Central Banking

Week 11: ML/AI and Big Data in Central Banking

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Agenda

1. ML/AI and Big Data in Central Banking (Intro)
2. Guest Speaker: Dr. Cory Baird
3. Class Activity

1. ML/AI and Big Data in Central Banking

Introduction

- Central banks are increasingly adopting ML/AI and big data to enhance decision-making, operational efficiency, and risk management.
- This lecture will cover:
  - Key use cases of ML/AI in central banking.
  - Potential risks and governance challenges.
  - Frameworks and guidelines for responsible AI adoption.
  - Real-world examples and case studies.

Why ML/AI in Central Banking?

- Data-intensive industry with massive datasets.
- Need for rapid, accurate analysis in policy decisions.
- Predictive analytics for economic forecasting, fraud detection, and risk management.
- Enhanced supervision and regulatory compliance.

Applications of ML/AI in Central Banks

- **Economic Forecasting:** Predicting GDP, inflation, and financial stability indicators.
- **Fraud Detection:** Identifying suspicious transactions and anomalies.
- **Risk Management:** Stress testing, scenario analysis.
- **Communication Analysis:** Sentiment analysis on policy announcements.
- **Data Quality Management:** Detecting data inconsistencies and outliers.

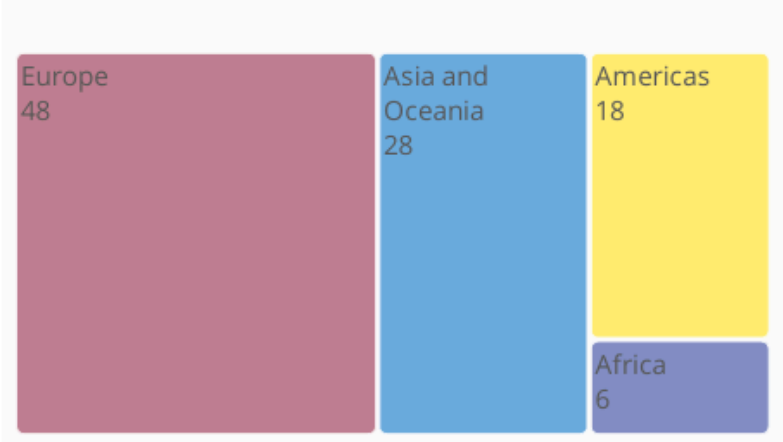
Generative AI in Central Banking

- **What is Generative AI?**
  - AI systems that create content, such as text, images, or simulations based on data.
- **Applications in Central Banking:**
  - Automated report generation for economic forecasts and policy analysis.
  - Sentiment analysis of news and social media to assess financial stability.
  - Simulating economic scenarios for stress testing and policy planning.
- **Risks and Considerations:**
  - Accuracy vs. misinformation risk.
  - Ethical concerns: Data privacy, bias in generated content.
  - Dependence on AI-generated outputs may reduce analytical depth.
- **Example:**
  - ECB's use of generative AI to draft initial economic assessment reports before human review.

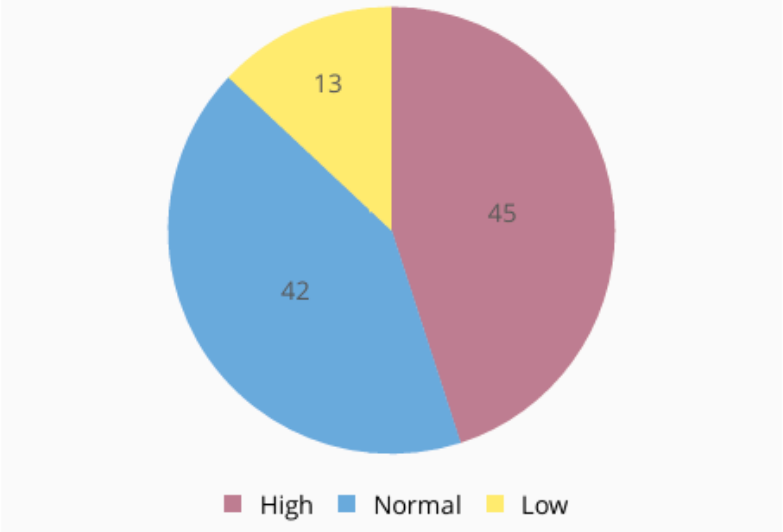
Artificial intelligence is a priority for central banks

In per cent of respondents — Graph 1

A. Survey coverage



B. Evaluating AI/ML importance in strategic planning



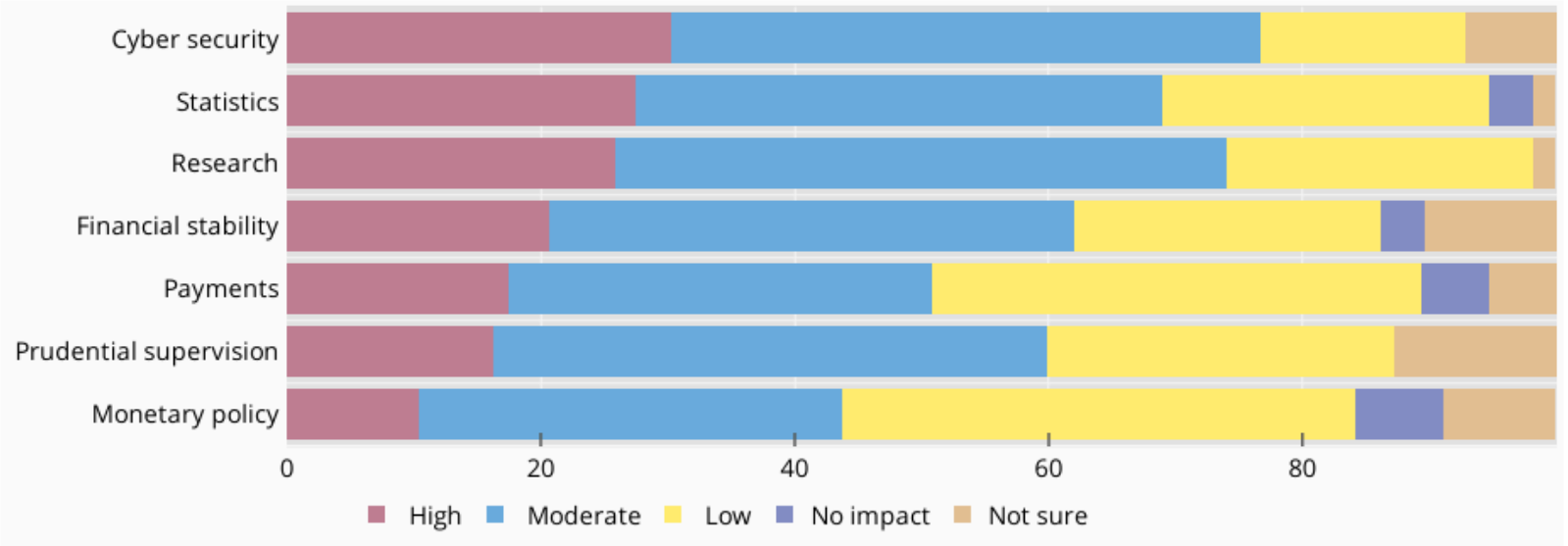
Sources: IFC survey on AI and ML (2024); authors' calculations.

(Source: IFC (2025) Governance and implementation of AI in CBs)

AI is expected to have a significant impact in general and particularly in the areas of cyber security, statistics and research[1]

In per cent of respondents

Graph 3



[1] Share of the expected impact from AI/ML (from "high" to "not sure") per each functional domain in the next two years.

Sources: IFC survey on AI and ML (2024); authors' calculations.

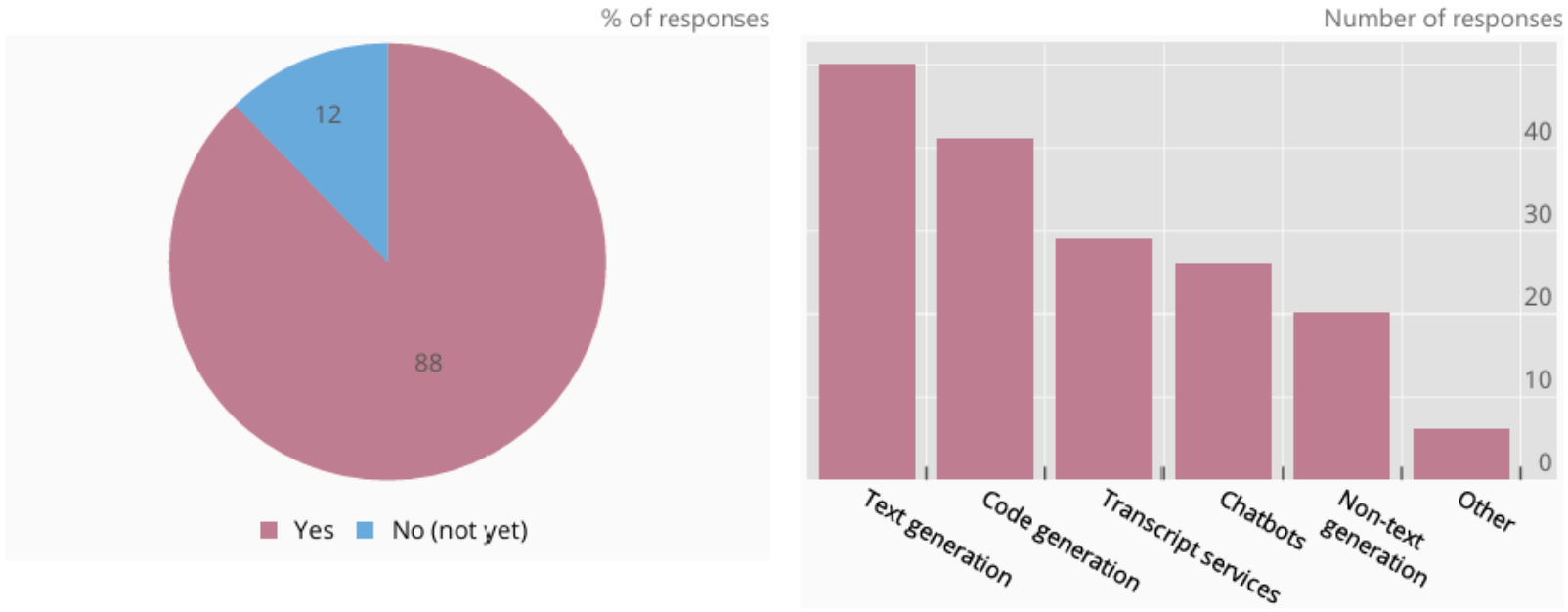
(Source: IFC (2025) Governance and implementation of AI in CBs)

Generative AI applications in central banks

Graph 5

A. Almost all reporters use generative AI...

B. ...especially for text and code generation



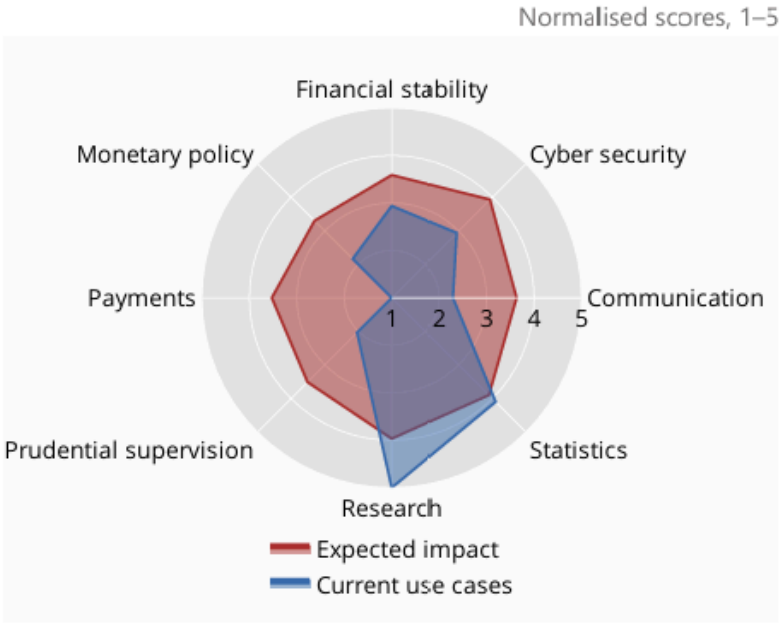
Sources: IFC survey on AI and ML (2024); authors' calculations.

(Source: IFC (2025) Governance and implementation of AI in CBs)

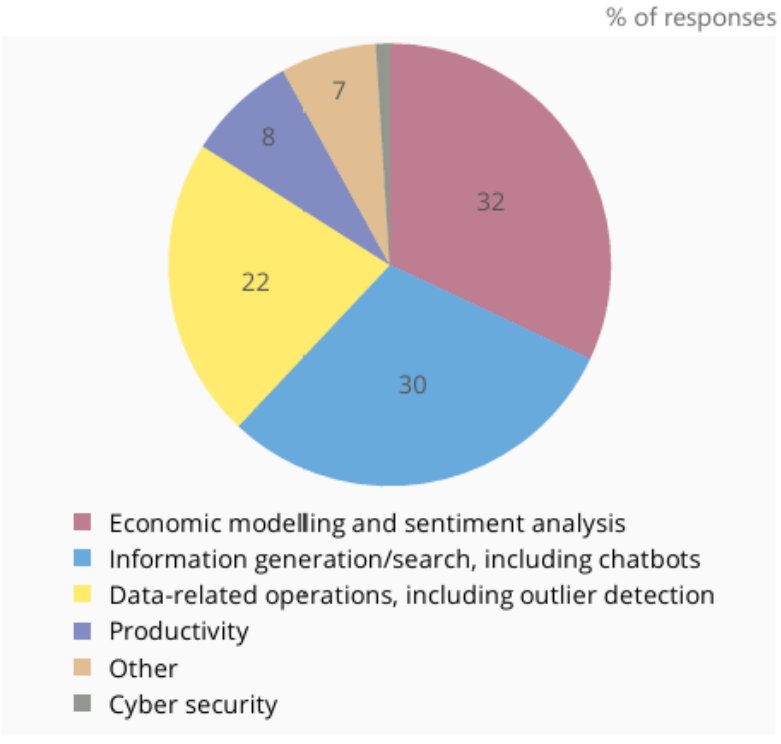
Despite high expectations, current AI-based applications remain limited and primarily relate to economic research, communication chatbots and statistics

Graph 6

A. Expected impact and current applications of AI/ML[1]



B. Reported AI/ML use cases by application scope[2]



[1] Expected impact is calculated as the average of the responses rated on a scale from 1 to 5 (1 = not sure; 2 = not impactful at all; 3 = slightly impactful; 4 = moderately impactful; 5 = highly impactful). The number of current use cases is presented normalised on a scale from 1 (min) to 5 (max). [2] Pilot or ongoing use cases also included. Respondents could indicate more than one answer.

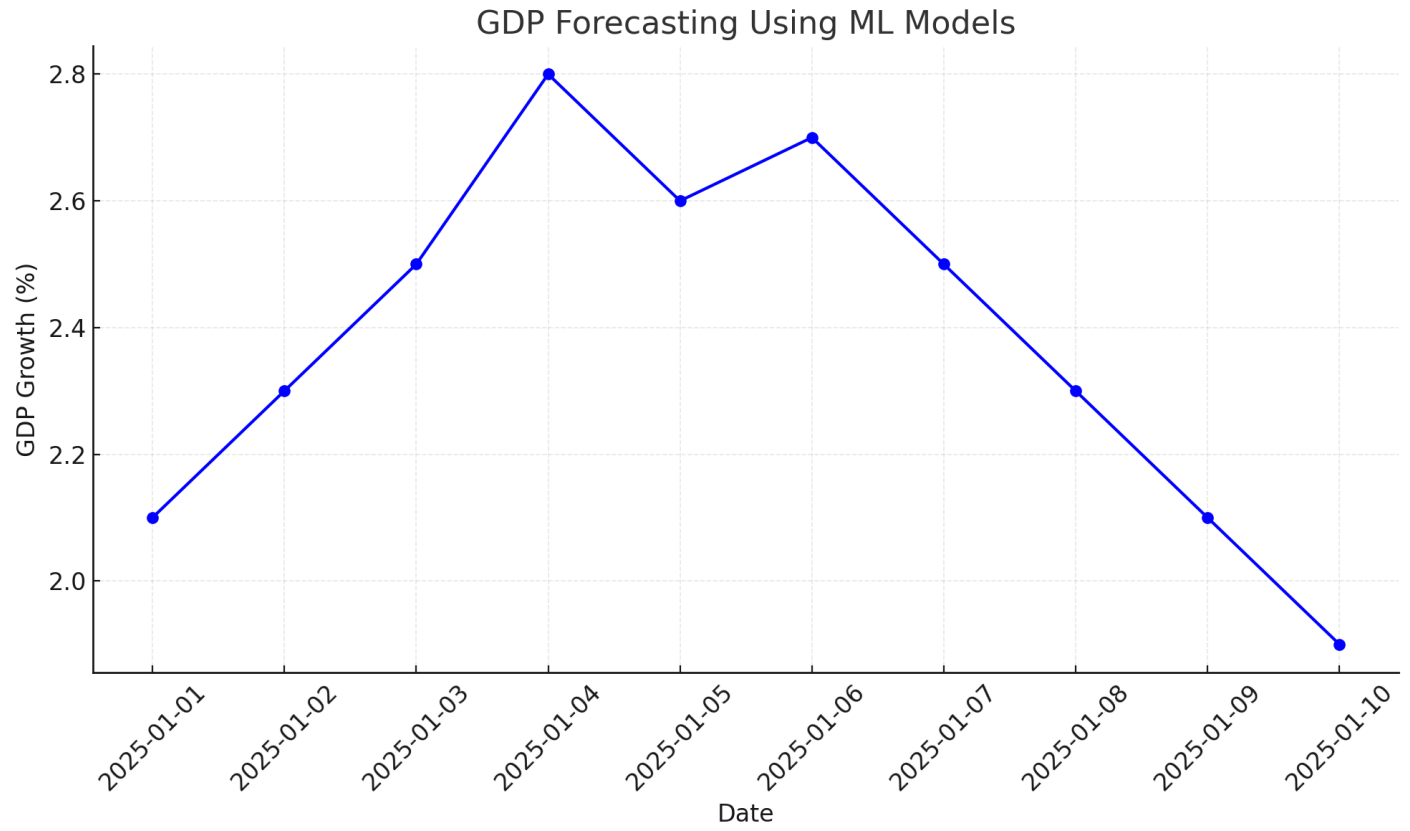
Sources: IFC survey on AI and ML (2024); authors' calculations.

(Source: IFC (2025) Governance and implementation of AI in CBs)

Use Case: Economic Forecasting

- Central banks utilize ML models to:
  - Nowcast GDP using high-frequency data (e.g., retail sales, electricity consumption).
  - Forecast inflation through sentiment analysis of news articles.
- Example: The ECB's application of NLP for sentiment analysis to predict macroeconomic trends.

Visualization: Forecasting GDP with ML Models



- The plot illustrates a predicted trajectory of GDP growth (%) over a 10-day period in January 2025, using a machine learning model.
- The line chart connects each data point to show the trend in GDP growth

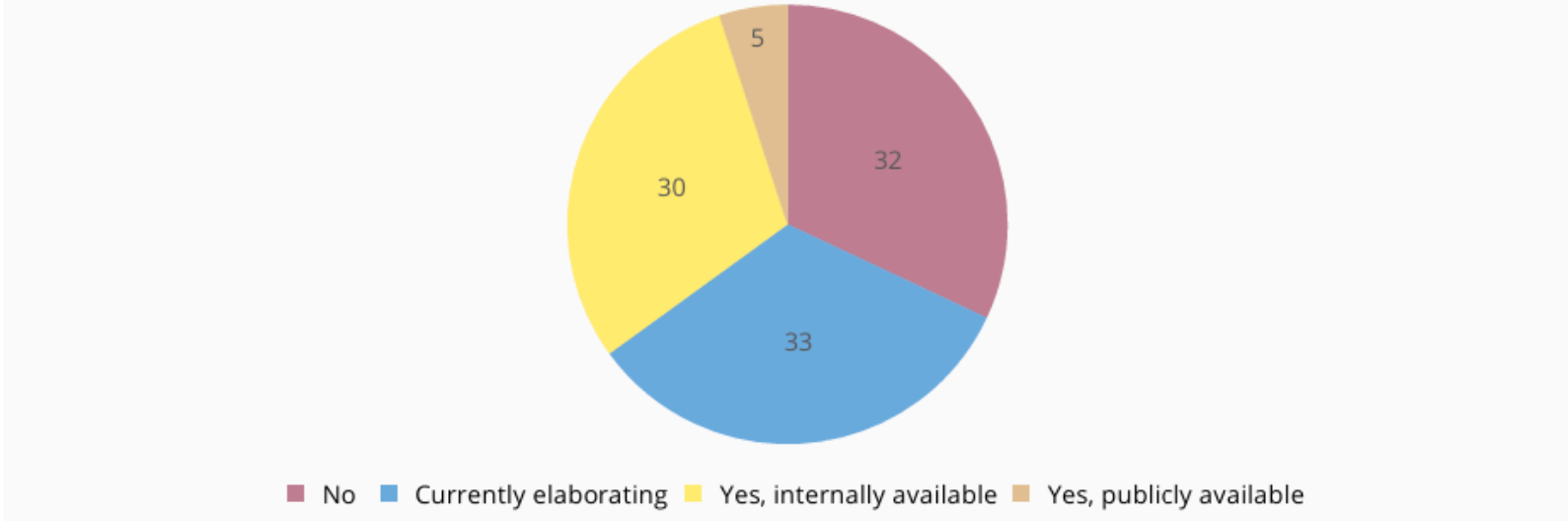
Governance and Risks in AI Adoption

- Potential Risks:
  - Data security and privacy concerns.
  - Model interpretability and transparency.
  - Algorithmic bias and fairness.
  - Operational risks from over-reliance on automated systems.
- Proposed Governance Framework (BIS 2025):
  - Establish interdisciplinary AI committees.
  - Implement robust data governance policies.
  - Conduct regular AI audits and risk assessments.

Most central banks do not have or are only just elaborating their policies for using AI

In per cent of respondents

Graph 8



Sources: IFC survey on AI and ML (2024); authors' calculations.

(Source: IFC (2025) Governance and implementation of AI in CBs)

Case Study: AI Governance in Central Banks

- **BIS 2025 Report on AI Governance:**
  - Highlights the importance of adaptive governance frameworks.
  - Recommends integrating AI oversight into existing risk management systems.
  - Emphasis on transparency, accountability, and compliance.

AI and Data Management in Central Banks

- Data quality is crucial for effective AI applications.
- Key challenges:
  - Data integration across departments.
  - Data privacy and security.
  - Real-time data processing.

Case Study: Federal Reserve's Use of Big Data

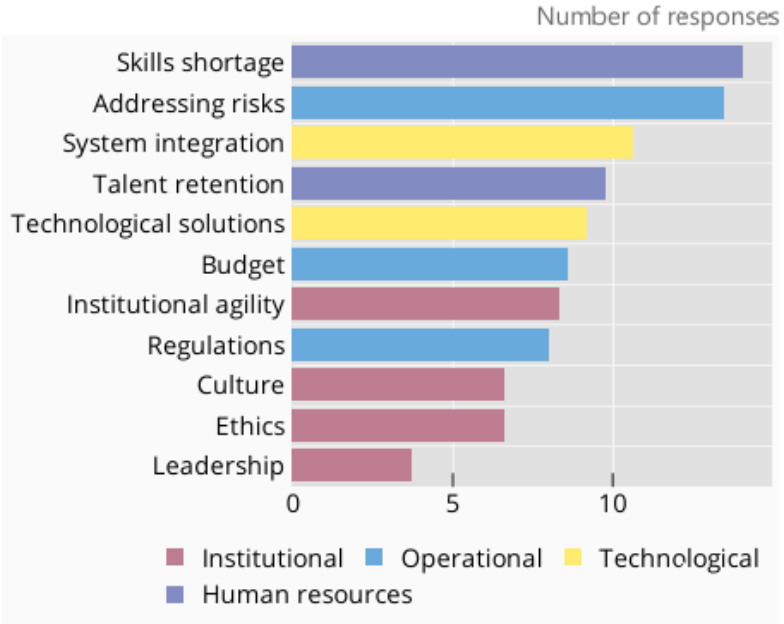
- The Federal Reserve leverages big data for:
  - Monitoring financial stability.
  - Detecting systemic risks.
  - Enhancing economic forecasting accuracy.

Risks and Ethical Considerations

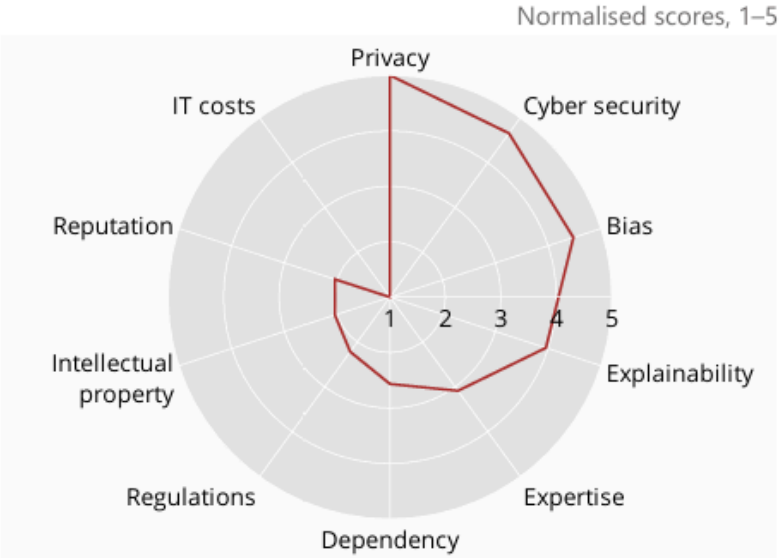
- Risks:
  - Potential biases in ML models.
  - Cybersecurity threats.
  - Model drift over time.
- Ethical Considerations:
  - Ensuring fair and unbiased outcomes.
  - Maintaining data privacy and confidentiality.

Central banks face significant challenges and risks in adopting AI/ML Graph 9

A. Skills shortage and addressing risks are key barriers



B. Privacy, cyber security and biases are top concerns[1]



[1] Normalised scores from 1 to 5 (1 = not sure; 2 = not impactful at all; 3 = slightly impactful; 4 = moderately impactful; 5 = highly impactful).

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(Source: IFC (2025) Governance and implementation of AI in CBs)

Discussion

- How can central banks balance AI adoption with data privacy and security?
- What governance structures can mitigate AI risks?
- How can ML models improve economic forecasting accuracy?

Summary and Key Takeaways

- ML/AI offers transformative potential for central banking but introduces significant risks.
- Robust governance frameworks are essential for responsible AI adoption.
- Ongoing training and interdisciplinary collaboration are key for successful AI implementation.

2. Guest Speaker: Dr. Cory Baird

Dr. Cory Baird

- Senior Analyst, GeoQuant (Fitch Group)
- Visiting Professor, University of Tokyo
- LinkedIn: Cory Baird

Academic Background

- **PhD in Public Policy, University of Maryland**
  - Focus: ML & NLP for Central Bank Communication Analysis
- **Master's in Public Policy, University of Tokyo**
  - Focus: Asian Financial Markets & FX Reserve Management

Professional Expertise

- Develops **NLP systems and MLOps/LLMOps infrastructure** at GeoQuant.
- Analyzes the intersection of **monetary policy and financial markets** using ML models.
- Combines **academic research with industry applications**, enhancing data-driven decision-making.

2. In-class Group Activity

Your Takeaways from the Guest Speaker:

- What are the key insights from Dr. Baird's presentation?
- How can you apply these insights to your own research or work in central banking?

Any QUESTIONS?

Thank You!

Next Class

-(May 21) Central Bank Digital Currencies (CBDCs)

- The readings will be posted on the Cyber Campus website.