on inflation	Conditions and indicators to monitor
Supply: productivity and marginal costs	AI creates a new input, machine intelligence, that can complement or substitute workers. As its quality-adjusted price falls, firms can reorganise production and lower costs.	Mainly disinflationary after productivity gains spread beyond frontier firms and are passed through to prices.	Firm-level integration; sectoral productivity; marginal costs; unit labour costs; services inflation; pass-through to final prices.
Supply: complementary inputs and bottlenecks	AI deployment raises demand for electricity, chips, data centers, grid connections, software, skilled labour and organisational capital before supply capacity fully adjusts.	Potentially inflationary during the transition, even if eventually the productivity effect dominates.	Data centers investment; electricity and gas prices; compute capacity; construction costs; skilled-labour shortages; energy bottlenecks.
Supply: measurement and cost diagnostics	AI may generate quality-adjusted price declines that inflation statistics capture imperfectly. Unit labour costs may also become less informative when firms substitute towards AI services and energy-intensive inputs.	Ambiguous for measured inflation: true cost reductions may be understated, while conventional cost indicators may not anticipate disinflationary pressure.	Quality adjustment in services; labour cost shares; non-labour input costs; margins; direct measures of marginal costs and pricing behaviour.
Demand: household income and consumption	Labour-augmenting AI may raise wages and employment. Labour-saving AI may shift income towards capital owners with lower propensities to consume. Expectations of future income gains may also affect spending.	Inflationary if expected income gains and labour demand strengthen consumption; weaker or disinflationary if labour displacement reduces household income.	Wages and employment in AI-exposed occupations; household expectations; consumption growth; distribution of AI-related income between labour and capital.
Demand: business investment	AI adoption requires upfront spending on compute infrastructure, data centers, software, data preparation, cybersecurity, training and organisational restructuring.	Inflationary in the short run if investment demand rises faster than productive capacity; disinflationary later if investment generates broad productivity gains.	Digital and intangible investment; AI-related capital expenditure; data centers construction; financing conditions; adoption by smaller and non-frontier firms.
External sector and production geography	Frontier AI production and upstream capital expenditure remain concentrated outside the euro area. Europe may import AI services while specialising more in applications and adoption.	Ambigous. Imported AI can be disinflationary if access is competitive, but inflationary pressures may arise through supplier power, access restrictions to AI priced in US dollars and increased global demand for energy and semiconductors.	Geography and ownership of AI activity; cloud and compute prices; euro-dollar exchange rate; imported IP payments; exposure to US and Chinese AI cycles.

Source: Authors' elaboration.

2.4. AI Production, Adoption and Regional Inflation

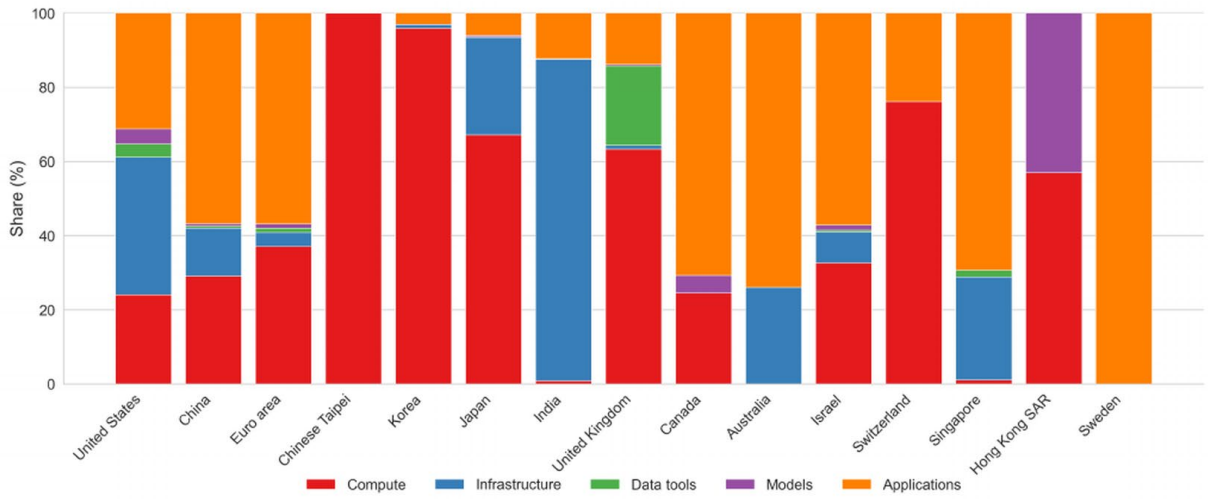
The AI supply chain is concentrated largely outside Europe. With the important exception of ASML based in the Netherlands, most large firms operating in frontier chip design, semiconductor fabrication, hyperscale cloud services and frontier AI models are based in the United States, China, Taiwan and South Korea (Lane, 2026). ASML illustrates both Europe's strategic importance and the limited breadth of its AI production base. As the sole global supplier of the extreme ultraviolet lithography equipment required to manufacture frontier chips, it occupies a critical position in the global supply chain. As of September 2026, its market capitalisation was approximately USD 680 billion, still below that of any individual member of the group of large US technology firms commonly referred to as the "Magnificent Seven", whose combined market capitalisation was approximately USD 24 trillion. ASML sells mainly to semiconductor foundries in Taiwan, South Korea and, increasingly, the United States rather than to

European frontier chip producers. Europe's position in advanced lithography therefore does not translate into a comparably broad domestic AI production base. Producing frontier AI domestically is not necessary to benefit from its productivity effects: European firms can adopt technologies developed elsewhere if they have competitive access and the complementary capabilities required to deploy them. Production location nevertheless matters for where investment, profits, intellectual-property income and knowledge spillovers accrue. The macroeconomic consequences therefore depend on both where AI is produced and where it is successfully adopted.

2.4.1. The AI supply chain and Europe's position

Rishabh and Shreeti (2026) divide AI producing firms into five layers: compute, cloud and related infrastructure, data tools, AI models and AI applications. This classification is useful for macroeconomic analysis because the different layers generate distinct forms of investment, income and cost pressure. The United States and China dominate both the number and valuation of AI producing firms, while the euro area is more specialised in applications. The scale of this difference is substantial: their database identifies 59 AI-producing firms in the euro area, compared with nearly 700 in the United States and around 250 in China. AI firms also accounted for 23% of total US corporate capital expenditure in 2024, compared with less than 5% in the euro area and each of the other economies considered apart from Korea. Figure 2 shows that differences also extend to the composition of AI activity: euro area AI firm valuation is concentrated mainly in applications, while the United States has a more diversified presence across the supply chain.

Figure 2: Composition of AI firm valuation across the supply chain, 2025



Source: Authors' adaptation based on Rishabh and Shreeti (2026), using PitchBook data. Notes:Shares show the distribution of AI firm valuations across compute, cloud and related infrastructure, data tools, AI models and AI applications. Euro area countries are pooled into a single observation.

Europe should not, however, be described simply as an AI consumer. Firms developing industrial, medical, financial or legal applications are themselves part of the AI production ecosystem. Moreover, specialisation in applications is not necessarily a disadvantage. A substantial part of the productivity effect of AI is likely to arise from its integration into existing industries rather than from frontier model development alone.

The distinction between upstream and downstream activities nevertheless has macroeconomic consequences. Semiconductors, data centres, cloud infrastructure and frontier models require large capital outlays, specialised labour and energy infrastructure. They also generate substantial profits and intellectual property income. Application development relies more heavily on sector specific

knowledge, proprietary data, software integration and organisational change. Economies hosting upstream production are therefore more likely to experience an early infrastructure investment cycle, whereas economies specialising in adoption may face a smaller upstream boom but still require considerable downstream investment.

2.4.2. What producing AI adds beyond access

Production may also generate stronger local knowledge spillovers. Researchers, suppliers and specialised firms interact within domestic innovation ecosystems, facilitating learning and adaptation that are only partly embodied in internationally traded AI services (Cohen & Levinthal, 1990; Jaffe et al., 1993). These spillovers provide a possible advantage to producer economies, although their scale is difficult to measure and should not be assumed to arise automatically from the presence of AI firms.

The Bank for International Settlements (BIS) dataset also documents a strong domestic concentration in AI investment: US and Chinese AI firms direct 64% and 74% of investment deals respectively towards domestic targets, which may reinforce local innovation ecosystems and complementary investment (Rishabh & Shreeti, 2026). These figures are consistent with home bias, but they also reflect the greater number of domestic AI firms we cited above and investment opportunities in the United States and China. They should therefore not be interpreted as a pure measure of investor preference for domestic firms.

Finally, domestic production can improve resilience by reducing exposure to supplier markups, export controls, semiconductor shortages and geopolitical fragmentation. The benefit is greatest in parts of the supply chain where concentration is high, switching is costly, and alternative suppliers cannot be developed quickly. This does not imply that Europe should replicate every layer of the AI supply chain domestically. Rather, policymakers should identify those segments where concentration and switching costs create material risks to access, prices or strategic dependence.

2.4.3. Adoption and complementary investment

Equal access to AI does not guarantee equal productivity. Realised gains depend on firms' absorptive capacity: management quality, workforce skills, data readiness, digital infrastructure, organisational flexibility and access to finance (Cohen & Levinthal, 1990).

This distinction helps explain current evidence for the euro area. Although around two thirds of firms report some employee use of AI, only 7% report significant use, indicating that integration within firms remains limited (Lane, 2026). Firm wide adoption requires integration with internal data and business processes, workforce training and organisational change. The gap between widespread employee use and limited firm level deployment therefore indicates that diffusion remains shallow at the organisational level. It does not establish whether access to AI is adequate, competitively priced or comparable across firms and Member States.

These complementary investments are largely intangible and often difficult to finance through traditional bank lending. The BIS finds that venture capital activity is strongly associated with AI firm density, which is consistent with a role for financial market development in supporting AI production and adoption (Rishabh & Shreeti, 2026). The association should not be interpreted as establishing causality: venture capital may be attracted to economies that already have stronger AI ecosystems, while those ecosystems may themselves benefit from better access to risk capital.

Europe's productivity challenge is therefore not simply that frontier models are developed abroad, but that firms may invest too slowly in the complementary assets required to deploy them effectively. This

problem is likely to be most acute among smaller firms, for which the fixed costs of data preparation, integration, cybersecurity and training are relatively high.

Recent evidence further suggests that successful AI adoption may itself foster domestic AI production. Bena et al. (2026) find that industries more exposed to generative AI experience higher rates of new business formation, with many entrants developing AI products rather than merely adopting existing technologies. The evidence suggests that complementary investment in skills, finance and organisational capabilities may strengthen not only productivity but also Europe's future AI ecosystem. The result should nevertheless be interpreted cautiously, because industries with greater AI exposure may differ in other ways that also encourage business formation and innovation.

2.4.4. Consequences for regional inflation

Production location changes the regional balance between the demand and supply effects of AI. Economies hosting frontier AI production are more likely to experience an early demand impulse from semiconductor capacity, data centres, electricity networks and specialised labour markets. Because these investments precede the full productivity gains, they can temporarily raise inflation through construction, energy and labour market bottlenecks.

An economy importing competitively priced AI may avoid much of this upstream investment boom while still benefiting from user side productivity gains. European firms could therefore lower unit labour costs without generating the same domestic pressure on construction, electricity demand and specialised labour as in the United States. Under this configuration, AI would be less inflationary in the euro area during the adoption phase. This conclusion is conditional: broad downstream adoption could itself generate a meaningful domestic investment impulse, although current euro-area investment patterns make a boom comparable to that in the United States less likely in the near term.Foreign AI production is more likely to generate inflationary pressure for Europe when concentration interacts with supplier market power, exchange rate movements, restrictions on access to frontier technologies[4] or disruptions to global supply chains. Foreign AI investment may also affect euro area inflation through stronger global demand for energy, semiconductors and other inputs, even without a disruption to supply.

Exchange rates provide another channel through which the uneven geography of AI could affect euro area inflation. If AI-related investment and productivity gains strengthened US growth prospects relative to those of the euro area, international capital flows and the associated monetary-policy response could put downward pressure on the euro. Because many AI services, cloud contracts and compute resources are priced internationally in US dollars, a weaker euro would increase the domestic-currency cost of AI adoption even if their dollar prices remained unchanged. The inflation effect ultimately depends on whether these imported cost pressures and domestic investment constraints outweigh the productivity gains from adoption, and on the extent to which higher costs pass through to final prices. The ECB should distinguish temporary relative-price changes from pressures that propagate into underlying inflation through wages, margins and expectations.

[4] Cross-border access to frontier AI may also be affected by national-security policy. In June 2026, restrictions temporarily limited foreign nationals' access to Anthropic's Fable 5 and Mythos 5 models before being subsequently relaxed, illustrating how policy decisions can affect the international availability of advanced AI technologies (Anthropic, 2026a, 2026b).

3. AI AND THE ECB REACTION FUNCTION

In the canonical representation of the monetary policy reaction function, the central bank adjusts the policy rate in response to deviations of inflation from its target and output from potential. In the original Taylor rule, the nominal policy rate responds to contemporaneous inflation and the output gap, while the intercept, i.e. the equilibrium interest rate when inflation is at its target and output is at its potential level, can be interpreted as the sum of target inflation and the equilibrium real interest rate, the natural rate of interest, R* (Taylor, 1993). In this simplified setting, a real policy rate above R* is contractionary, while one below R* is expansionary. In practice, the monetary policy stance also depends on the expected path of interest rates, risk premia, credit conditions, and the strength of monetary policy transmission. Because monetary policy affects the economy with lags, forward looking reaction functions allow the policy rate to respond to expected inflation and economic slack rather than only to their current values (Clarida et al., 1998).

The informational problem for the central bank is therefore twofold: it must estimate the unobservable natural rate of interest and potential output, and it must extract signals about future inflationary pressure from imperfect and noisy indicators. AI can affect both sides of this problem. First, by changing productivity growth, investment demand, labour market structure and capital flows, AI may shift R*. Second, by altering the relationship between output, employment, wages, marginal costs and prices, AI may reduce the reliability of traditional slack indicators. As a result, the central bank may face greater uncertainty both about the neutral policy stance and about the correct interpretation of incoming macroeconomic data. The main issue is therefore not whether the ECB should respond directly to AI adoption, but whether AI changes the variables and relationships used to assess inflationary pressure and calibrate policy.

3.1. Implications of AI for the Natural Rate of Interest, R*

AI may affect it through productivity, investment, expected income, income distribution and cross border capital flows. Because these channels can offset one another, the current evidence does not support a fixed directional adjustment to euro area R*.

3.1.1. Productivity and investment

The conventional starting point is the distinction between a productivity level effect and a productivity growth effect (see, for example, Ambrosini et al.(2026)). If AI follows the S shaped diffusion-path of earlier technologies, initially growing in divergent way and then settling to a convergent pattern, investment and adoption may accelerate temporarily before eventually plateauing. Productivity would settle at a higher level, while its long run growth rate would return towards its previous trend. In this case, R* could rise during the investment intensive transition before gradually returning towards its previous level. If AI instead permanently improves the process of innovation, it could raise the long run growth rate of productivity. Faster expected income and consumption growth would then support a persistently higher natural rate. The available evidence does not yet distinguish between these possibilities, making the persistence of AI driven productivity gains one of the central uncertainties for monetary policy. The ECB's current estimates likewise do not identify a material AI related movement in euro area R*. The range reviewed in this report (Brand et al.(2025)) extends from approximately -0.25% to 0.75%, with the recent increase in some upper range estimates attributed primarily to higher long term market rates and fiscal policy expectations rather than to AI. Accordingly, the relevant policy question is not whether AI has already shifted the natural rate, but whether future productivity gains prove sufficiently persistent to alter its long run trajectory.

3.1.2. Production geography and relative R*

The distinction between AI production and adoption matters because investment in these activities is distributed differently across economies. Economies that host AI production are more likely to attract investment in semiconductors, cloud infrastructure, data centres and frontier models. The domestic concentration of investment documented by the BIS suggests that a substantial share of this expenditure may remain within the existing US and Chinese AI ecosystems (Rishabh & Shreeti, 2026). Other things being equal, this would generate stronger domestic investment demand and could place greater upward pressure on R* in those economies.

This does not imply that R* in the euro area would decline or remain unchanged. European firms still require substantial complementary investment to deploy effectively the AI developed elsewhere. A transition from experimental use to deep integration at the firm level could therefore generate a meaningful domestic investment cycle, even if frontier AI production remains concentrated abroad. Differences in pressures on R* therefore depend both on the location of AI production and on the scale of complementary investment associated with adoption.

Based on current investment patterns, AI appears likely to generate stronger domestic upward pressure on R* in the United States than in the euro area. This comparison remains uncertain, however, because national natural rates are not determined in isolation. International capital market integration can transmit higher returns and financing demands from producer economies to interest rates in the euro area, even when the underlying investment takes place abroad. Whether AI produces a persistent difference between the natural rates of the United States and the euro area will therefore depend on the strength of complementary investment in Europe, cross border capital flows and the transmission of global financial conditions. The relevant policy question is not simply whether AI widens the estimated gap between the natural rates of the United States and the euro area, but whether that difference materially changes equilibrium financing conditions in the euro area.

3.1.3. Income, saving and adoption

Adoption of foreign produced AI may raise productivity in the euro area, while payments to foreign providers reduce the share of the resulting income retained domestically. Cross border ownership may offset part of this effect. The implications for R* depend on who receives the income and whether it is consumed, saved or reinvested.

The distribution of AI gains within the economy is equally important. Under the mechanism proposed by Fornaro and Wolf (2026), automation may shift income from labour towards capital owners with a higher propensity to save. If AI primarily substitutes for labour, higher desired saving and weaker household consumption may place downward pressure on R*. Conversely, if AI complements labour and productivity gains are reflected in wages and employment, it may strengthen domestic demand and place upward pressure on the natural rate. The outcome will depend on how productivity gains are distributed and on the response of consumption, investment and fiscal policy. Finally, adoption speed influences the magnitude and timing of these effects. Slower diffusion would initially limit complementary investment, expected income growth and productivity improvements, reducing one possible source of upward pressure on R*. Its overall effect is nevertheless ambiguous, since slower automation may also limit labour displacement, precautionary saving and downward pressure on household consumption. Europe's capacity to adopt and integrate AI is therefore an important determinant of its effect on R*, but it must be considered together with the ownership and distribution of the income generated by that adoption.

3.1.4. Slack indicators and diagnostic complications

A further concern, and a central theme of the IMF's analysis (Barhoumi et al., 2026), is whether AI weakens traditional indicators of economic slack as guides to underlying price pressure. The relevant indicators include unemployment, the output gap and capacity utilisation. The mechanism is not limited to labour substitution. AI may change labour requirements, raise productive capacity, alter the composition of skills demanded and create new constraints in areas such as specialised labour, data, compute capacity and electricity. As a result, unemployment could rise even while particular sectors face capacity constraints and price pressure. Conversely, strong employment could coexist with an expansion of productive capacity that reduces inflationary pressure. AI may also make estimates of the output gap less reliable because potential output is not directly observed and productivity gains may appear in the data only gradually. If the increase in potential output is underestimated, monetary policy may respond too strongly to growth that is mistakenly interpreted as excess demand. If it is overestimated, policy may remain too accommodative and allow inflationary pressure to persist. Traditional slack indicators would therefore remain relevant, but the ECB may need to complement them with a broader analytical toolkit that better captures emerging trends in productivity, wages, sectoral bottlenecks and AI adoption.

3.1.5. Assessment for the ECB

The analysis does not support a predetermined upward or downward adjustment to R*in the euro area. The effect will depend on the interaction between productivity, investment, income distribution, saving and international capital flows. These channels can be organised into three possible scenarios.

In an investment led configuration, rapid adoption and substantial expenditure on complementary investment would strengthen demand for investment and place upward pressure on R*. This pressure would be more persistent if AI raised the growth rate of productivity rather than only its level. Under gradual adoption, productivity gains and complementary investment would emerge slowly. The effect on R* would probably remain limited, particularly if a significant share of expenditure and income continued to accrue to foreign technology providers. In a configuration dominated by labour displacement, productivity could rise while labour income and household consumption weakened. If the resulting income accrued mainly to capital owners with a greater propensity to save, desired saving could increase and place downward pressure on R*, even in the presence of stronger productivity.
Current investment patterns suggest that domestic upward pressure may initially be stronger in the United States, where more investment in AI production is concentrated. This comparison remains conditional because complementary investment in Europe and international capital flows may transmit part of the effect to financing conditions in the euro area.

Revisions to expected AI returns may also increase uncertainty around R* by producing large changes in investment and financial conditions. In this environment, the uncertainty surrounding estimates of the natural rate may be more relevant for policy than small changes in their central values.
The ECB should therefore incorporate AI into its assessment of R* through scenario analysis and observed data rather than through a predetermined adjustment to the natural rate. The ECB should assess whether observed developments in productivity, saving and investment indicate a persistent change in R*. Section 5 describes the indicators required for this assessment.

4. MONETARY POLICY TRANSMISSION UNDER AI DIFFUSION

Monetary policy is transmitted to the real economy through several channels, including labour market adjustment, bank lending, asset prices and financial market expectations. AI diffusion may affect each of these channels. It can change the relationship between wages and labour market slack, alter firms' pricing and investment behaviour, shift the composition of corporate finance and make financial conditions in the euro area more sensitive to global technology valuations. This does not imply that monetary policy transmission will necessarily become weaker. AI may instead make its strength and speed less uniform across firms, sectors and phases of the economic cycle, while reducing the information provided by aggregate indicators.

A first channel operates through the labour market. Where AI can substitute for labour, the possibility of automation may weaken workers' bargaining power, particularly in occupations containing routine and codifiable tasks. Barhoumi et al. (2026) identify this as one mechanism through which AI could weaken monetary policy transmission in the labour market. The effect is likely to differ across workers and sectors. It may be stronger in routine cognitive occupations and weaker in jobs that depend on physical presence, interpersonal interaction or complex judgement. Aggregate relationships between wages and labour market slack may therefore become less informative unless they are supplemented with indicators of AI exposure across occupations, sectors and tasks.

The employment effects of AI nevertheless remain uncertain. Survey evidence for the euro area does not yet indicate a clear negative effect on aggregate employment. According to the SAFE survey[5], AI use has so far been broadly neutral for employment, with more positive outcomes among firms where adoption is intensive and directed towards research and development (Lane, 2026). Evidence for the United States is also mixed. Massenkoff and McCrory (2026), as discussed in Lane (2026), find no systematic increase in unemployment among highly exposed workers since the emergence of generative AI in late 2022, although they find suggestive evidence of slower hiring among younger workers in more exposed occupations. These findings do not establish that AI will have no adverse employment effects. They indicate only that displacement has not yet appeared clearly in aggregate data. Effects on occupations, sectors and age groups may become visible before any change in total employment.

A second channel concerns firms' price setting behaviour. AI can allow firms to process information on demand, inventories, competitors and costs more rapidly. This may accelerate price adjustment and shorten the time between changes in demand conditions and changes in prices. Whether this strengthens monetary policy transmission depends on how firms use the technology and on the degree of competition in the relevant market. AI supported pricing may also allow firms to use market power more effectively, particularly in concentrated sectors. Algorithmic pricing could facilitate coordination or allow firms to adjust margins strategically. ECB staff analysis discussed by Lane (2026) suggests that the use of pricing algorithms in banking may be associated with wider lending margins where competition is limited. This evidence concerns a specific sector and does not establish that the same effect will arise throughout the economy. It nevertheless cautions against treating the use of AI in pricing as necessarily disinflationary or as automatically strengthening monetary policy transmission.

A third channel operates through corporate finance. Firms with high levels of AI activity increasingly use finance from capital markets and hold larger cash buffers, while bank lending growth to sectors

[5] SAFE is the ECB's Survey on the Access to Finance of Enterprises. It collects firm-level information on firms' financing conditions, financial situation and expectations about prices, costs, employment and inflation, with results broken down by firm size, sector and country.

with high AI activity has been comparatively subdued (Lane, 2026). These patterns are consistent with a change in financing behaviour, although they do not establish that AI activity itself caused the change. If firms undertaking the largest AI investments rely more on bond markets, equity issuance, retained earnings or accumulated liquidity, the bank lending channel may become less representative of aggregate investment. Monetary policy would still affect these firms through market interest rates, asset valuations, discount rates and risk premia. However, the direct effect of policy rates on the supply of bank credit could become less important for the part of the corporate sector responsible for a large share of AI investment.

AI may also increase the importance of asset prices and financial market expectations in monetary policy transmission. Since 2023, AI related valuations have accounted for a substantial part of US equity market performance and have been concentrated among a small number of large technology firms. Direct exposure in the euro area is smaller but has increased through holdings of US technology shares and through the influence of global market sentiment on risk appetite. As a result, financial conditions in the euro area may become more sensitive to expectations concerning the profitability of US technology firms and the longer-term productivity effects of AI. This channel lies partly outside the ECB's direct influence and can operate through equity prices, risk premia, exchange rates, investment and trade.

A substantial downward revision in expected AI returns could reduce equity valuations, increase risk premia and cause firms to postpone investment. The effects could spread to semiconductor producers, data centre operators, energy infrastructure providers and other suppliers. They could reach the euro area through European investors' exposure to US assets, tighter global financial conditions and weaker demand for European firms connected to the AI investment cycle. Lower equity valuations could also reduce household wealth and consumption, although this channel is likely to be stronger in the United States, where household exposure to equity markets is greater. In an adverse scenario, weaker investment, tighter financing conditions and negative wealth effects could reinforce one another and turn a market correction into a broader slowdown. Recent volatility shows that AI related valuations are sensitive to changing expectations, but it does not demonstrate that a wider correction is under way.

Overall, AI diffusion could make monetary policy transmission more dependent on economic and financial conditions by changing how wages, credit, investment and asset prices respond to policy rates. During an AI investment boom, high equity valuations, low risk premia and expectations of strong profitability may sustain investment and partly offset the effects of monetary tightening. Conversely, a reassessment of AI profitability could amplify monetary tightening through falling asset prices, rising risk premia and weaker investment. If AI also changes workers' bargaining power, firms' pricing practices or their reliance on bank finance, established relationships used to assess monetary transmission may become less stable.

The ECB should therefore distinguish changes in financial conditions caused by domestic monetary policy from those originating in global AI valuation cycles. It should monitor AI not only as a possible influence on inflation and R*, but also as a factor that may change the speed, strength and distribution of monetary policy transmission. Traditional indicators would therefore be associated with a broader analytical toolkit to capture emerging trends, and monitor the stability of monetary policy transmission under the diffusion of AI. The relevant indicators include firm level significant AI use, employee level use, digital and intangible investment, AI related patenting, investment in data centers and electricity demand, intellectual property import payments, occupational exposure, wage developments in AI intensive sectors, and the exposure of banks and non-bank financial institutions to AI related assets.

5. IMPLICATIONS FOR THE ECB'S ANALYTICAL TOOLKIT AND FRAMEWORK

The required changes to the ECB's toolkit are material but not structural. The ECB does not need a new monetary policy framework to handle the AI transition at this stage. It needs a more explicit AI specific layer inside tools it already possesses. The 2% medium term inflation target, data dependent calibration, a risk management orientation to policy, and the two-pillar economic and monetary financial analysis framework remain fit for purpose. However, uncertainty about the speed and consequences of AI diffusion strengthens the case for scenario analysis and for additional indicators where conventional signals become less reliable, as emphasised by Barhoumi et al. (2026). This would build on practices already used by the ECB. Since 2022, ECB staff projections have included alternative inflation scenarios, while estimates of R* are reported as ranges derived from several methods rather than as a single point estimate. The ECB also uses machine learning tools in forecasting, including quantile regression forests for inflation density forecasts and text mining of news sources to measure attention to inflation (Lane, 2026). The proposed adjustment would therefore extend existing practices rather than replace them. The framework proposed by Barhoumi et al. (2026) contrasts gradual diffusion with a much more rapid diffusion path. For the euro area, an intermediate scenario is also useful. The resulting three scenarios are not forecasts. They illustrate how the economic consequences of AI could change as adoption deepens and help identify the evidence that would distinguish one path from another.

The gradual diffusion scenario is closest to the euro area's present position. As documented in Section 2, employee use is increasing, but significant integration within firms remains limited. Under this scenario, the effects on productivity, demand and inflation would remain modest relative to other macroeconomic forces over the policy horizon. Existing forecasting tools would remain broadly adequate, although indicators of adoption and complementary investment should be monitored. AI would be treated as one structural influence on the projections rather than as a separate policy variable. Under the moderate diffusion scenario, adoption in the euro area would deepen and move closer to the intensity observed in the United States without necessarily reaching it. This is a plausible medium-term path, but it should not be described as a forecast or assigned a precise probability. Productivity gains and complementary investment would become more visible. Consistent with the assessment in Section 2.3, the central expectation would be modest disinflationary pressure, although confidence in both its size and direction would remain low. The effect on R* would remain uncertain. The ECB would need to assess incoming evidence on adoption, digital investment, productivity, wages and saving rather than assume either an inflationary or a disinflationary effect.

Under the rapid diffusion scenario, adoption would accelerate across sectors with relatively limited institutional or organisational obstacles. Demand from investment, energy and specialised labour could increase before the full productivity gains appeared. At the same time, automation and lower production costs could place downward pressure on wages or prices in exposed sectors. The coexistence of these forces could make aggregate inflation signals harder to interpret, as demand-side and supply-side effects have an opposite impact on inflation.

Given the limited evidence of deep adoption in the euro area, this scenario is more appropriate for stress testing than for the central projection. The ECB should identify in advance the evidence that would indicate movement towards the rapid scenario. Relevant signs would include a sharp increase in significant adoption at the firm level, a broadening of AI investment beyond the largest technology firms and a marked acceleration in electricity demand associated with data centres and compute infrastructure.

Scenario analysis allows the joint evaluation of the path of monetary policy and macroeconomic outcomes under the different scenarios, but it has inherent limitations due to the fact that scenarios are typically constructed and assessed outside a coherent probabilistic framework (Adrian et al., 2025). Whenever a scenario is simulated, there is a key question: which is the probability that the policy maker attaches to the scenario? This key question is left virtually unanswered in the standard scenario-based approach. As a result, while such scenarios are useful for structuring discussion and stimulating judgment, they provide little guidance on their relative plausibility, their contribution to overall risk, or the extent to which they collectively capture the uncertainty implied by the data.

A first consequence of this informality is that scenarios tend to be only modest perturbations of the baseline. Because they are usually designed to be plausible and communicable, extreme but statistically relevant tail risks are often underrepresented. (Adrian et al., 2025) document that scenario sets used in policy institutions frequently cluster around the central forecast and fail to reflect the fat tails or multimodality present in statistical risk models such as Growth-at-Risk distributions (Adrian et al., 2019). This can lead to a systematic understatement of downside risks, particularly in periods of heightened uncertainty or structural change, like the ones potentially induced by AI when historical regularities are less informative, and the true distribution of outcomes may be highly asymmetric or heavy-tailed.

A second limitation is that informal scenarios cannot be rigorously compared either with one another or with statistical forecasts. Without an explicit probabilistic structure, it is impossible to assess whether a given scenario is broadly consistent with the distribution implied by a reference model, or whether it represents an implausible or internally inconsistent configuration of outcomes. This lack of comparability makes it difficult to evaluate scenario set completeness, that is, whether the collection of baseline and alternative scenarios spans the relevant space of risks identified by model-based forecasts. In practice, this weakens both policy analysis and communication, as policymakers cannot clearly articulate how narrative risks map into the overall balance of risks.

The approach proposed by Adrian et al. (2025) addresses these shortcomings by formally combining narrative scenarios with statistical models within a unified Bayesian framework. Their methodology treats statistical density forecasts, such as those produced by Growth- at-Risk or quantile regression models, as a reference distribution summarising data-driven risks. Narrative scenarios are turned into probability forecasts by making small, controlled adjustments to a central baseline outlook. These adjustments are designed to reflect the key messages of each scenario, such as a higher or lower central outcome or changes in the range of possible results, without rewriting the entire forecast. The method ensures that the revised scenarios remain consistent with the original baseline while clearly incorporating the specific risks and assumptions described in the narrative. Once scenarios are embedded in this probabilistic form, they can be systematically evaluated and combined.

This new methodology preserves the communicative strengths of informal scenarios while restoring probabilistic discipline. The resulting synthesis offers a more coherent representation of uncertainty, improves internal policy analysis by clarifying the relative importance of different risks, and enhances external communication.

The ECB could also incorporate a limited set of AI assumptions into its existing scenario exercises. These would cover the pace of diffusion, the extent to which AI complements or substitutes for labour, the balance between domestic and imported AI capabilities, additional energy demand and the financing of complementary investment. The purpose would be to make the assumptions behind each scenario transparent, not to introduce a separate AI model. To assess which scenario is becoming more plausible, the ECB should monitor a stable set of indicators. These should include employee and firm adoption rates from the Consumer Expectations Survey and SAFE, AI related patent activity, payments

for imported intellectual property, investment in data centres and energy infrastructure, occupational exposure to AI, digital and intangible investment, and the exposure of banks and non-bank financial institutions to sectors and assets with high AI activity. These indicators would provide a more consistent basis for assessing the pace and nature of diffusion. They would not eliminate uncertainty, but they would allow the ECB to explain why it considers one scenario more relevant than another. To address the risk of less reliable inflation signals identified, unemployment and output gap estimates could be considered alongside more detailed evidence. This evidence could include hiring patterns in occupations exposed to AI, wage developments in sectors with intensive AI use, and direct measures of constraints affecting compute capacity, electricity and specialised labour.

Overall, the data dependent approach described by Lane (2026) provides an appropriate starting point. Its value would be strengthened if the ECB identified the indicators informing its assessment and explained how changes in those indicators altered the relative probabilities attached to different scenarios. Table 3 provides a summary of our recommendations by listing for each of them the action, the rationale and the key indicators to monitor.

Table 3: Summary of recommendations for the ECB's analytical toolkit

Recommendation	Action	Rationale	Key indicators to monitor
Add an AI-specific analytical layer	Keep the current monetary policy framework, while adding AI variables to projections and diagnostics.	The AI transition is material but uncertain. It does not yet require a new monetary-policy framework but a real-time evaluation of the impact of AI.	AI Diffusion speed; productivity; wages; margins; investment with particular focus on AI related investment; energy bottlenecks.
Use standing diffusion scenarios	Assess three alternative scenarios (gradual, moderate and rapid AI diffusion paths) in each projection round	Different diffusion speeds generate different problems for inflation, the natural rate of interest, slack indicators and monetary-policy transmission.	Significant firm-level AI use; employee-level use; digital and intangible investment; data-centers and compute demand.
Give scenarios probabilistic content	Where feasible, link AI scenarios to explicit probabilities or to density-forecast tools, so that narrative risks can be compared and updated.	Informal scenarios are useful for communication but can understate tail risks and make it difficult to assess relative plausibility.	Probabilities assigned to gradual, moderate and rapid diffusion paths; changes in risk balance over time.
Build a recurring AI state vector	Monitor a dashboard of AI indicators and use it to track the evolution of scenarios.	AI may weaken conventional signals by changing cost structures, labour demand, pricing behaviour and financing patterns.	SAFE and Consumer Expectations Survey adoption measures; AI patents; imported IP payments; data-centers and electricity demand; stock-market performance of AI assets and bank and non-bank exposure to them.
Complement slack and cost diagnostics	Read unemployment, output gaps and unit labour costs alongside more granular sectoral and occupational evidence.	AI may raise productive capacity while creating sectoral bottlenecks, changing labour demand and reducing the information content of traditional aggregate slack indicators.	Hiring in AI-exposed occupations; wages in AI-intensive sectors; sectoral productivity; margins; compute, electricity and specialised-labour constraints.
Communicate structural uncertainty explicitly	Explain how incoming evidence changes the ECB assessment of AI-related risks and the probabilities attached to the different scenarios.	Uncertainty on the sign, timing and magnitude of AI effects on inflation, the relevant indicators to determine monetary policy stance and the transmission of monetary policy.	Mapping from observed indicators to scenario probabilities, and the associated inflation risks.

Source: Authors' elaboration.

6. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligence should be treated by the ECB as a macro critical transition whose effects are potentially large but not yet sufficiently visible in aggregate euro area data to justify a mechanical adjustment to monetary policy. The central conclusion of this paper is therefore deliberately cautious. AI is likely to be mildly disinflationary for the euro area over the next five to ten years, and this effect is expected to be small, delayed and conditional on the breadth of adoption, the strength of complementary investment, the evolution of energy demand, and the degree to which AI increases competition rather than market power. The ECB should not ignore the prospective productivity gains from AI, but neither should it pre-emptively look through realised inflation on the assumption that a productivity dividend will soon arrive.

The inflationary consequences of AI are best understood as the net outcome of opposing forces. On the supply side, AI can reduce unit labour costs, accelerate productivity growth and generate relative price declines in sectors where tasks are more easily automated. On the demand side, it can raise investment in software, data, skills, compute infrastructure and organisational capital, while also affecting consumption through expected income gains. In addition, AI related energy demand may create sector specific upward pressure on electricity and gas prices during the adoption phase, even if the aggregate magnitude of this channel is likely to be smaller than recent geopolitical energy shocks.

The practical implication is that the ECB should assess AI through observed movements in unit labour costs, services inflation, sectoral productivity, margins, wages, adoption intensity and energy market bottlenecks, rather than through a single narrative in which AI is assumed to be either inflationary or disinflationary. The implications for the natural rate of interest are equally conditional. AI can raise R* if it produces persistent productivity growth and stimulates broad complementary investment. Yet the euro area effect is likely to be weaker than the US effect because frontier AI production, upstream capital expenditure, cloud infrastructure and the associated financial returns remain geographically concentrated outside Europe. This does not imply that euro area R* must fall. European firms will still need to invest in data, software integration, cybersecurity, worker training and organisational capital to use AI effectively.

The relevant policy question is therefore comparative rather than absolute: whether AI widens the gap between the US and euro area natural rates, and whether domestic adoption becomes strong enough to generate a meaningful euro area investment cycle. For the ECB, this reinforces the case for treating R* as a range surrounded by uncertainty rather than as a point estimate to be shifted mechanically in response to AI news. AI also changes the transmission challenges faced by monetary policy. If AI weakens labour bargaining power in exposed occupations, aggregate wage indicators may become less informative about underlying slack. If algorithmic pricing increases market power, faster repricing need not imply stronger competitive pass through. If AI intensive firms rely increasingly on market-based finance, cash buffers and equity valuations rather than bank credit, the traditional bank lending channel may become less representative of the investment segment most exposed to AI. Moreover, euro area financial conditions may become more sensitive to global AI valuation cycles, especially those originating in US technology markets.

It is therefore important for the ECB to distinguish movements in domestic financial conditions caused by its own policy stance from those imported through global expectations about AI profitability and long run productivity. The appropriate policy response is not a new monetary policy framework, but an important extension of the existing one. The 2% medium term inflation target, data dependent calibration, risk management approach and two pillar strategy remain suitable. What is needed is an AI specific layer within the ECB's projection and diagnostic framework. Gradual, moderate and rapid

diffusion scenarios should become standing elements of the projection process. These scenarios should not be presented as isolated stories, but should be attached to observable indicators and, where possible, to explicit probabilities.

The broader recommendation is that the ECB should communicate AI uncertainty explicitly rather than absorb it silently into the baseline forecast. AI may alter inflation dynamics, R*, slack indicators and transmission channels, but the timing, magnitude and sign of these effects remain uncertain. A scenario conditioned communication strategy would allow the ECB to explain how its assessment would change if adoption remained shallow, broadened gradually, or accelerated rapidly. This would preserve the medium-term orientation of monetary policy while making clear that the policy stance will respond to realised evidence on productivity, wages, prices, investment, financial conditions and energy costs. In this sense, the main policy lesson is not that AI requires a different monetary policy objective but rather a more explicit treatment of structural uncertainty within the existing framework.

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This paper analyses how artificial intelligence may affect euro area inflation dynamics and ECB monetary policy. It argues that AI is likely to be mildly disinflationary over the medium term, while its speed of diffusion and its effects on the natural rate of interest (R*), monetary transmission and inflation diagnostics remain uncertain. The ECB should expand its existing toolkit by incorporating AI specific indicators, probabilistic scenario analysis, and explicit communication of structural uncertainty.

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