EUROPEAN CENTRAL BANK

EUROSYSTEM

Central Banking in the Age of Artificial Inteligence

Impact of AI on Economy, Finance, and Supervision

Bank of Finland
11 November 2026

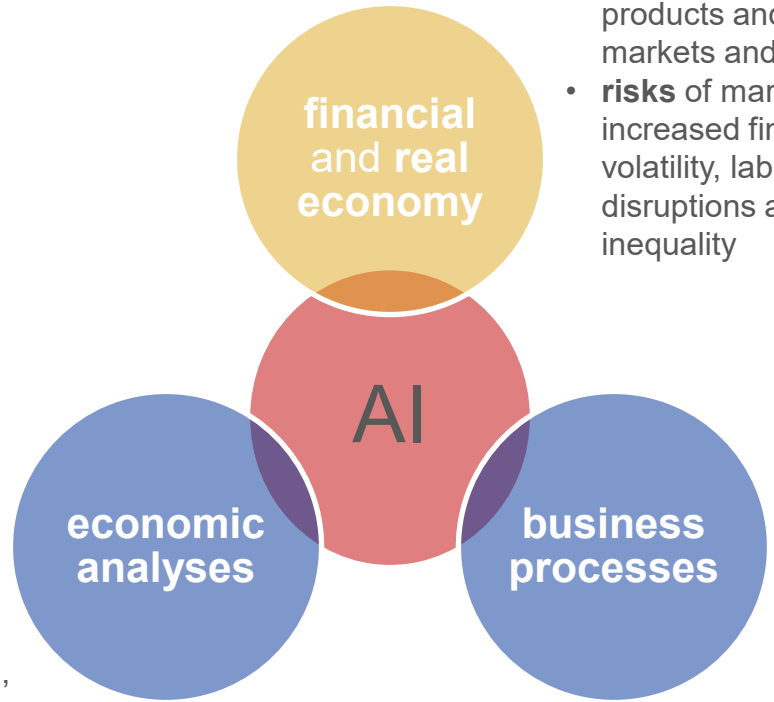


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Maximilian Freier

AI and its impact on central banking

- **opportunities** for new products and services, markets and industries
- **risks** of market concentration, increased financial market volatility, labour market disruptions and increasing inequality



- macroeconomic **forecasting**, nowcasting and event prediction (e.g., economic or fiscal crisis)
- creating and evaluating **alternative data** (incl. textual, satellite image, videos)
- macro **modelling** (e.g., solution methods for macro models).
- new tools in **econometrics** (e.g., causal tree techniques)

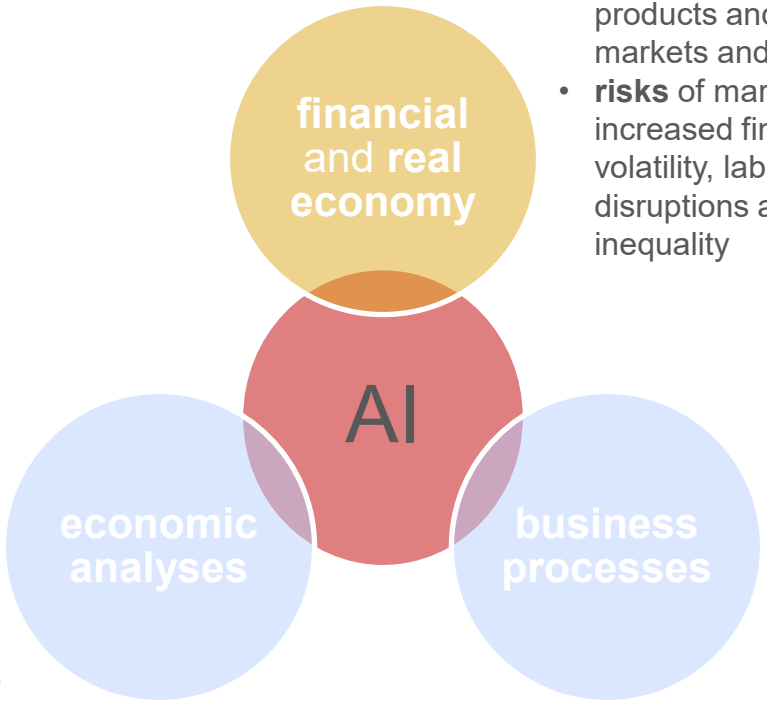
- **information access** (e.g., query function with access to information repository)
- **data management** (e.g. data cleaning or chart preparation)
- preparation of **policy document** (e.g. briefings, meeting summaries, data commentaries)
- recurring **administrative tasks**

Source: Own elaboration.

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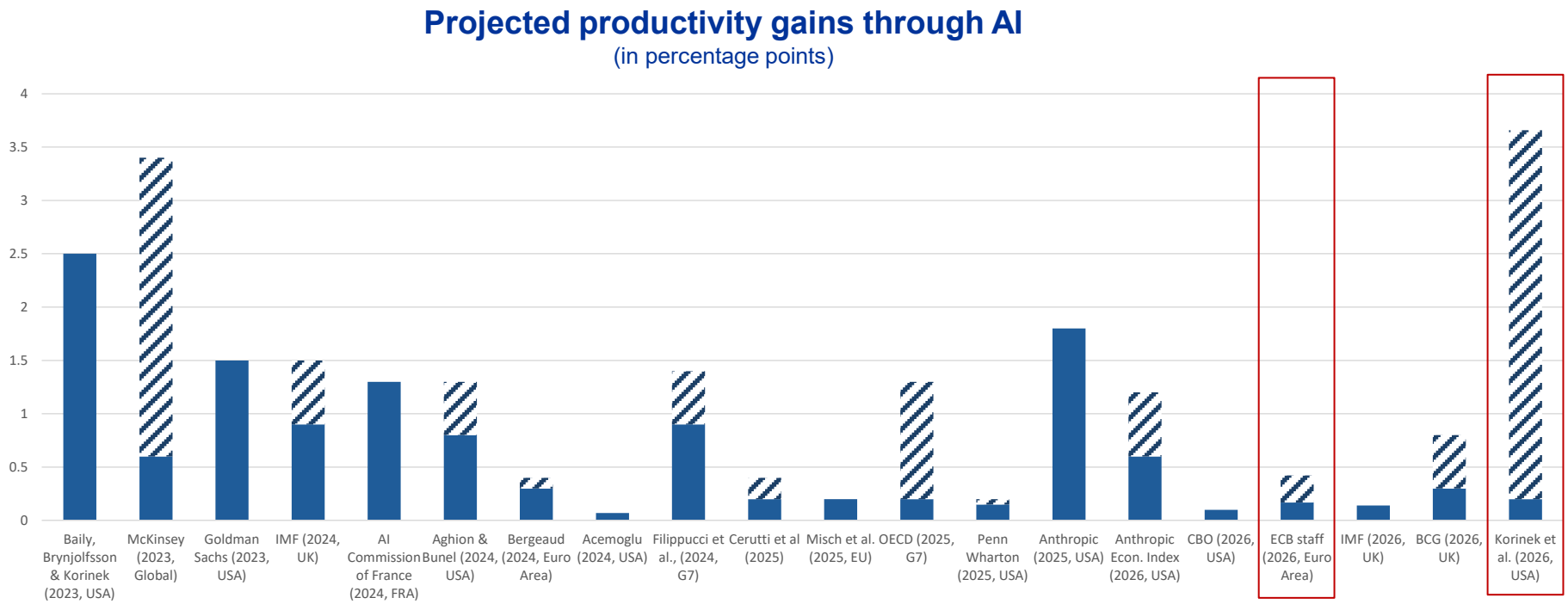
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Predictions on AI range from barely measurable to transformative



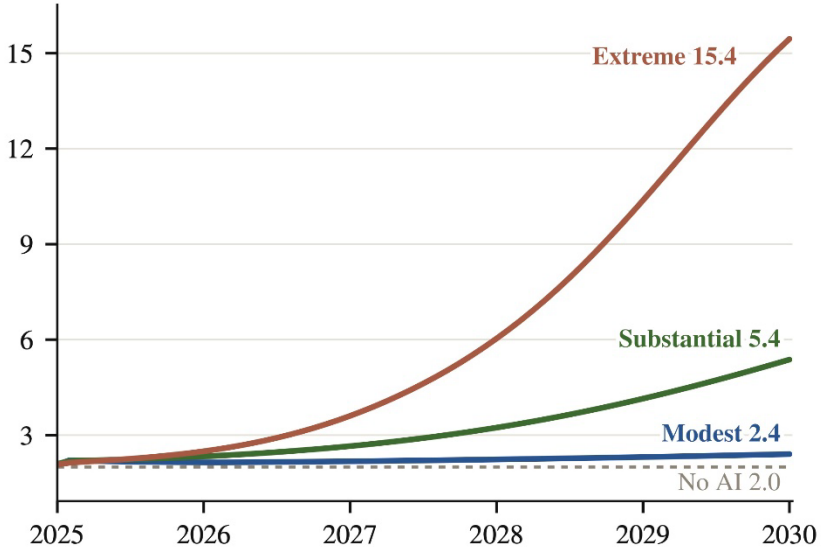
Source: Extended presentation according to Filippucci et al. (2024).
Notes: Estimated additional contribution of AI to annual productivity growth, in percentage points per year, relative to a scenario without AI. Filled bars: lowest or central estimate; hatched: range to highest estimate. The studies differ in measure (labour productivity or total factor productivity), in the region and in the time horizon (usually ten years).

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AI promises higher growth...

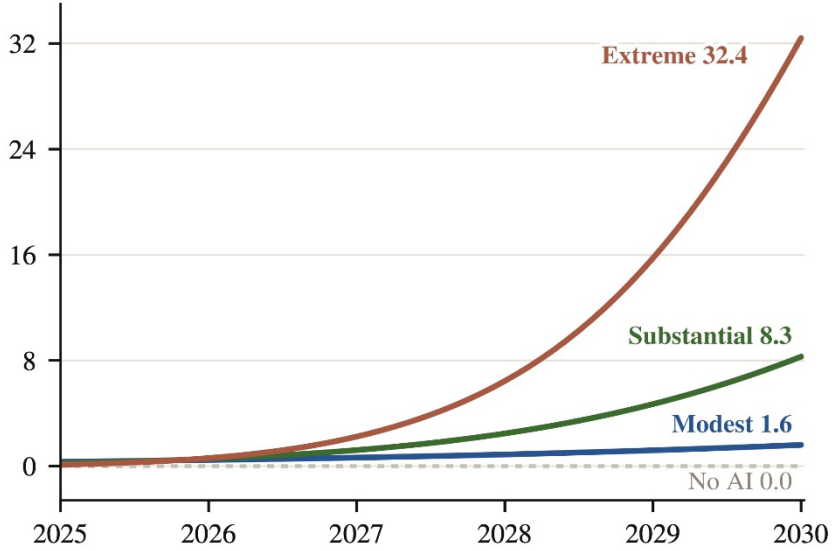
US economic growth

(Percent per year,
2% of growth excluding AI)



US economic output

(Gross domestic product, deviation from
the growth path without AI)

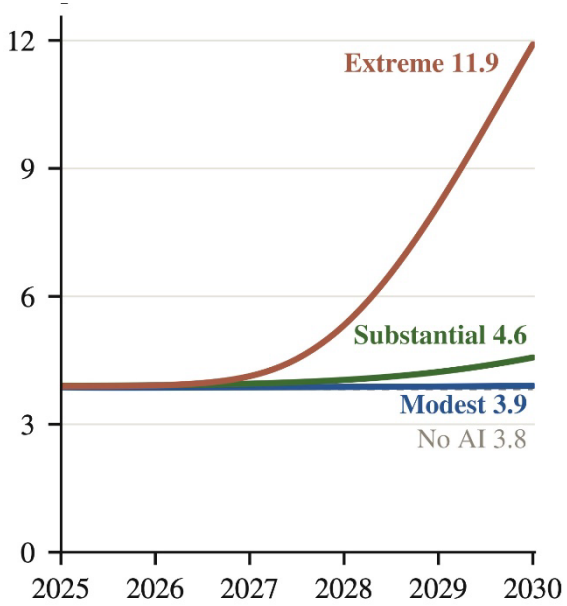


Source: Korinek et al. (2026). "Economic Scenarios for Transformative AI".
Note: Left: GDP growth rate over the previous twelve months. The dotted line represents the economy without AI; each line is labeled with its value for January 2030. Right: GDP, actual economic output as a percentage above the path without AI.

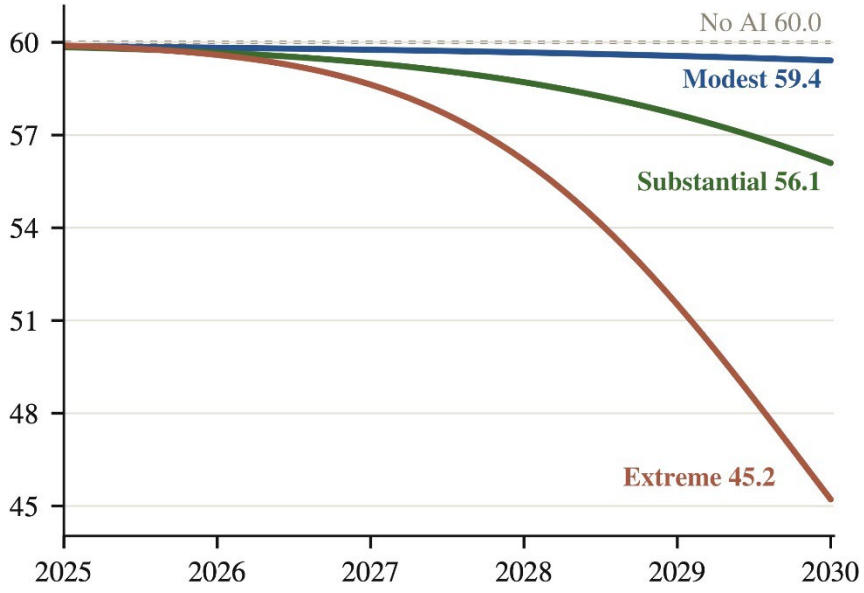
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… and there is a threat of structural change in the labour market

US unemployment
(Percent of the labour force)



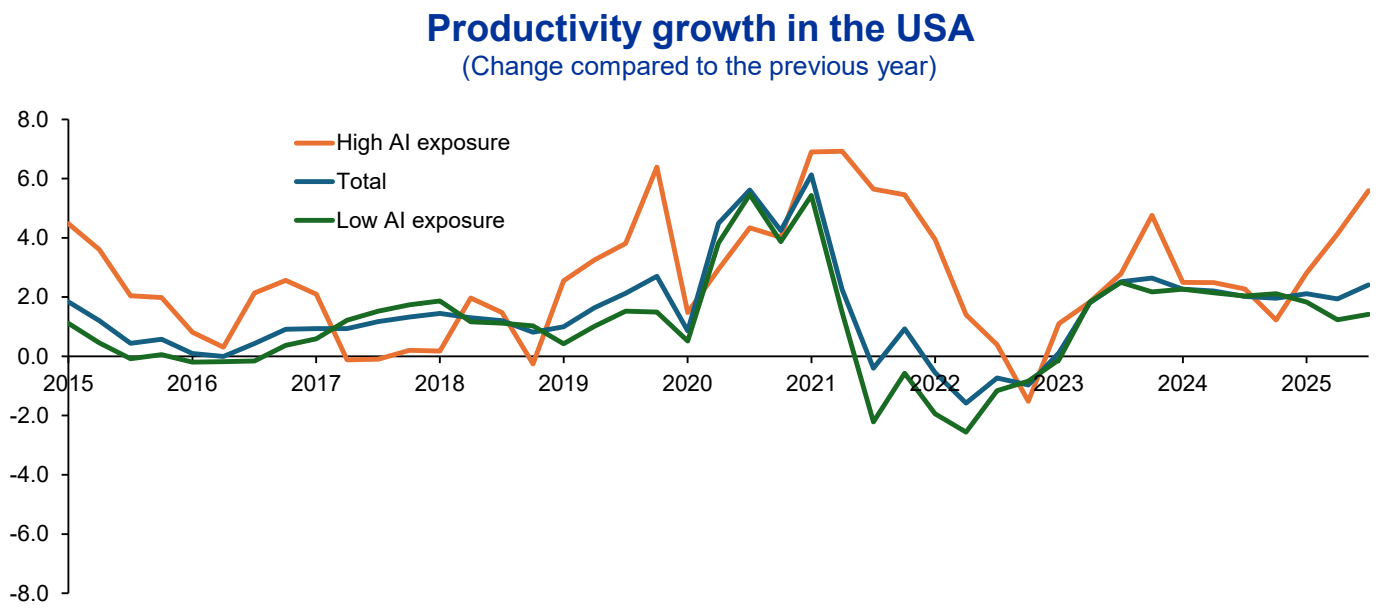
Labour share of income
(Percent of income; 60% without AI)



Source: Korinek et al. (2026). "Economic Scenarios for Transformative AI".
Notes: Left: The dashed lines represent the economy without AI, in which both rates are at their normal level of 3.8 percent; Each line is labeled with its value in January 2030. Right:

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But not much to see in the macro statistics (so far)



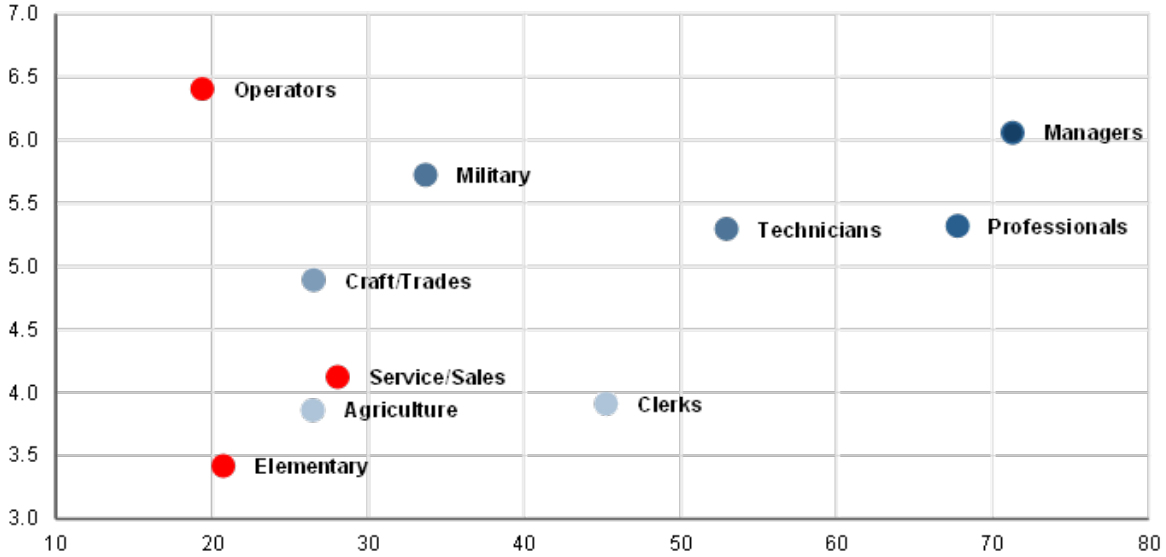
Source: Davis (2026). "International comparisons show AI effect on productivity".
Notes: The last data points refer to the third quarter of 2025. "High exposure" is the weighted average of real hourly value added in the information, finance, and professional and technical services sectors (NAICS 51, 52, 54). 'Low exposure' is the weighted average of real hourly value added in mining, energy and water, construction, manufacturing, wholesale, retail, transport and warehousing, real estate, business management and administration, healthcare, leisure and hospitality, and other services (NAICS 21, 22, 23, 31–33, 42, 44–45, 48–49, 53, 55–56, 62, 71–72, 81). Total is the weighted average of real hourly value added across all these sectors. This total is approximately equal to the hourly real economic output in the private sector (non-agriculture).

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Microdata suggests high productivity gains

Hours saved and adoption of AI

(x-axis: proportion of employees; y-axis: number of hours saved per week)



Source: Dias Da Silva et al. (2026). "AI adoption and the productivity promise: what workers report".
Notes: The colors of the dots reflect the net assessment of the impact of AI on the world of work: red represents a predominantly negative assessment, while different shades of blue represent a spectrum of positive assessments – with a dark blue denoting the strongest positive value. The graph contains information on three survey questions: (i) "How many additional hours do you think you would have needed in a typical week in the past month to handle the same workload without the use of artificial intelligence (AI)?", (ii) "Do you personally use artificial intelligence (AI) in your work (including tools like ChatGPT, Claude, Gemini, etc.)?" and (iii) "Do you think technological developments (e.g., the increasing use of artificial intelligence, large language models, or automation) will affect your current job or career prospects over the next five years?"

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Why don't we see the AI effect yet?

1. Not everything can be measured

If you use AI to plan a vacation or fill out a form faster, you save time, but economic statistics don't count that.

2. New technology, old processes

New technologies only take effect when companies reorganize their processes. In the case of electricity, this took decades because factories had to be built from scratch.

3. Superficial instead of significant use

7 out of 10 companies in the euro area use AI, but only 7 out of 100 use it intensively. A chatbot in the office is not yet a new production process.

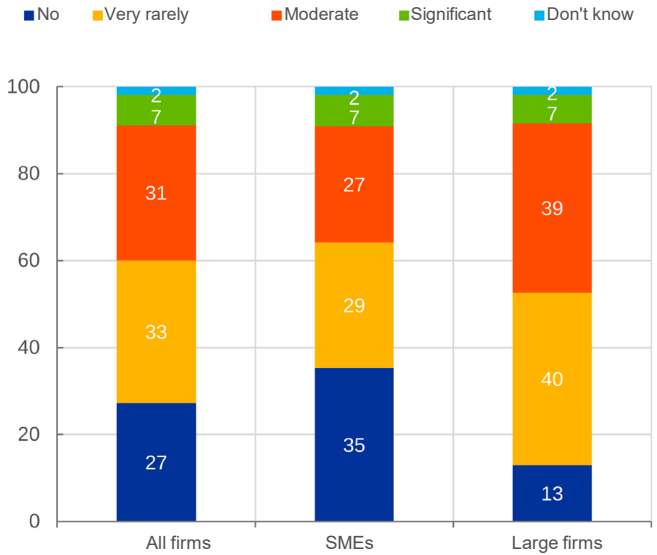
4. True AI implementation in only a few industries

In the US, IT, finance and consulting account for 40% of productivity gains, even though only 16% of working hours are done there. The rest of the economy is not yet following suit.

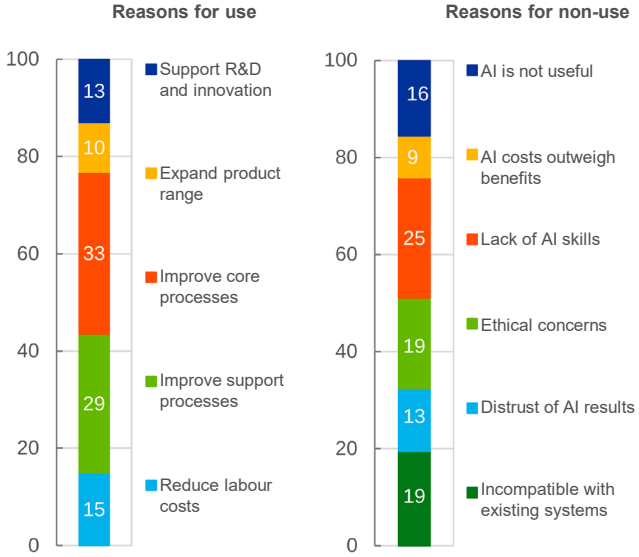
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AI use in the euro area

AI usage by company size
(% of respondents)



Reasons for and against the use of AI
(% of respondents)



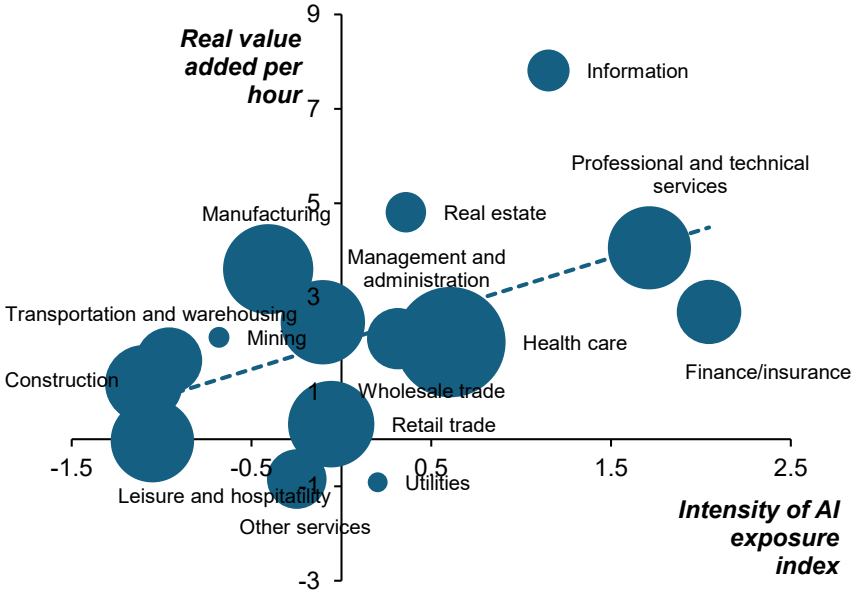
Source: ECB Survey on the Access to Finance of Enterprises (SAFE).

Notes: The left chart shows the weighted share of enterprises by overall AI usage intensity and by size class. The right chart shows the weighted shares by reasons for using AI (left) or not using it (right). On the left, the population includes companies that use AI very rarely, moderately or to a significant extent; on the right, companies that do not, very rarely or moderately use AI. The most recent observations refer to the 4th quarter of 2025.

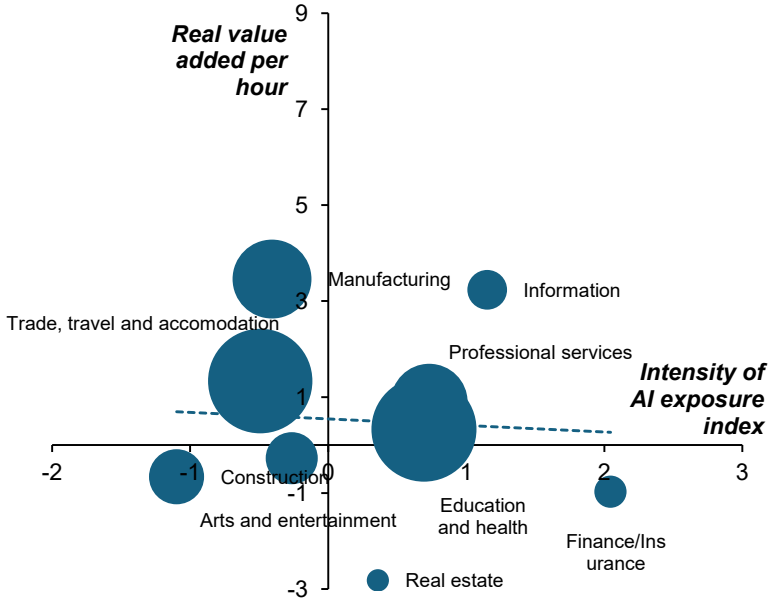
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Europe lags behind the US in AI implementation

Productivity growth in US industries



Productivity growth in EU industries



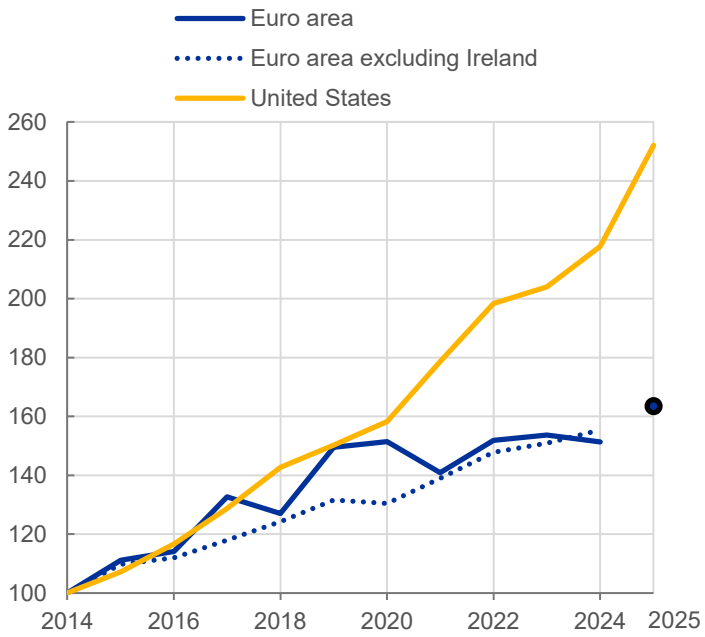
Source: Davis (2026). "International comparisons show AI effect on productivity".
Notes: The vertical axis shows the annualized trend growth of the logarithm of real value added per hour for the period from the first quarter of 2024 to the third quarter of 2025. The horizontal axis represents AI exposure, based on the "Industry AI Exposure Index" by Felten, Raj and Seamans (2021). The area of the bubbles is proportional to the share of each sector in the total number of hours worked (outside agriculture).

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AI investments in the euro area lower than in the US

Proxy for investments in digitalization

(2014 = 100)

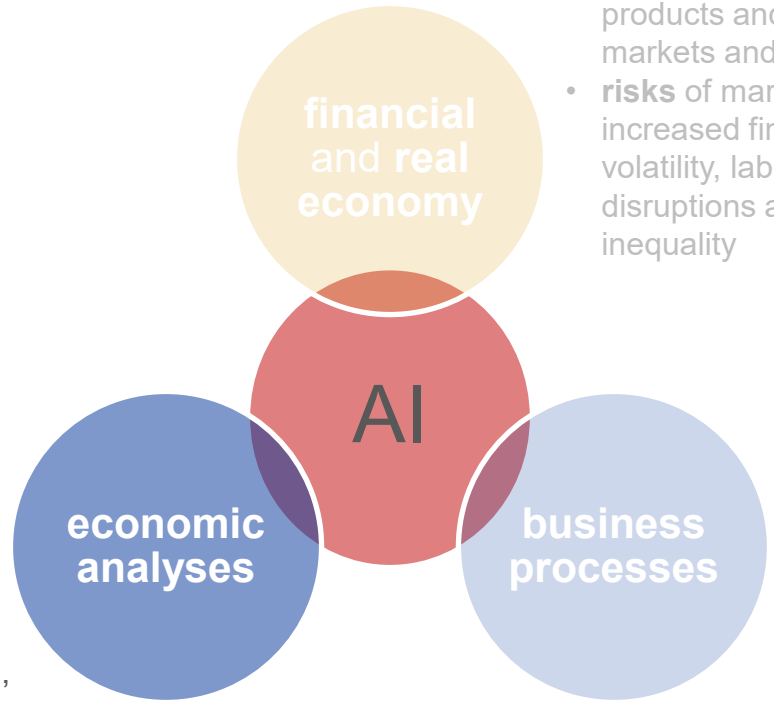


Source: ECB Calculations.
Notes: Black point for 2025 continues this indicator based on the annual growth of a digital services output measure (weighted, non-seasonally adjusted output in publishing, programming, consultancy and related activities, and information services). The corresponding indicator for the United States includes investments in data centres, data processing equipment and computer software.

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Areas of AI-driven macroeconomic analysis

Nowcasting

- **GDP proxies**, e.g., using satellite data of harvests or cement plant activity
- **Trade dynamics,** e.g., using satellite data of port movements
- **Consumer prices**, e.g., using barcode data or web-scraped online prices
- **Inflation perceptions**, e.g., using social media feeds

Forecasting

- **Nonlinearities:** random forests outperforming linear benchmark models
- **Risk assessment**: density & quantile forecasts produce forecast distributions
- **Alternative data inclusion** , e.g., text embeddings can improve forecasts
- **Market reactions:** GenAI simulates market agents

Macro Analysis

- **Model solution**, e.g., neural networks handling DSGE and HANK models
- **Imposing economic structure:** constraints on otherwise flexible models
- **Parameter instability:** tree-based time-varying coefficients in Bayesian VARs
- **Regime switches**, e.g., recurrent neural networks recovering shifts in US inflation dynamics

Communication

- **Stance measurement**, e.g., LLMs scoring hawkish and dovish language in central bank communication
- **Text similarity**: embeddings comparing statements across institutions and over time
- **Attention scores:** identifying which words drive a sentiment reading
- **Voice and facial analysis:** detecting tone in press conference delivery

Source: Araujo & Freier (2025).

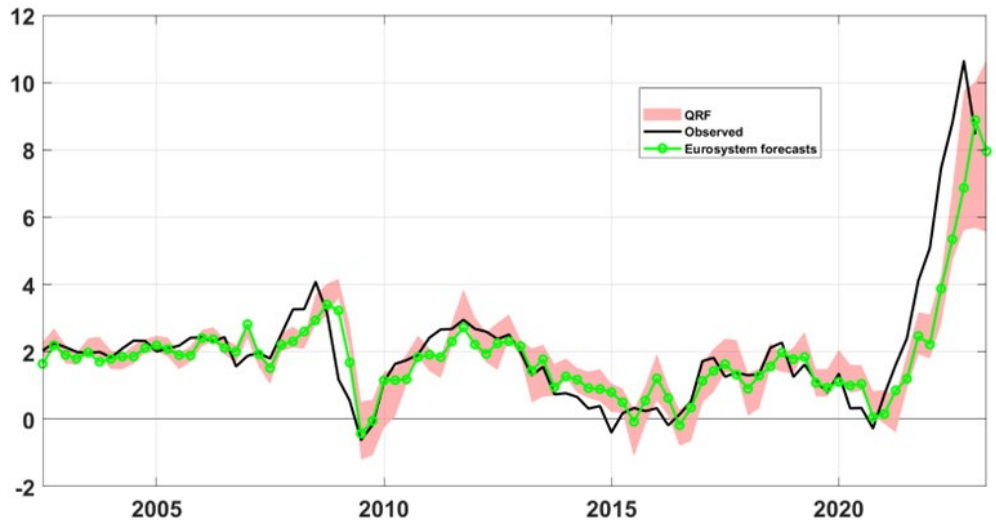
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AI applications for economic analysis: Forecasting

- Use machine learning to identify **non-linearities in macro forecasting**
- Example: Quantile Regression Forest models for **non-linear forecasts** (Lenza, Moutachaker and Paredes 2023)
- Models do not (yet) systematically **outperform** the Eurosystem forecast or Survey of Professional Forecasters

Headline inflation and forecasts

(percentage)



Source: Arce et al. (2026) and Lenza, Moutachaker and Paredes (2023)
Notes: Black solid line: year-on-year growth rate of the HICP (headline inflation); red area: 16th to 84th quantiles of the density forecasts from the non-linear model (QRF), with a horizon of six months ahead, for the year-on-year growth rate of the HICP; green line with circles: Eurosystem inflation projections, with a horizon of six months ahead, for the year-on-year growth rate of the HICP.

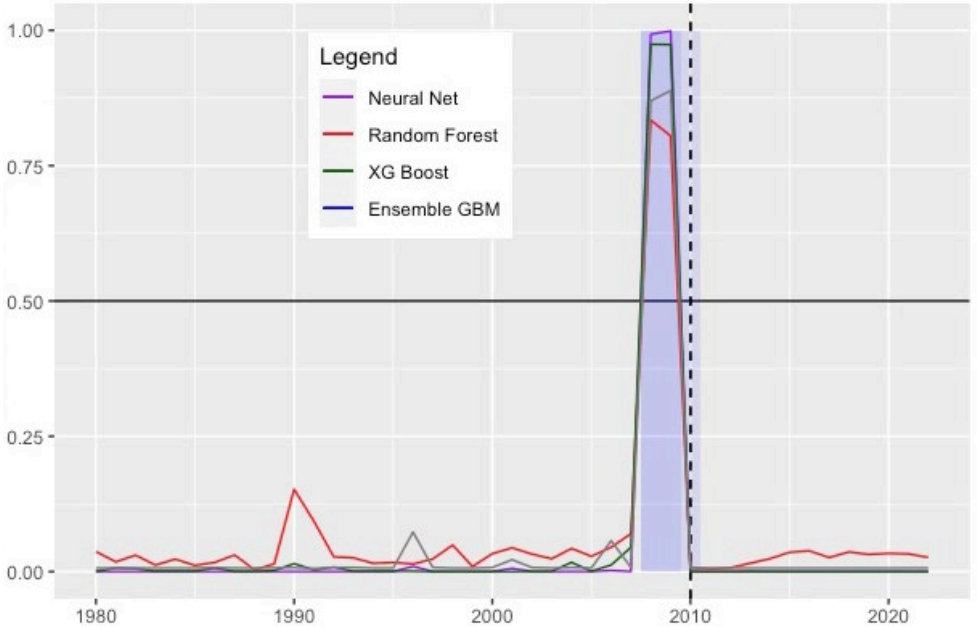
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AI applications for economic analysis: event prediction

- Use large data and machine learning for **event prediction** (e.g., economic or fiscal crisis)
- Example: 36 million observations of macro and fiscal, financial and political data used to **predict fiscal crises**
- Machine learning models **outperform** standard logit/probit regression models (Hellwig 2021)

Predicted probability of fiscal crisis in Greece

(probability one and two year ahead)



Source: Bischl, Freier & O'Doherty (forthcoming).

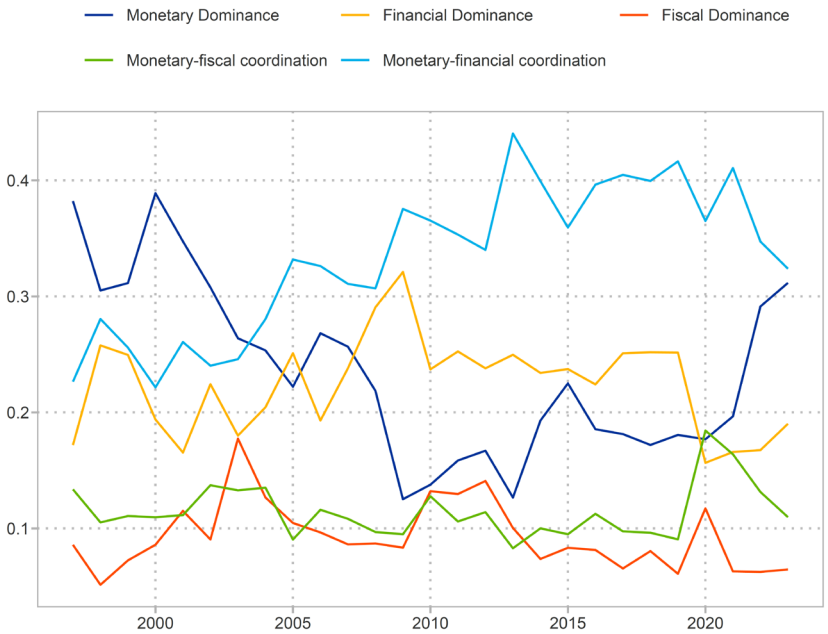
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AI applications for economic analysis: textual analysis

- Use document repositories and large language models (LLMs) for **analyses of central bank communication**
- Example: Using **GPT algorithm**, analysis of rhetoric on policy linkages in 18.000 central banker speeches

Policy interaction in central bank speeches

(percentage of sentences in a given year)



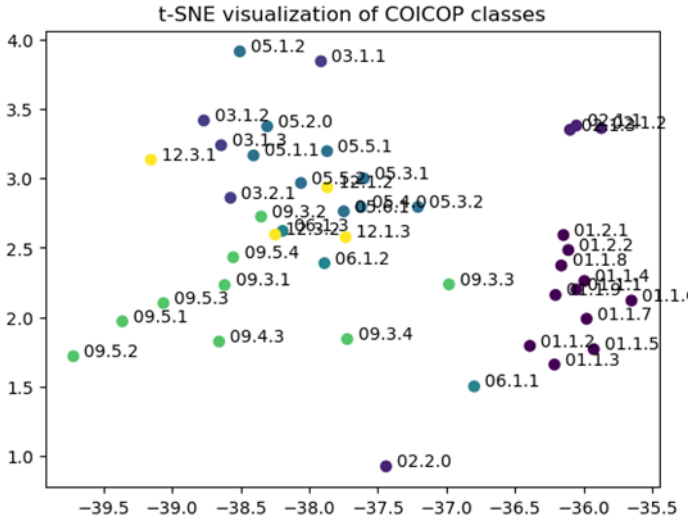
Source: Bischl, Freier & Leek (2024). Beyond Monetary Separation: A Textual Measure of Central Bank Policy Interactions Using ChatGPT.
Notes: two million sentences taken from 20.000 central bank speeches in the BIS database; analyse of sentence in context; all includes all normative sentences concerning monetary, fiscal or financial policy

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AI applications for economic analysis: inflation nowcasting

- Use LLMs to improve **inflation nowcasting**
- Example: **Daily Price Dataset (DPD)** - classification of 38 million individual products to COICOP with the FastText algorithm (Facebook 2015) to separate inflation components for classification of individual products
- **Collaboration with BIS-Eurosystem Innovation Centre** for use of LLM (GPT 4) for classification

COICOP classes visualization

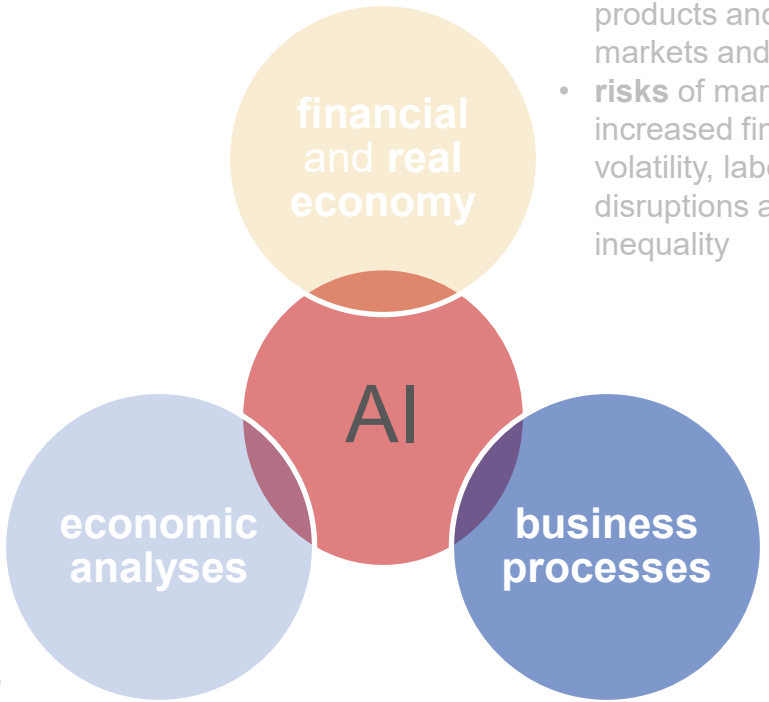


Source: DPD classification pipeline, cf. also Osbat (2022).
Note: Similar COICOP classes have a semantically similar description, and therefore a similar vector representation. For instance, food COICOP classes (01.x.x) are clustered together.

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Source: Araujo & Freier (2025).

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AI Transforming Business Processes

Information Management

- AI assistants (LLMs + RAG) answer queries in plain language
- Benefits: quick access, cross-department consistency, democratised knowledge
- Challenges: technological debt, data-security trade-offs, hallucinations, updating content/access rights

Data Management

- Tools in statistics: supervised machine learning for data quality, unsupervised clustering for anomalies etc.
- Tools in data analysis: No-code data retrieval and transformation (e.g. text2SQL), visualisation (e.g. AI agent alters and executes code) and narration

Text Analysis & Creation

- Drafts, summarises, translates, checks documents such as reports, minutes etc.
- Benefits: Faster drafting, consistency of tone, multilingual coverage, focus on interpretation
- Risks: Accuracy, hallucinations, confidentiality, accountability for AI-assisted text, need for secure on-prem deployment and clear human sign-off

Workflow Automation

- Handles repetitive reporting, HR/IT help-desk queries and physical operations
- Benefits: Saves time, cuts errors, ensures consistency, improves service
- Challenges: Process rigidity, maintenance, staff adaptation, cybersecurity and auditability

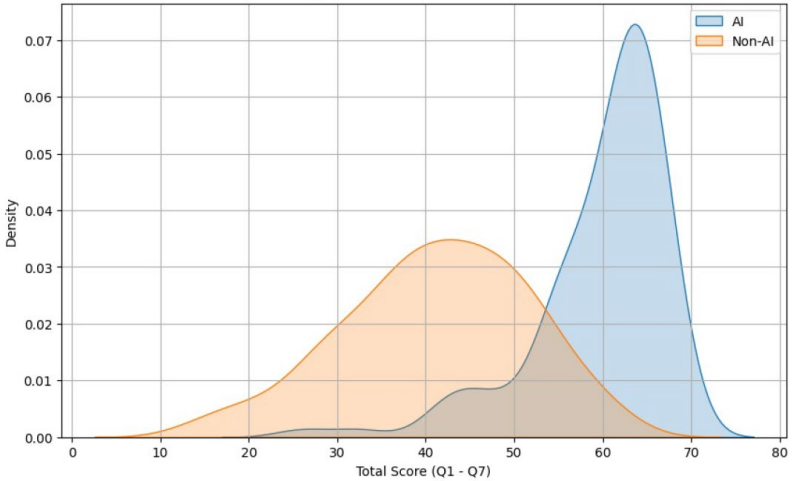
Source: Araujo & Freier (2025). Monetary Policy Tech: A primer to novel techniques for monetary policy analysis and business processes.

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AI improves the quality and speed of central banking work

Quality of work with and without AI support

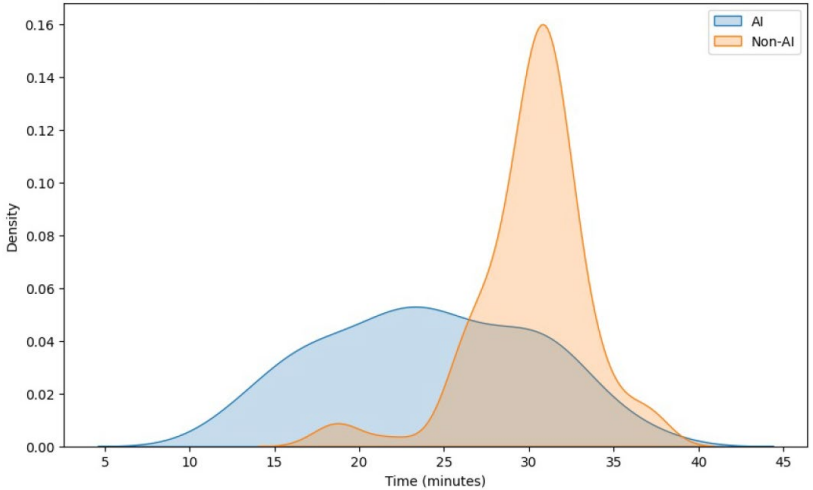
(distribution of quality scores across seven tasks)



Source: Maršál and Perkowski (2025).
Notes: Experiment run with around 100 experts at the National Bank of Slovakia. Experts were given seven standard tasks covering (i) routine cognitive, (ii) non-routine cognitive, (iii) routine manual, (iv) nonroutine manual, (v) analytical, (vi) leadership, and (vii) interpersonal and communication tasks.

Speed of work with and without AI support

(distribution of time needed across seven tasks)



Source: Maršál and Perkowski (2025).
Notes: The density plot indicates that generative AI led to large average improvements in terms of the time spent on the task (mean 23 versus 30 minutes for those who did not use generative AI). Distributional effects: while generative AI may level the playing field in terms of output quality, it simultaneously amplifies disparities in task completion speed.

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Use of AI for business analysis: The five lead projects



document interaction
in development



Data processing
in use, advanced version
in development



interview summary
in production
since summer 2025



briefing preparation
in pre-production
since Oct 2025

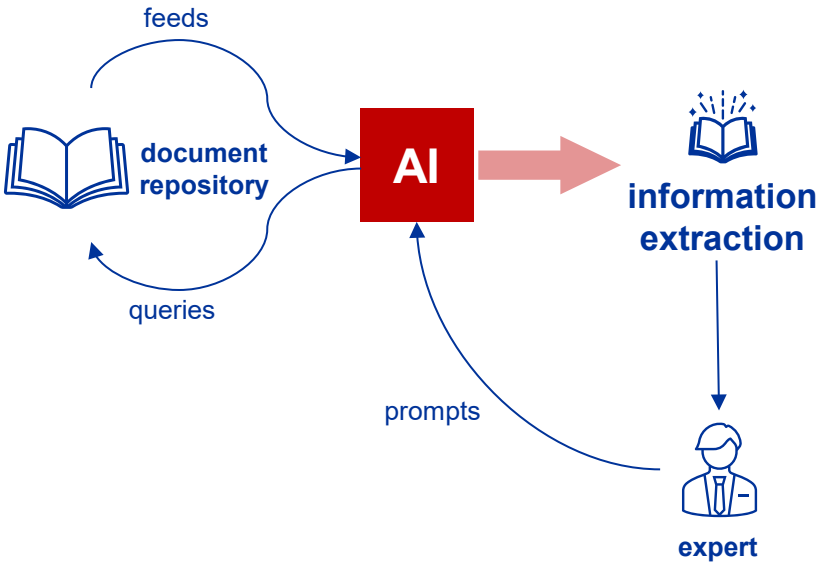


internal meeting minutes
in testing
since April 2025

- Develop five GenAI-driven tools to **facilitate business processes**
- Functionality of proprietary GenAI **adapted to central bank requirements**
- Using **different technology platforms** across projects allows for test and compare performance across products
- Projects owned by individual business areas, with regular exchange in AI network to **exploit synergies across projects**
- Lead projects become **blueprint** for other business process applications

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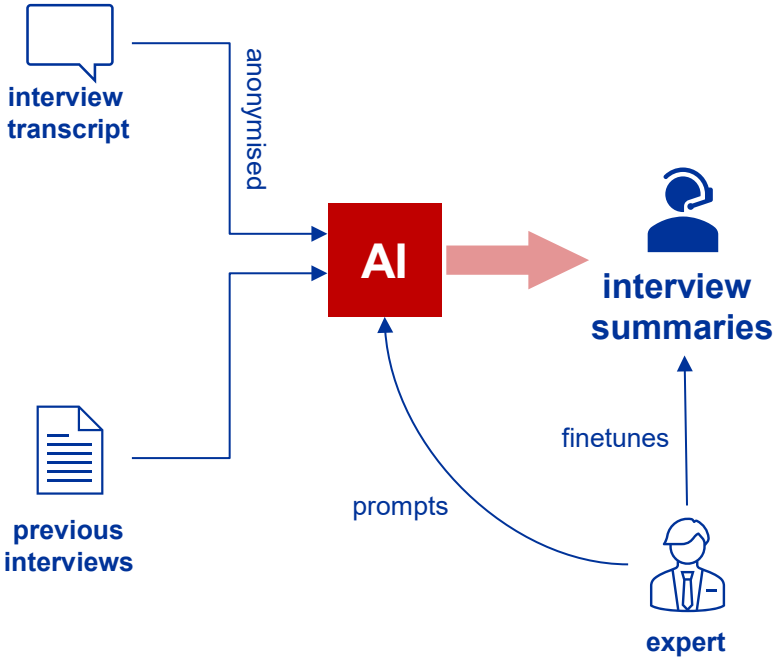
1. Document interaction tool



- GenAI-based tool that allows for **interaction with existing institutional repository**
- Tool with **multiple functions**, incl. (i) information extraction, (ii) information summarisation, and (iii) bringing information into different styles (e.g. speaking points or publication text)
- Main takeaways:
  - **Vast document repositories** pose significant challenge (“technological debt”)
  - **Choice between breadth and depth** in vectorisation

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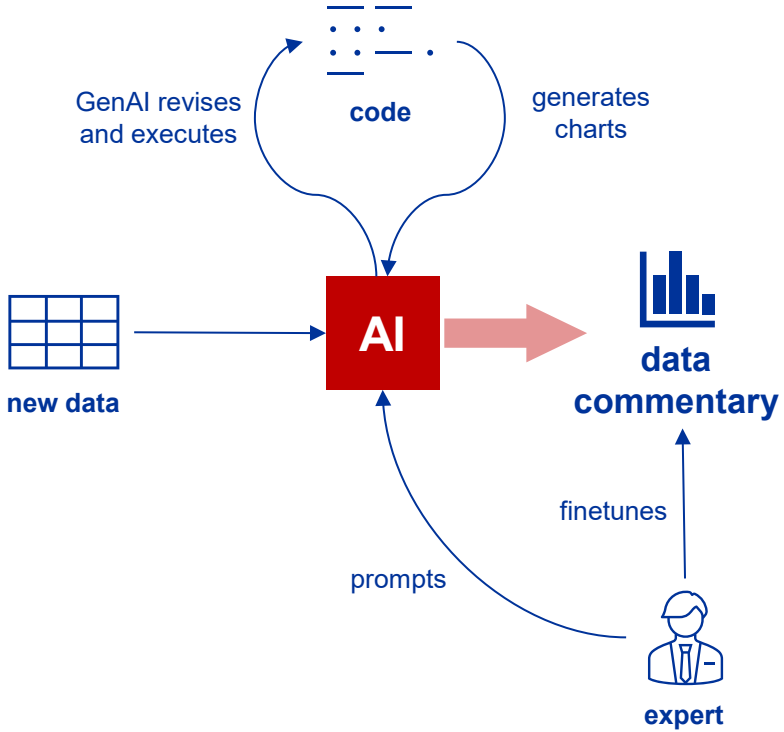
2. Interview summary tool



- GenAI-based tool that supports the **summarising of interviews** in the context of the ECB's Corporate Telephone Survey
- Used to help **write-up interviews**, based on transcripts
- Also used to help draft the **summary note** based on the write-ups and make **sentiment scores**
- Main takeaways:
  - Reduces **time spent on each interview by at least 60%**
  - Provides **safety net for scoring** (including reasoning behind scores)
  - **Improves operational efficiency**

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5. Data processing tool



- Tool creates **charts and narrative around a new data release**
- No-code **AI-agent** solution to (i) retrieve data, (ii) write and execute code to visualise data, and (iii) develop a narrative around the data

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A practical approach to risks identified and mitigation measures

Risks identified

- inaccurate or false output (“hallucinations”)
- biases in output (due to third-party training data)
- data breaches or leakages
- personal data abuse

Risk mitigation measures

- creating awareness (seminar series, trainings)
- anonymisation of personal data
- manual checks and many-eye human validation (e.g. through the approval process)

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Main takeaways

- AI is **changing the macro-financial environment in which central banks operate**, although there is much uncertainty with regard to scope and speed of the transformation.
- **AI is expanding the analytical toolkit for monetary policy** by helping to capture nonlinearities and tapping alternative data provide new economic signals.
- **AI is delivering tangible improvements in central banking business processes,** reducing time spent on administrative and recurring tasks and improving task quality**.**
- **Success of AI adoption depends on deep integration and coordination between policy and support areas in central banks.** Off-the-shelf solutions help but do not bring significant productivity gains.
- **Human-in-the-loop and and robust governance remain essential.**

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