Primary questions

From the full list below we have highlighted some primary questions which will form the core of the Bank's research, reflecting our responsibility for monetary and financial stability. The purpose of doing so is to provide guidance to external researchers on the Bank's priorities amongst all the topics on the long list.

A. What could be the economic impact of a CBDC?

Macroeconomics

- How could it impact the level, growth and volatility of economic output and other macroeconomic variables? Through what channels would this occur? What attributes would CBDC need to have in order to realise these effects?

- How does the way CBDC enters the economy (by being spent, lent, or sold by the central bank) influence the effect of CBDC on the economy in the introduction phase, steady-state and crisis periods?

- What is the estimated magnitude of the macroeconomic effects of a CBDC? What attributes would a CBDC need to have in order to achieve these effects? This question is addressed in Barrdear and Kumhoff (2016), which also sets out useful empirical extensions to their approach.

B. What could be the impact on the financial system of a CBDC, and how could this affect financial stability?

Financial system

- To what degree would holdings of money (and near money substitutes) shift from banks deposits to CBDC? What would be the likely dynamics of shifts between bank deposits and CBDC in any introduction phase, in steady-state and crisis? How is this affected by the characteristics of the CBDC itself (e.g. how it enters the economy, who holds it, its functionality and relative price)?

  o What factors affect the propensity to substitute into CBDC, and the flows between bank deposits and CBDC?

  o How could relative demand for bank deposits and CBDC be managed?

  o What is the percentage change in demand for bank deposits due to a given percentage point change in its interest rate (i.e. the semi-elasticity)? Similarly, in the presence of a CBDC, what would be the change in demand for CBDC

relative to bank deposits due to a change the rate on bank deposits, the rate on CBDC and to the CBDC-bank deposit interest rate spread? How would this vary over different holders of bank deposits? How do the characteristics and functionality of the CBDC affect these semi-elasticities?

- o How would the presence of CBDC affect bank funding and the cost and provision of credit in the economy?

- How else might a CBDC affect commercial banks' activities? How would this affect the stability and resilience of banks? What are the implications for overall financial system stability?

C. How would a CBDC interact with monetary, financial stability and fiscal policy? How could it be used as a new policy tool?

Monetary and financial stability

- What new monetary policy tools could the CBDC offer? What is their transmission mechanism and how would they operate? What are their welfare properties?

- How could a CBDC interact with existing monetary policy tools?

- How would the introduction or steady-state presence of CBDC interact with the unwinding of Quantitative Easing?

- What financial stability tools could a CBDC offer? How could CBDC interact with existing financial stability tools (including government backed deposit insurance, countercyclical capital buffers, and the lender of last resort function)?

D. How could CBDC be technically implemented? How could this be configured to meet the requirements of a CBDC?

- Is the technology sufficiently scalable for a CBDC?

    - o Could a system cope with the required transaction through-put and frequency?

    - o How is the performance of the system affected as the scale increases?

- How should the security and resilience of CBDC be assured?

    - o What degree of centralisation is optimal for systemic security? What are the potential vulnerabilities of distributed systems?

    - o How resilient are different models? What happens if multiple nodes are absent, malicious or faulty?

    - o How secure are various consensus processes? Are collusions possible?

    - o What cryptographic techniques are appropriate? Can the system be designed to be "future proof" against developments in cryptographic

techniques? Should post-quantum cryptographic techniques be considered?

- How can interoperability be implemented? Is it possible for blockchain-based systems to function alongside existing infrastructure?

  - How could interoperability between other distributed ledgers, and also with existing systems, be achieved? Is there a need to introduce standards for distributed ledger technology (DLT)?

  - Could a national platform for distributed record keeping be created, to support numerous government-sector activities, potentially including the issuance of a (or several) national digital currencies?

All questions

A. What could be economic impact of a CBDC?

    i.   Macroeconomic

        a. How could it impact the level, growth and volatility of economic output and other macroeconomic variables? Through what channels would this occur? What attributes would CBDC need to have in order to realise these effects?

        b. How does the way CBDC enters the economy (by being spent, lent, or sold by the central bank) influence the effect of CBDC on the economy in the introduction phase, steady-state and crisis periods?

        c. How could a CBDC (or multiple CBDCs) affect capital flows, exchange rates and trade exposed sectors of the economy?

        d. What is the estimated magnitude of the macroeconomic effects of a CBDC? What attributes would a CBDC need to have in order to achieve these effects? This question is addressed in Barrdear and Kumhoff (2016), which also sets out useful empirical extensions to their approach.

    ii.   Microeconomic

        a. How could a CBDC affect competition and efficiency in the economy? What new business models may emerge? What business models may become obsolete? How will CBDC affect different industries? What attributes would CBDC need to have in order to realise these effects?

B. What could be the impact on the financial system of a CBDC? How could this affect financial stability?

    i.   To what degree would holdings of money (and near money substitutes) shift from banks deposits to CBDC? What would be the likely dynamics of shifts between bank deposits and CBDC in any introduction phase, in steady-state and crisis? How is this affected by the characteristics of the CBDC itself (e.g. how it enters the economy, who holds it, its functionality and relative price)?What factors affect the propensity to substitute into CBDC, and the flows between bank deposits and CBDC?

        b. How could relative demand for bank deposits and CBDC be managed?

        c. What is the percentage change in demand for bank deposits due to a given percentage point change in its interest rate (i.e. the semi-elasticity)? Similarly, in the presence of a CBDC, what would be the change in demand for CBDC relative to bank deposits due to a change the rate on bank deposits, the rate on CBDC and to the CBDC-bank deposit interest rate spread? How would this vary over different holders of bank deposits?

How do the characteristics and functionality of the CBDC affect these semi-elasticities?

    d. How would the presence of CBDC affect bank funding and the cost and provision of credit in the economy?

  ii. How else might a CBDC affect commercial banks' activities? How would this affect the stability and resilience of banks? What are the implications for overall financial system stability?

  iii. What could be the impact of CBDC on financial markets?

    a. What would be the likely impact on money markets?

    b. What would be the likely impact of instantaneous settlement on financial markets? Is instantaneous settlement desirable? Does this change if it is instantaneous settlement achieved with or without CBDC? Is there enough liquidity in the system for real time gross settlement of all payments?

    c. What impact would issuing CBDC have on market frictions?

  iv. How could CBDC impact the overall structure of the financial system (including the payment system)? What benefits would be introduced?

    a. How could the presence of CBDC affect the resolution of a financial institution or financial market infrastructure?

    b. Would the introduction of a CBDC make the financial system more/less stable and resilient to shocks?

  v. How does the way CBDC enters the economy (by being spent, lent, or sold the central bank and to whom?) affect the financial stability in the transition phase, steady state and in crisis?

  vi. What are the risks to financial and monetary stability of an alternative digital currency (private or other national CBDC, fiat or non-fiat linked) being used in the UK? How would the presence of a UK CBDC affect this risk?

C. How would a CBDC interact with monetary, financial stability and fiscal policy? How could it be used as a new policy tool?

  i. What new monetary policy tools could the CBDC offer? What is their transmission mechanism and how would they operate? What are their welfare properties?

  ii. How could a CBDC interact with existing monetary policy tools?

  iii. How would the introduction or steady-state presence of CBDC interact with the unwinding of Quantitative Easing?

iv. What financial stability tools could a CBDC offer? How could CBDC interact with existing financial stability tools (including government backed deposit insurance, countercyclical capital buffers, and the lender of last resort function)?

v. What, if any, are the trade-offs between using a CBDC tool for monetary versus financial stability policy?

vi. How could CBDC interact with fiscal policy?

D. How could CBDC be technically implemented? Is a form of distributed ledger the most appropriate method? How could this be configured to meet the requirements of a CBDC?

i. Is DLT the most appropriate technology for a CBDC? Are there alternative technologies which provide the required features and resiliency for a digital currency?

ii. If using DLT, would a permissioned or permissionless system be more appropriate? What mechanism could transaction verifiers (nodes) use to arrive at consensus, and how does this differ for permissioned and permissionless systems?

  a. In a permissionless system, are there consensus mechanisms which enable genuine decentralisation, whilst maintaining security and without resulting in an overinvestment in computing resources or high concentration of mining power?

  b. If using a permissioned system, could a version of practical byzantine fault tolerance (PBFT) or two-phase commit be used? What are the benefits and the risks in terms of scalability, security and privacy? What other consensus mechanisms might be appropriate?

iii. How can appropriate privacy levels be implemented technically?

  a. Can a system be designed without the full ledger being visible to external transaction verifiers? Is it possible to enable full privacy whilst also achieving the resiliency benefits of distribution? Are there cryptographic techniques that could help enable this (e.g. zero knowledge proofs)?

  b. How long should data be stored for? Can a system be designed so that data is only kept for the appropriate period of time?

iv. Is the technology sufficiently scalable for a CBDC?

  a. Could a system cope with the required transaction through-put and frequency?

  b. How is the performance of the system affected as the scale increases?

v. How should the security and resilience of CBDC be assured?

    a. What degree of centralisation is optimal for systemic security? What are the potential vulnerabilities of distributed systems?

    b. How resilient are different models? What happens if multiple nodes are absent, malicious or faulty?

    c. How secure are various consensus processes? Are collusions possible?

    d. What cryptographic techniques are appropriate? Can the system be designed to be "future proof" against developments in cryptographic techniques? Should post-quantum cryptographic techniques be considered?

vi. How can interoperability be implemented? Is it possible for blockchain-based systems to function alongside existing infrastructure?

    a. How could interoperability between other distributed ledgers, and also with existing systems, be achieved? Is there a need to introduce standards for DLT?

    b. Could a national platform for distributed record keeping be created, to support numerous government-sector activities, potentially including the issuance of a (or several) national digital currencies?

vii. How could the system implement the functions of a central bank?

    a. How could the central bank control the supply of narrow money (the issuance and withdrawal of currency)?

    b. How could the central bank apply interest to holdings of currency?

    c. Could policy be implemented dynamically through automatic rules? (e.g. changing the interest rate depending on flows or the state of the financial system?)

E. Who should be the participants of a CBDC system, what should be their roles and how could incentives be aligned?

i. What is the appropriate role of the central bank in the system, and what functions of the system could or should be performed by third parties? (For example, modification to the source code, node operation, storage of the ledger, transaction verification, exchange provision, wallet provision.)

    a. What is the business model rationale for these third parties? How will they make money and will this detract from any of the efficiency and disintermediation benefits that might have been identified in the macroeconomic research?

ii. How, and by whom, are transactions initiated, validated and processed? How should the costs of transaction verification be dispersed to the users of the system?

iii. How should users interact with the system? (e.g. should they be able to directly hold CBDC though accounts at the central bank and/or have indirect holdings through custodial third-party wallet providers?)

iv. How much data should be available to various parties (e.g. transaction verifiers, central bank, government authorities), and what could it be used for?

   a. How could data analytics techniques be applied to CBDC data to aid existing analysis (e.g. for regulation, risk management, credit ratings, crime prevention, research)? What new analysis could be possible with CBDC? Could data be aggregated for analytical purposes? How should data be structured?

v. How could participants in a CBDC be incentivised?

a. What incentive structures could ensure wallet providers and users prioritise wallet security or encourage operational resilience?

   b. What incentive structure encourages efficient use of the system?