Bank of England

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House of Commons
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Andrew Bailey
Governor

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Dear Harriett,

Thank you for your letter on 22 January 2024 following the Treasury Committee evidence session on the December Financial Stability Report. I have provided responses to the questions raised below.

Artificial intelligence and quantum computing

1. **What additional risks does Artificial Intelligence pose to financial stability, taking into account (i) its potential impact on speed of transactions (ii) herding and (iii) potential problems arising from "hallucinations"?**

AI and machine learning could deliver significant benefits to the UK financial services sector, by driving greater operational efficiency, improving risk management, and providing new products and services, but it could also pose new or increased risks. Given the speed, scale and complexity of AI systems, the use of AI by individual firms and within financial markets may amplify many of the existing risks to financial stability through various transmission channels[1]. AI may increase the scale of procyclical behaviour and herding and so greatly amplify swings in market prices.

[1] See **DP5/22 - Artificial Intelligence and Machine Learning | Bank of England**

A further key challenge lies in firms' ability to monitor operations and risk management activities that take place at third parties. Operational failures and cyberattacks at critical third parties could result in disruption to AI services that lead to a single point of failure impacting multiple firms and markets. In addition, a third-party AI model not performing as intended, including "hallucination" (i.e. the generation of plausible sounding but inaccurate outputs), could conceivably impact multiple firms and markets.

The supervisory authorities published CP26/23 'Operational resilience: Critical third parties to the UK financial sector'[2] in December 2023 which proposes how the authorities might identify and recommend third parties for designation by HM Treasury, where disruption to the services they provide could threaten the stability of, or confidence in, the UK financial system.

Given the rapid pace of innovation and potentially widespread use cases, the impact of AI and machine learning on financial stability will need careful monitoring and consideration. The FPC will further consider the financial stability risks of AI and ML in 2024 and, working alongside other relevant authorities, will seek to ensure that the UK financial system is resilient to risks that may arise from widespread adoption of AI and ML.

2. **How can the operation of machine learning-generated algorithms, which may be biased or discriminatory, be made more transparent?**

As noted in the Government's March 2023 AI Regulation White Paper[3], the increasing adoption of machine learning algorithms raises a number of issues relating to transparency and, related, explainability. Specifically, they relate to at least three issues relevant to the Bank and PRA's regulatory remits:

- **Transparency of data used to train the model.** The PRA's Supervisory Statement 1/23 on Model Risk Management (MRM) principles for banks includes a number of expectations under Principle 3.2 on 'the use of data'[4], such as ensuring there is no inappropriate bias in the data used to train models.

[2] **CP26/23 - Operational resilience: Critical third parties to the UK financial sector | Bank of England**

[3] **Error! Hyperlink reference not valid.**

[4] **Model risk management principles for banks supervisory statement (bankofengland.co.uk)**

- **Complexity of the model.** While the PRA's SS1/23 does not require firms to make their machine learning algorithms more interpretable or explainable, firms are expected to assign higher model risk to more complex models. Risk-based model tiering should then be used to prioritise their validation activities and other risk controls through the model lifecycle, and to identify and classify those models that pose most risk to a firm's business activities and/or firm safety and soundness.

- **Effective oversight and accountability**. The PRA's SS1/23 includes a number of expectations under Principle 2 on Governance. For example, firms should identify a relevant SMF(s) most appropriate within the firm's organisational structure and risk profile to assume overall responsibility for the MRM framework, its implementation, and the execution and maintenance of the framework. The accountable SMF(s)'s responsibilities regarding MRM may include: establishing policies and procedures to operationalise the MRM framework and ensure compliance; assigning the roles and responsibilities of the framework; ensuring effective challenge; ensuring independent validation; evaluating and reviewing model results and validation and internal audit reports; taking prompt remedial action when necessary to ensure the firm's aggregate model risk remains within the board approved risk appetite; and ensuring sufficient resourcing, adequate systems, and infrastructure.

It should be noted that the Bank's statutory responsibility is to maintain financial stability, including the safety and soundness of firms. Issues relating to biased and discriminatory outcomes are more likely to be relevant to the FCA given its consumer protection objective.

3. **What are the risks arising to financial stability from a so-called 'Quantum Apocalypse' and quantum computing generally; and how is the Bank mitigating them?**

Quantum computing[5] uses the laws of quantum mechanics to perform computations with orders of magnitude increases in performance over conventional computers. Quantum computing can therefore perform computations not possible with conventional computers.

[5] Current quantum computers are highly sensitive to electrical interference and suffer from relatively high computing error rates. Quantum computing is reported to require further development to be productionised, and a viable quantum computer is expected by 2030.

Advances in quantum computing could pose risks to public key cryptography widely used to secure data and systems today. Public key cryptography uses a pairs of public and private keys to encrypt messages in a way which is all but impossible to decrypt using conventional computers without access to the private keys.

However, quantum computers are able to decrypt messages without access to the private key, which therefore presents the following risks:

- Threat actors with access to a public key and a viable quantum computer might derive the corresponding private key and: impersonate the key owner, forging their digital signature and authorising spending of funds; and/or tamper with information whose authenticity is protected by a digital signature, compromising the integrity and authenticity of payment data.
- Threat actors might collect volume encrypted data anticipating decryption in the near future. As such, a viable quantum computer could present a threat to the security of payment and personal data stored at scale.
- Threat actors with access to future viable quantum computers are likely to be nation states. Their prime target would likely be systemic disruption, rather than financial crime and fraud.[6]

In order to mitigate these risks, the Bank will continue to build on its established framework to enhance the cyber and operational resilience of the financial sector, including the FPC's cyber stress tests, Supervisory Statement 1/21 on Operational Resilience, and through its participation with the Cross Market Operational Resilience Group (CMORG)[7]. The Bank will continue to engage and collaborate with other relevant authorities, both domestically and internationally, including the National Cyber Security Centre. Bank staff will continue to consider the wider implications of quantum computing for the financial system[8] and closely monitor the work of other authorities on this issue[9].

[6] See **The digital pound: Technology Working Paper (bankofengland.co.uk)**

[7] See **Thematic findings from the 2022 cyber stress test | Bank of England**, **SS1/21 Operational resilience: Impact tolerances for important business services | Bank of England** and **Operational resilience of the financial sector | Bank of England**

[8] See **Schrodinger's market: what the quantum internet could mean for the financial system – Bank Underground**

[9] See **Project Leap: quantum-proofing the financial system (bis.org)**

4. **What additional work on Artificial Intelligence and quantum computing is the Bank intending to do in 2024?**

Given the rapid pace of innovation and potentially widespread use cases, the impact of AI and ML (including LLMs) on financial stability needs careful monitoring and consideration. As such, the FPC will further consider the financial stability risks of AI and machine learning in 2024. The PRA will supervise the risks that arise from firms' using models in line with existing supervisory guidance, and as AI and machine learning models become more prevalent and used for activities that matter for its objectives, then they will naturally begin to fall within the scope of supervisory reviews. We will work closely with the FCA, other UK sectoral regulators and our international counterparts on how they are approaching the regulatory issues posed by the use of AI within their remits. We will continue to engage with and support Government as it continues to develop its approach to AI regulation in the UK.

On quantum computing, please see answer to question 3.

Flooding

5. **How likely is it that flooding could significantly increase the risk of financial instability in the UK in the future, including through homes losing value and becoming uninsurable?**

Scientific projections suggest climate-related storm surges will increase UK inland flooding and coastal inundation over the coming decades[10]. This could create financial risks via several channels, primarily by lowering property values and the affordability of insurance coverage.

These risks were explored within the Bank of England's 2021 Climate Biennial Exploratory Scenario (CBES). This exploratory exercise indicated that an increase in the frequency and severity of flooding incidents could pose risks to property and infrastructure assets and that some of these risks would be higher in the UK postcodes most exposed to flooding. In addition, it confirmed that banks may also experience asset stranding in their mortgage portfolios.

The extent of financial stability risk depends on various factors, for example the effectiveness of climate adaptation measures and infrastructure developments.

[10] For example, by 2070 the Met Office has projected the >30mm per hour threshold required to issue a flash flooding alert will be met twice as often in the UK as it was in 1990. See: **https://www.metoffice.gov.uk/weather/climate-change/climate-change-in-the-uk**.

The PRA is taking steps to help ensure the banks and insurers that it regulates are developing approaches to understand and manage these risks. This includes insurers modelling the impacts of physical change, including flood risks.

6. **How critical is Flood Re in mitigating the losses from flooding and reducing any risks of financial instability?**

Flood Re is an important component of the UK's strategy to mitigate the risks posed by physical climate changes to the financial system. However, the Flood Re scheme only covers residential property and has specific eligibility requirements including that properties covered were built before 2009 and are owner-occupied. To better understand the potential for protection gaps arising from uninsurability linked to flood risk, the PRA is actively working with industry stakeholders, particularly in relation to the conclusion of the Flood Re scheme in 2039.

7. **Is it a realistic prospect that Flood Re ends in 2039, and the market be able to take on the provision of insurance for those properties?**

The decision on whether Flood Re continues beyond 2039 is for the Government. The Bank's CBES exercise indicated that if the Flood Re scheme ended in 2039, insurance on some properties would become unaffordable and the coverage of household flood insurance would fall. The domestic insurance market's ability to provide sufficient affordable flood cover post-Flood Re will depend on several factors, including: individual firms' risk appetite; the level of adaptation measures that are in place; and the structure of any Government policies to replace Flood Re.

The PRA is working with the insurance industry to understand further the impact of any future protection gap in insurance provision to policyholders and how it might be partially mitigated. For example, the insurance industry is already increasing the availability of parametric insurance flood products[11], that can address part of the gap.

Liability Driven Investment (LDI)

8. **In the Annex to the latest Financial Stability Report, there are recommendations, still outstanding, that the Financial Policy Committee made in response to the LDI episode. When will these be fully implemented?**

[11] A non-traditional form of insurance where coverage is priced according to the magnitude of an event rather than the extent of losses incurred.

The FPC is considering the measures TPR has taken in response to both the FPC's recommendations and the Work and Pensions Select Committee's recommendations on LDI.

Following the FPC's recommendations, in April 2023, TPR and the FCA issued guidance on LDI resilience. The FPC welcomed this guidance and the steps taken by TPR and the FCA to ensure the continued resilience of LDI funds, and will continue working with the FCA, TPR and overseas regulators to monitor the resilience of LDI funds closely. The Central Bank of Ireland (CBI) and Luxembourg's Commission de Surveillance du Secteur Financier (CSSF) have also recently closed submissions for their consultation processes on macroprudential measures for sterling LDI funds.

The Government response to the Work and Pensions Select Committee's recommendations on the use of LDI by DB schemes noted that Government "accepts the FPC's recommendation that TPR should incorporate financial stability considerations in its decision making and balance them with its objectives as a pensions regulator." The Bank will continue to engage with HM Treasury and DWP as this recommendation is considered.

Progress on LDI resilience and on regulatory guidance has been encouraging, and the FPC will continue to consider overall progress against its recommendations.

9. **Has progress been slower than you would like on the LDI recommendations? What are the main obstacles to implementation?**

As noted above, progress on LDI resilience and on regulatory guidance has been encouraging. The FPC noted in its October 2023 Record that its resilience framework for LDI funds had been functioning broadly as intended in an environment of higher market interest rates: funds had maintained overall levels of resilience consistent with the recommended minima, and had initiated recapitalisation processes at higher levels of resilience than previously.

Sustainability of debt

10. **Public debt as a proportion of GDP is close to 100 per cent in the UK. How does this impact on financial instability risks?**

In the December 2023 Financial Stability Report, the FPC noted that vulnerabilities created by high public debt levels in major economies could pose challenges in an environment of tightening financial conditions. They could have several consequences for UK financial stability. First, higher servicing costs on public sector debt could reduce Governments' capacity to respond to future shocks, which could make global GDP more volatile.

Second, there may be more pronounced volatility in Government bond prices if market perceptions for the path of public sector debt deteriorate. Were this to interact with vulnerabilities in market-based finance, it could result in a tightening in credit conditions for households and businesses. And third, concerns about the sustainability of Government debt in some countries could prompt capital outflows. This could lead to increased market volatility and losses for financial market participants, including banks.

The FPC will continue to monitor these risks and take into account the potential for them to crystalise other financial vulnerabilities and amplify shocks when making its assessment of the overall risk environment.

11. To what extent do high levels of public debt worldwide, in part due to the Covid-19 pandemic, add to global financial instability risks?

Answered above in response to question 10.

Assessment of Financial Policy Committee (FPC)

12. The FPC has now been in existence for over 10 years. What is your assessment of how the first decade had gone?

The FPC seeks to ensure that the UK financial system is prepared for, and resilient to, a wide range of risks – so that the system can absorb rather than amplify shocks, and so serve UK households and businesses.

Since its establishment in 2013, significant work has been delivered by the FPC, including:

- **Successfully building financial resilience in the UK banking sector** through the implementation of post-crisis reforms to the regulatory capital framework and regular stress-testing of the major UK banks. The FPC has also developed its policy for, and actively used, the UK countercyclical capital buffer. This work has meant that UK banks have been able to absorb a variety of shocks (for example, Brexit, the Covid pandemic, Russia's invasion of Ukraine, and tighter financial conditions) and continue to support the UK economy.

- **Successfully building financial resilience in the UK real economy.** For example, the introduction of the FPC's mortgage market measures in 2014 have helped to guard against a material increase in household indebtedness (the overall household debt to income ratio was 139% in 2023 Q2, its lowest level since 2002).

- **Supporting successful system-wide contingency planning** that has ensured the UK financial system was able safely to navigate the UK's exit from the European Union. The FPC performed a similar role in relation to an orderly transition from Libor to alternative risk-free rates.

- **Improving understanding and resilience of market-based finance.** Informed by the 'dash for cash' in March 2020, the FPC published an analysis of the market-based finance vulnerabilities revealed during this period and the policy actions required at international level to address them. Building on this, the Bank has played a key role in shaping the international agenda on market-based finance led by the Financial Stability Board. The FPC has also taken domestic action to build resilience in this sector (for example, in relation to LDI as set out above).

- **Assessing new and emerging risks to financial stability.** The FPC has explored the risk posed by climate change, digital money, cryptoassets and decentralised finance. The FPC has also considered operational resilience of the financial system, including overseeing cyber stress testing and assessing financial stability risks from the financial system's increasing reliance on critical third parties.

Notwithstanding these achievements, the FPC's work to address risks to financial stability is necessarily ongoing. The Committee's medium-term priorities, published in April 2023, include further improving risk identification in, and the functioning and resilience of, market-based finance; continuing to identify, assess and respond to structural changes and new risks in the financial system (such as digital money and climate change); responding to the lessons we have learned for macroprudential policy from recent experiences of financial stress, including in overseas banks; and continuing to improve macroprudential oversight of operational risk.

13. **What are the FPC's successes and failures; and what impact have the measures the FPC has taken since inception had on financial stability in the UK and the UK's economic growth?**

Answered above in response to question 12.

Yours sincerely,