# Artificial intelligence in EU securities markets: outlook and risks

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# AI: Recent advances drive market interest

## Broad concept, multiple methods

- AI: umbrella term for broad set of methods for problem-solving via statistics and computer science
- Vocabulary includes machine learning (ML), natural language processing (NLP), large language models (LLMs), analytical/predictive AI and generative AI (GenAI)

## New phase in long-standing methodological and technological development

- Predictive ML has long been used as part of financial and econometric modelling techniques
- Catalysed in the last decade by (1) explosion in data generation, storage and computing power (cloud, big data), (2) advances around deep-learning techniques and language models
- Value-creation potential across industries has sparked firms' and investors' interest; spending within finance sector forecast to double to USD 97 bn over 2023-2027 period (IMF, 2023)
- Economic impact uncertain: estimates range from +0.05% TFP growth (Acemoglu, 2024) to +1.5% labour productivity growth (Goldman Sachs, 2023) p.a. over next ten years in the US, or larger

# AI in securities markets: Gradual pick-up

## Predictive AI: Cutting-edge ML deployed by only few

- Simpler ML models (e.g. regressions, decision trees, k-nearest neighbours) and NLP widespread in data analytics and as part of wider decision-making processes
- More complex (e.g. neural networks) and self-updating (e.g. reinforcement learning) ML cutting edge in some applications, but still rare in practice
- Differing degrees of adoption within investment research and strategies, algorithmic trading and execution, securities pricing and lending, market infrastructures, credit rating

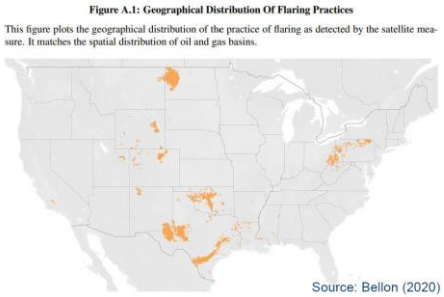
## Generative AI: large potential productivity impact

- Ubiquitous interest for GenAI and LLMs as support tools:
  - Boost unstructured data analytics and research
  - Automate compliance and reporting, administrative tasks
  - Client interaction, possibly robo-advising
- Potentially large operational impact, productivity and efficiency gains; 28% adoption rate in financial services globally (McKinsey, 2024; Turing Institute, 2024)

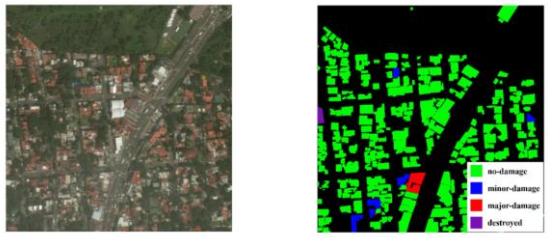
# Asset management: Diverse range of applications

- Broad spectrum of AI applications in **investment strategies**, from fully autonomous processes driven by **predictive AI** to those that integrate AI models' output to inform stock selection
- Quant and hedge funds can leverage AI (machine learning) models for **portfolio optimisation** and **asset allocation**, e.g. in estimating expected returns and their variance-covariance structure
- When used to support **fundamental analysis** and **research**, AI often includes different forms of **natural language processing** for textual analysis of companies' disclosures, news, broker research, call transcripts, regulatory filings, social media, etc.
- NLP is a key tool for **ESG assessment**, e.g. to measure companies' sustainability commitments, climate risks exposure, involvement in specific sub-themes
- AI also includes techniques to evaluate other **unstructured** and **alternative** data sources, such as satellite and aerial imagery, sensor data, potentially in real time
  - Crude oil flow and storage, harvests, impact of extreme weather events (commodity traders)
  - Flaring activity, pollution, deforestation (ESG investment)
  - Impact of natural disasters (insurers)


Source: TankersTrackers.com



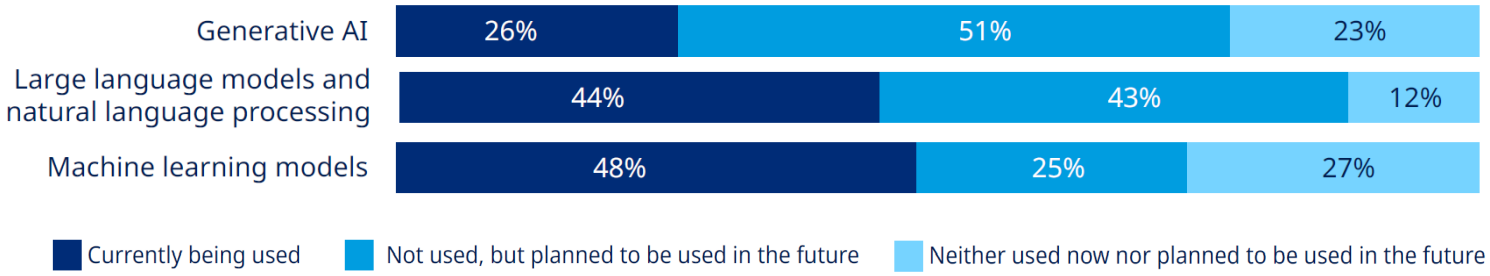

Source: Bellon (2020)




Source: Wang et al. (2022)

# Investment funds: AI as support, with “human in the loop”

- Most funds globally **are using or planning to use AI** to expand analysis, generate ideas, identify signals, incorporate alternative datasets (Mercer, 2024)

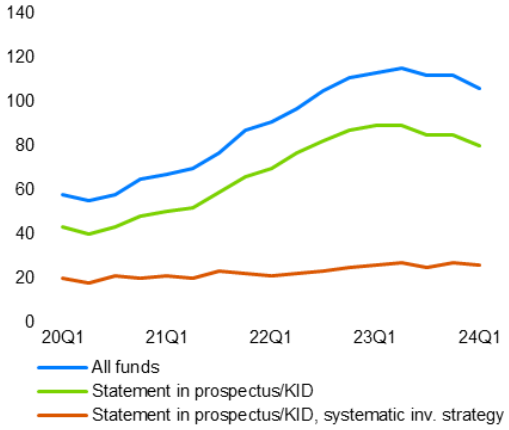



- However, a small minority of managers (14%) view AI as a key part of the investment process and **few report full automation** of ML models; most have not launched AI-supported investment strategies
- In practice, funds’ use of AI for investment management is largely focused on **supporting decision making**: AI informs rather than determines the final investment decisions
- Generative AI and LLM-based NLP expected to bring substantial **productivity gains across operations**:
  - In the investment process, through more efficient valuation modelling, financial statement analysis, opportunity screening, etc.
  - For marketing, client interaction, compliance, other administrative and control tasks

# Investment funds: limited public promotion

Number of funds stating use of AI

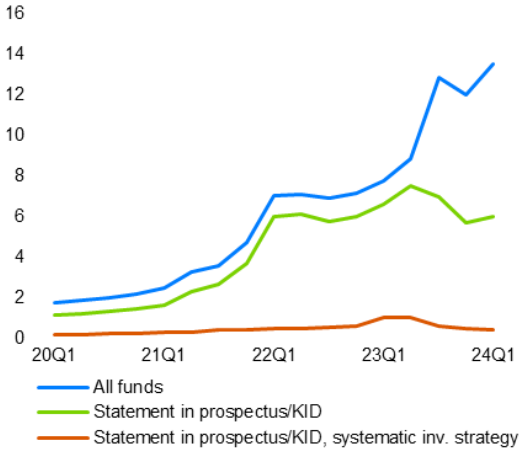
## Number of funds peaked in 2023




Note: Number of EU investment funds that state using AI or ML in the investment process.
Sources: Morningstar, ESMA

Assets of funds stating use of AI

## Insignificant volume impact




Note: Assets under management (EUR bn) of EU investment funds that state using AI or ML in the investment process.
Sources: Morningstar, ESMA

## AI use seldom publicised

- We monitored EU funds via text mining (44k existing and past funds screened, ~1M regulatory and marketing documents – 500k KIDs, 80k prospectuses, 250k factsheets)
- Only 80 funds currently state AI or ML is integral to the investment strategy (<0.1% of sector's assets); some more publicise AI use loosely in marketing material
- Fewer still have entirely AI-driven strategies or use AI as selling proposition by including AI in their name; AI often used in combination with other strategies

## Non-differentiating returns and costs

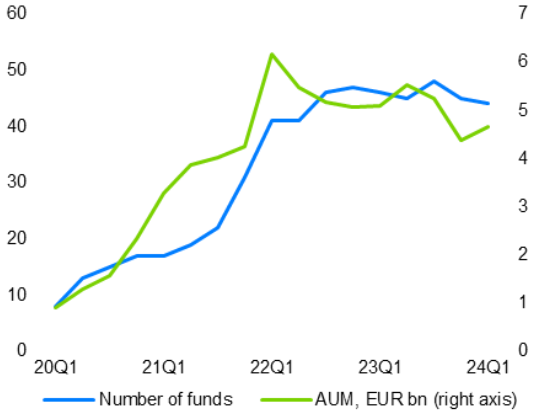
- No significant outperformance of AI funds
- Total expense ratio not significantly higher or lower

| | AI funds | Others | Difference (95% conf. interval) |
|---|---|---|---|
| Return (%) | 0.30 | 0.26 | [–0.24, 0.30] |
| Alpha (%) | 0.17 | 0.23 | [–0.32, 0.22] |
| TER (%) | 1.33 | 1.43 | [–0.30, 0.11] |

# Investment funds: scarce investor “hype”

Funds stating use of NLP

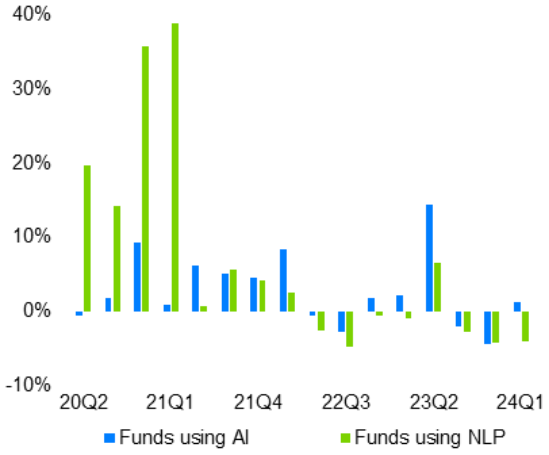
## Boom of NLP funds has stabilised




Note: Number and AuM (EUR bn) of EU investment funds that state using NLP in the investment process. Includes index-tracking funds stating that NLP is used by the index provider.
Sources: Morningstar, ESMA

Flows of funds stating use of AI or NLP

## Inflows uneven




Note: Investor flows (in percentage of AuM) at EU investment funds that state using AI or NLP in the investment process.
Sources: Morningstar, ESMA

## Mixed success in recent periods

- 50 funds stated that NLP enters their investment process; often for ESG assessment or to determine components of the tracked index
- AI and NLP funds saw alternating inflows and outflows in last two years

## Interpretation: gradual adoption, “AI-washing” unpalatable

- Full AI-driven systematic strategies involve data and modelling challenges (time series breaks, regime shifts, low signal-to-noise ratio)
- AI and NLP gradually becoming part of the toolbox (just like Bloomberg or Python); not promoted formally
- “Black box” stigma with clients may also be a limit; little incentive for “AI-washing” (exaggerating AI’s role)

# Algorithmic trading: substantial ML use

## Investment decision algorithms

- AI (ML) used in trading algos by hedge funds, trading desks of investment banks, proprietary trading firms; incl. for high-frequency trading; esp. for liquid instruments with plentiful and timely data (equities, futures, forex)
- Simpler supervised learning models already widespread in some segments; Dutch trading firms use ML in 80%-100% of their trading algorithms (AFM, 2023)
- Some brokers use ML for hedging and quoting decisions, e.g. responding to clients' requests for quote based on client-related past data
- Securities lenders use ML to set optimal pricing and predict "hard-to-borrow" securities

## Trade execution

- Some brokers and large buy-side investors such as pension funds use ML to minimise market impact by optimally splitting large trades across trading venues and times
- Nonparametric ML models such as neural networks allow better modelling of non-linearities of market impact, esp. for less liquid securities where past data is scarce

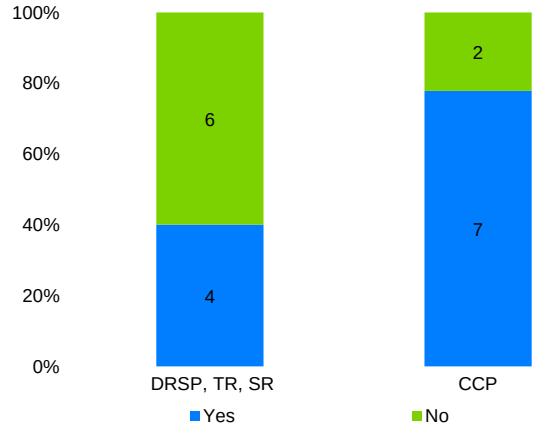
# Market infrastructures: potential for process optimisation

## Main use cases

- Some central securities depositories, CCPs and brokers use ML to optimise trade settlement cycle and predict settlement failures (e.g. neural networks, XGBoost)
- Some CCPs use ML for risk management (optimize portfolio structure, credit risk, collateral requirements), client segmentation
- Some trade repositories and data reporting service providers use ML models or NLP for anomaly detection, data verification, data quality checks, automated data extraction from unstructured documents

Market infrastructures using GenAI

Heterogeneous GenAI adoption




Note: The chart shows the answers to the question "Is your entity using generative AI tools or planning to do so in the near future?". Survey conducted in November 2023 among EU entities. DRSP = data reporting service providers, TR = trade repositories, SR = securitisation repositories, CCP = central counterparties.
Sources: ESMA

## Outlook on AI use

- Many entities plan to use GenAI; often "off-the-shelf" general-purpose models (MS Copilot, ChatGPT, GitHub Copilot, etc.) with some planning fine-tuning of models; few are exploring in-house tools, e.g. for client interactions, synthetic data generation
- Large operators more advanced in adoption cycle, esp. for more sophisticated methods requiring large amount of data
- Potential for larger cost savings and process optimisation, but concerns around operational and cyber risks, third-party dependency, data privacy

# Credit ratings: Enhanced data handling

## Main use cases

- Credit rating agencies use analytical AI (Bayesian statistics, clustering techniques) for unstructured datasets, risk management, credit rating assessment; no automation of credit ratings
- Since well before GenAI, NLP and NLG had become popular tools to enhance information sourcing and processing, report writing
- As of late 2023, few CRAs used GenAI, but 60% were testing or making plans; one large CRA combines off-the-shelf GenAI technology with internal data, analytics and research

Activities performed with AI by CRAs

AI mostly used in support functions


Note: The chart is based on a survey submitted to 24 CRAs based in the EU in April 2022. 11 CRAs provided their responses to the question: "Does your entity make use of AI to perform one or more of the following activities?".
Sources: ESMA

## Outlook on AI use

- Potential for AI to further enhance credit rating assessment (predictive AI for quantitative side, GenAI for discretionary side)
- Limitations from large investments to acquire expertise and technology, regulatory uncertainty around AI; concerns around proprietary data handling and privacy, models' accuracy and bias

# Risks: Multiple open ends

## General AI risks

- Vulnerability to algorithmic biases and data quality not new, but amplified as AI systems become more complex and used on a large scale; risk management impaired by lack of model explainability (e.g. neural networks)
- Risks of reinforcement learning trading algorithms to learn unintended and collusive behaviour, exacerbate volatility and shocks

## GenAI implications

- GenAI can exacerbate several risks such as operational, data protection and privacy risks; potential impact suddenly increased by low barriers to use and consumer-facing role
- Concentration of AI providers increases third-party dependency and systemic risk, pro-cyclicality and herding due to greater homogeneity in risk assessments and credit decisions
- Malicious use of GenAI may distort markets via fake content, data poisoning and cyber attacks; indicators constructed using textual data are prone to manipulation

## Broader market developments

- Booming valuations of AI-centred companies may lead to price bubbles, lack of diversification; start-ups may market themselves as “AI” to attract funding

## Supervisory perspective

- Use of AI not yet disruptive, but warrants risks monitoring
- EU AI Act to promote risk management and ensure tools are developed and used responsibly across sectors

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