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Reporting, Disclosure, Data Strategy and AI Team
Prudential Regulation Authority
Threadneedle Street
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Via email: DP5_22@bankofengland.co.uk

Re: Bank of England and Financial Conduct Authority discussion paper on Artificial Intelligence and Machine Learning

Dear Sir/ Madam:

State Street Corporation ("State Street") welcomes the opportunity to respond to the Discussion Paper ("DP") issued by the Bank of England ("BoE"), including the Prudential Regulation Authority ("PRA"), and the Financial Conduct Authority ("FCA") on the use by financial institutions of artificial intelligence (AI) and machine learning (ML) in the provision of services to their clients and in the conduct of their operations. The BoE, PRA, and the FCA seek to encourage a broad-based and structured discussion with stakeholders on the challenges associated with the use and regulation of AI, including clarifying how the existing regulatory framework applies to AI and addressing any identified gaps in the regulatory framework.

Headquartered in Boston, Massachusetts, State Street is a global custodian bank which specializes in the provision of financial services to institutional investor clients, such as pension plans, mutual funds, alternative investment funds, central banks, charitable foundations and endowments. These services include the provision of investment servicing, investment management, data and analytics, and investment research and trading. With $36.7 trillion in assets under custody and administration and $3.4 trillion in assets under management, State Street operates in more than 100 geographic markets globally.[1]

[1] As of December 31, 2022.

We appreciate the opportunity to offer insight on the use of AI/ML, informed by our role as global custody bank, a role that is widely understood by the market and by the regulatory community as providing important benefits for the safety of client assets and the seamless day-to-day operation of the financial system.

We broadly support the BoE, PRA, and the FCA efforts to explore the trends and the regulatory implications in the use of AI/ML by financial institutions and we believe that the existing model risk management framework for prudentially regulated entities, when combined with existing information technology ("IT") risk management and third-party risk management standards, is sufficiently robust to address potential risk related to the deployment and use of AI/ML.

Below we offer: (i) certain high-level observations regarding the use of AI/ML by prudentially-regulated financial institutions; (ii) considerations regarding the proper definition of AI/ML; (iii) an overview of current select State Street use cases; and (iv) responses to the some questions posed within the DP that are relevant to our business model and its specialized focus on meeting the financial services needs of institutional investors.

Use of AI/ML by prudentially-regulated financial institutions

As emphasized above, we believe that the existing model risk management framework for financial institutions subject to prudential regulation, when combined with existing IT risk management and third-party risk management standards, is sufficiently comprehensive to address potential risks related to the deployment and use of AI/ML solutions. This includes well-established expectations for model identification, model development, model implementation, model validation, and ongoing monitoring and use, which properly accommodate differences in underlying use cases and business models.

In general, we do not face major challenges in the use of AI/ML models in our operations, since existing risk management expectations are well-suited to identify and address potential risks. Still, given the growing use of AI/ML within the industry and the expanding range of use cases involved (across both financial and non-financial models), we recognize the importance of industry focus on the particular challenges that AI/ML models may present.

Key practices, in this regard, includes the implementation by financial institutions of enhanced and scalable IT infrastructure, the ongoing monitoring of model outputs, the use of targeted internal testing strategies and the implementation of adequate data governance oversight and controls. Furthermore, we believe that the financial industry would benefit from greater clarity on the use of third-party vendor products for AI/ML, given the increasing prevalence of these tools and applications in the market.

Definition of Artificial Intelligence

Broadly speaking, we would define AI as the intelligence by machines or systems to perform tasks normally requiring human intelligence. Under the umbrella of AI, there are two primary categories of activities requiring different internal risk governance approaches:

- The first category involves the use of ML, which leverages techniques or algorithms to identify patterns in large amounts of data from increasingly diverse and innovative sources to make inferences. ML is used to 'enable' the subjective attributes of AI, including the ability of systems to emulate visual perception, decision making and natural language recognition. ML employs statistical methods or subjective judgment to model inputs, which are then used to derive quantitative outputs. Within this category, there are different types of potential algorithms used based on the level of human involvement required in labelling the data:
    - Supervised learning is where the algorithm will detect certain patterns (e.g. linear relationships) from the training data that are labelled (e.g. a defaulted loan is labelled as 'defaulted'), patterns that can then be used to predict labels for the validation data. Supervised learning includes parametric/non-parametric algorithms, support vector machines, kernels and neural networks. Linear regression is a type of supervised learning, but AI/ML algorithms are not constrained to the linear relationship.
    - Unsupervised learning is where the algorithm is trained on data without any label. The algorithm detects patterns in the data through grouping observations with similar underlying characteristics. Unsupervised learnings include clustering, dimensionality reduction (such as principal component analysis) and recommender systems.
    - In Reinforcement learning, data is not pre-defined. The goal is to explore or learn a series of actions, rather than predict an output or find a pattern. While supervised learning maps labelled data to a known output, and unsupervised learning finds the pattern and predicts the output, reinforcement learning follows a trial and error method. It learns through delayed feedback by interacting with its environment. In other words, the algorithm is fed an un-labelled set of data, chooses an action for each data point, and receives feedback (including from a human) that helps the algorithm learn. Reinforcement learning can be used in robotics, game theory and self-driving cars.
    - Deep learning uses algorithms that work in 'layers' (called artificial neural networks), inspired by the structure and function of the brain. Deep learning algorithms can be used for supervised, unsupervised or reinforcement learning. Recently, deep learning has led to remarkable results in diverse fields, such as image recognition and natural language processing ("NLP"). NLP allows computers to 'read' and produce written text.
- The second category of AI relates to classic process automation, such as digital process automation, robotic process automation and business process management improvements. This category employs prescriptive, rule-based logic flow approaches that perform or simulate certain deterministic human tasks

without subjective judgement or forecasting elements. Within State Street, we subject these AI approaches to a separate technology risk management and governance management framework applicable to traditional software development.

Our observations in this comment letter are focused on the first category of AI/ML activities and their implications for our business model and its specialized focus on meeting the financial services needs of institutional investors.

State Street use cases

To help illustrate the importance of a risk management framework for AI/ML that properly accommodates differences in use cases and underlying industry business model, below we provide certain examples of AI/ML-based solutions currently deployed by State Street to help meet our clients' needs and enhance the overall efficiency of our operations. These use cases address several business imperatives in our role as a global custody bank, including the achievement of greater operational efficiencies, improved client service and asset management capabilities, and strengthened risk management and compliance controls.

- Transaction Processing: As part of our trade settlement processing function, we're leveraging deep learning-based computer vision models to locate and identify signatures on manual, faxed trade instructions. This process also leverages an optical character recognition and natural language processing-based machine reading service to extract key information from the unstructured manual trade ticket to automate data entry, thereby improving operational efficiencies and reducing potential risk.
- Client Inquiry Management: During the course of each trading day, we receive a large volume of inquiries from our clients. To accelerate and improve our client service function, we've deployed natural language processing and ML to automatically read client inquiries, classify them by type for efficient routing, extract the relevant information from the inquiry and automate the research and retrieval of additional data from our systems to expedite resolution.
- Regulatory Oversight: As part of our internal risk management controls, we maintain a current and comprehensive catalog of regulatory obligations which are mapped to the required compliance function. We've developed an internal solution to help automate this process, leveraging ML and deep learning trained models to ingest regulatory documents and examination handbooks to identify and classify regulatory obligations by business control type.
- Client Contracts: Our internal contract management system provides for the digitization of client contracts. This solution is foundational to satisfy our 'know your customer' obligations and the appropriate management of our contractual risk. We have recently State Street Corporation Page 6 enhanced this platform with an AI solution, using ML and natural language processing to classify contracts by type, extract key entity data and type of contract language (e.g. governing law, use of data consent, LIBOR clauses, proxy voting, etc.). We also provide an advanced AI-based search capability against the full repository of ingested contracts.

- Fund Compliance: To help support investment fund compliance with prospectus terms, including pre and post-trade obligations, we're deploying an AI-based solution to harvest compliance rules from complex fund documentation. Using deep learning based natural language processing, we are able to automatically identify compliance rule language and classify each rule for subsequent implementation within our rules management system. This solution also automates the discovery of new, modified or deleted rules between different versions of a fund's prospectus documentation.
- Fund Risk Assessment: The process of researching and assigning a risk rating for each of our investment fund clients is a highly manual and labor intensive undertaking, involving the review of hundreds of pages of fund, and in some cases multi-fund, prospectus documents in order to extract counterparty, domicile and other core information, answer a number of risk rating questions, and then feed the data into a risk rating model. Recently, we've deployed a solution leveraging ML and natural language processing to automate the information extraction process and help predict the answers to risk rating questions, thereby greatly improving internal efficiencies and reducing potential risk.
- NAV Quality: State Street is responsible for the calculation and generation of net asset values ("NAV") for tens of thousands of investment funds daily. We've deployed ML solutions to derive a custom benchmark for each investment fund, including what combination and weighting of market indices most closely represents that fund's historical performance. The customized benchmark is then used during the course of the daily NAV calculations to flag anomalies and areas requiring more focused investigation.
- Inadvertent Data Disclosure Prevention: As an additional safeguard to protect our client's data, we are deploying several AI-based checks on reports delivered to clients via e-mail. These checks automatically read the email and any attachments extracting sensitive information, such as client name, fund identification number and account number, and validates the data against a master record for the targeted recipient of the e-mail. The AI solution also detects behavioral differences and anomalies in the communication based on learning from the history of past communications between State Street and each client.
- Anti-Money Laundering Compliance: Like all banks, we have a responsibility to monitor our customers and their transactions that could be related to money laundering and/or terrorist financing and report any unusual activity to the Financial Crimes Enforcement State Street Corporation Page 7 Network. We have developed new models, architected as a collection of both supervised and unsupervised ML-based estimators that detect potential suspicious activity while reducing the 'noise' and inefficiencies inherent in legacy 'rules-based' logic models.
- Data Quality**:** We are developing an AI based Data Quality Platform incorporating a combination of machine learning and deep learning based models. The Data Quality Platform will cover a variety of data domains and business functions across State Street. Examples of the initial data domains being targeted include security master reference data, market data, security pricing valuation data, security analytics data and middle office portfolio data.

- File Quality Checks: Each day we distribute thousands of data files to our clients. These files are in various formats and span many business delivery functions. We are leveraging AI-based checks in the final stages of these file deliveries to detect anomalies in the files based on machine learning of past file deliveries to the client. These anomalies might be abnormal file sizes, dates, structures or content including statistical deviations of individual fields.
- Operational Incident Classification: To help expedite and accelerate our response and resolution to operational incidents, we are now leveraging machine learning and natural language processing to automatically classify new incidents based on learnings from past incidents to identify root cause analysis and to recommend and accelerate subsequent actions to resolve.
- Fundamental Review of Trading Book: We have added machine learning based models for improved data quality checks of vendor market data, with the ability to detect data anomalies, provide evidence and challenge the vendors. This helps to improve the quality and accuracy of our controls and risk measures.
- Bank Loan Processing: We have implemented an AI based data ingestion to automate and accelerate the transcription of bank loan agent notices, funding memos and pricing letters. We are also using machine learning based predictions to match incoming wires to issuer names.

Response to select questions

Q1: Would a sectoral regulatory definition of AI, included in the supervisory authorities' rulebooks to underpin specific rules and regulatory requirements, help UK financial services firms adopt AI safely and responsibly? If so, what should the definition be?

We welcome the DP analysis on the difficulties in bringing an accurate definition of AI. As explained above, there are already a considerable number of uses cases in the market for AI and Machine Learning which do not create material market risks, and which always preserve a "human in the loop" model, ensuring human supervision at all times. Therefore, we consider that anything the UK regulation plans to do should be commensurate to the material risk of each individual use case. A "one size fits all" set of regulations against the use of AI and Machine Learning would not be recommended. Instead, the BoE, the FCA and the PRA should continue with the current technology-neutral and outcome focused regulatory approach.

Q2: Are there equally effective approaches to support the safe and responsible adoption of AI that do not rely on a definition? If so, what are they and which approaches are most suitable for UK financial services?

As explained above, State Street mainly uses AI for processing improvements, not for balance sheet management or lending. This means that the risk to the firm is fairly limited in terms of material impacts that such AI/ML use can have on financial stability. Moreover, we note that firms' existing risk management frameworks, such as model risk management, have been in place for a long time and are comprehensively embedded in the three lines of defense model. These should already go a long way in addressing many of the risks AI might generate or emphasize.

We are nonetheless, consistent with the Federal Reserve guidance on Model Risk Management SR 11-7 and the PRA Supervisory Statement (SS3/18), our internal model risk management framework offers guidance on how to assess and address the conceptual soundness of AI/ML models. Specifically, our model risk management standards:

- Clarify that the model validator 'must determine if the model results are sound, stable, robust and properly interpreted.' A model that does not produce intuitive outcomes when tested over a wide range of inputs and parametric values, is assigned to a high-risk score when assessing robustness.
- Incorporate a detailed framework for the validation of AI/ML models, with preferred methods and statistical testing requirements clearly explained. This includes the use of multiple techniques to diagnose multicollinearity and ways for model developers to resolve this issue.
- Ensure the maintenance of human oversight when modelling choices cannot be fully supported via empirical evidence.
- Require robust ongoing monitoring practices to ensure that all components of a model function as designed, with an emphasis on data quality, dynamic model updates, and model performance monitoring for AI/ML models.

Moreover, we identify and manage potential risk of our AI/ML models through a tiering-based approach. This involves the assignment of our AI/ML solutions to one of four categories (tier 1, 2, 3 or 4) based on the inherent or potential risk that each model may pose to State Street. This assessment is based on several criteria including:

- Model application/use;
- Size impact, materiality and volatility; and
- Intrinsic model factors

A model's classification determines the scope, intensity, and frequency of our model risk management activities. Models considered to have the highest inherent risk or potential impact (tier 1 models) receive the greatest level of oversight and governance. Similarly, AI/ML models with a regulatory, risk management or critical business purpose are assigned to higher use priority in the tiering framework. By comparison, models that provide research, informational or internal reporting uses, or workflow enhancements of non-critical functions, are assigned a lower use priority and tier.

Q3: Which potential benefits and risks should supervisory authorities prioritise?

We are particularly worried by the risks that could come from AI/ML uses by non-regulated financial and technological companies. Prudentially regulated financial institutions are heavily regulated and scrutinized, with all the relative costs that come with that. There is not the same level of scrutiny on other Fintech firm that use the same kind of AI and machine learning models. On top of self-evident level playing field issues, this disconnect between

vendor AI models and the internally-built AI models risks opening the door to risks to the financial system coming from non-regulated entities.

We see greater challenges for prudentially regulated financial institutions when using third party vendor-based AI/ML models. While banks, such as State Street, are able to conduct due diligence on vendor products at the time of purchase and fulfill risk oversight and control on a periodic basis, the “black box” nature of third-party vendor products (e.g. no disclosure of the model construction) and the impact of dynamic updating may expose financial institutions to significant risk if legal contracts do not adequately limit its potential liability. Also, third party vendor products shared by major financial institutions may pose systematic risk due to the scope and ubiquity of use.

As such, we recommend that the BoE, the FCA and the PRA consider greater regulatory guidance on this topic. This includes the level of input, processing and output monitoring that is required of third-party vendor products, requirements for independent validation, the frequency of review and testing, and the enforceability of an industry-wide standard for model due diligence.

Q6: How could the use of AI impact groups sharing protected characteristics? Also, how can any such impacts be mitigated by either firms and/or the supervisory authorities?

As a global custody bank our use-cases do not deal with individual consumers as a retail bank would, so typical concerns around ethical bias at an individual level do not exist in our use-cases. Bias risk that is applicable to our use-cases would be inaccuracies in model outputs due to mislabelled training data or imbalances in the training data. In order to mitigate these risks it is important to:

- Ensure balanced representative samples for each target class
- Leverage diverse data labelling (categorization performed by diverse set of operators, similarity analysis across labelled data sets, synthetic labelled data set generation)

Protecting against incorrect, incomplete or mislabelled data is essential, and to this end statistical analysis and curation techniques to the training data input set can help, together with AI/ML based Anomaly detection to spot errors or omissions in the input data feature sets.

Q10: How could current regulation be clarified with respect to AI?

As stated above in our response to Q2, we do not consider that new regulation is required to address prudential regulated financial firms’ use of AI, as there is already a comprehensive regulatory framework that applies (data protection, model risk management, conduct rules etc).

We would like nonetheless to raise an issue in relation to third party-sourced AI systems, an area which requires greater regulatory attention and action, as explained in our response to Q3. This will help firms leverage third-party solutions in a more secure and transparency way, and also lead to a more robust AI eco-system.

Conclusion

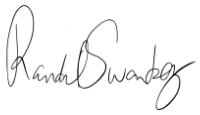
Thank you once again for the opportunity to respond to the DP and the key matters raised therein. In general, we believe that prudentially regulated financial institutions are well equipped to address challenges related to the increased use of AI/ML models in their products, services and operations, and that existing expectations regarding the management of model risk are sufficiently comprehensive and robust to address potential risks.

Still, given the financial industry's increasing use of AI/ML and expanded business use cases on the horizon, we recognize the importance of identifying and addressing the particular challenges that AI/ML models may pose over time. In our view, these challenges can be mitigated by banks and other financial institutions by:

- Enhancing the ongoing monitoring framework, notably in the areas of data quality, model updating and model performance;
- Exploring opportunities for enhancement in the validation process, including the development of targeted testing strategies to assess model risks;
- Implementation of enhanced IT-infrastructure, data governance oversights and controls; and
- Creation of industry working groups to share AI/ML knowledge and business use cases.

Finally, we note the particular challenges raised by the use of third-party vendor-based AI solutions and believe that prudentially regulated financial institutions would greatly benefit from additional clarification or guidance from the Agencies on expectations for their use, management and oversight.

Sincerely,



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