

Response to “The digital pound: a new form of money for households and businesses?”

A consultation response prepared for the Bank of England and HM Treasury

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1 Executive summary

This document constitutes a response to a Consultation Paper published by the Bank of England and HM Treasury, “The digital pound: a new form of money for households and businesses?” [1], the latest document in a series that includes “Central Bank Digital Currency: opportunities, challenges and design” [2] in 2020 and “New forms of digital money” [3] in 2021. The Consultation Paper concerns the adoption of central bank digital currency (CBDC) for retail use in the United Kingdom by the Bank of England. We shall address the consultation questions directly in Section 3 of this document. First, we offer a treatment of the following specific aspects of the Consultation Paper:

1. **Motivation and process.** Overall, although the Consultation Paper references a variety of specific benefits of CBDC, the Consultation Paper is broadly silent about the underlying motivation for considering implementing CBDC in the UK. Many of the arguments presented throughout the Consultation Paper depend upon accepting certain assumptions, for example that modern electronic payments are well-suited to serve the interests of those who use them, that negate important arguments for researching and developing CBDC, particularly the need to develop an adequate analogue for cash in the digital economy. The lack of clarity about the motivation for developing CBDC undermines the strength of those arguments and raises doubts about their validity.
2. **Privacy.** Consumer privacy in the digital economy is non-negotiable. Many serious articles have identified the threat posed by a cashless society to the human rights of individual persons, who must inexorably engage in the economy by making payments as part of their everyday lives. Reports acknowledging the threats posed by electronic transactions have been published around the world, by public-sector organisations [4, 5, 6, 7, 8], by private-sector businesses [9, 10], and by civil rights organisations and think tanks across the political spectrum [11, 12]. Central banks have also acknowledged the dangers that cashless payments pose to privacy [13, 14], and the degradation of consumer privacy is also understood to have significant implications for the broader economy [15]. We reject the argument that those with nothing to hide have nothing to fear [16], and exceptional access mechanisms, which seek to provide a means by which authorities can gain privileged access to data under certain circumstances, have been consistently dismissed as dangerous and untenable by the security community over the past quarter century [17, 18, 19].

Unfortunately, the privacy model for CBDC reflected in the Consultation Paper wrongly assumes that data protection by trusted parties is a substitute for not collecting data linking consumers to

their transactions in the first instance [20]. Fortunately, alternative approaches are available [21], and the rise of the digital economy does not imply that the relinquishment of privacy by individual consumers is inevitable. Some designs for CBDC that have been proposed promise true and verifiable privacy for consumers [22, 23], and the design of CBDC in the UK must do so as well.

3. **Custody.** A salient feature of money is the option of individuals to possess and control it directly, as they can with cash. However, the custody model described in the Consultation Paper assumes that consumers will not be able to possess or control CBDC. Instead, CBDC would be held in special “wallets”, which the Consultation Paper describes services offered by providers who would be *de facto* custodians of the money. The implicit definition of the term “wallet” as a *service* contrasts with the internationally accepted definition of a *wallet* as an “*application or mechanism* to generate, manage, store or use” digital assets [24] (emphasis added).

Direct custody of money as a means to exercise choice is a fundamental right, and if consumers cannot be in direct possession and control of their money, then it is not really theirs. Instead, they would be forced to contend with the possibility that their use of money might be restricted to certain purposes, as it was for recipients of the cashless welfare card in Australia [26], or curtailed completely, as it was for Canadian lorry drivers in early 2022 [28], who were subsequently exposed to public blacklisting [29].

Requiring that intermediaries stand between consumers and their own money is tantamount to requiring that consumers have money within custodial accounts. We question whether, from the perspective of a consumer, “digital currency” residing within an account of this type is significantly different from bank deposits residing within ordinary bank accounts. We argue that the promise of digital currency is intrinsically about the ability for the currency to be possessed independently of an accounting relationship.

4. **Role of identity.** Separately from the question of custody, which is about whether individuals can possess and control their own assets, is the question of the form that the assets take. Digital currency assets are fungible, so in principle they can take the form of either *balances* (“account-based access”) or *tokens* (“token-based access”) [30]. Both approaches are technically feasible: Some cryptocurrencies, such as Bitcoin, conduct transactions using tokens, while others, such as Ethereum, conduct transactions using balances.

However, the choice of balances versus tokens has implications for the role of identity in accessing the assets. In a digital currency system with balances, a number representing the size of some collection assets must be represented somewhere, and successive transactions must result in changes to that number. The state of a balance, therefore, is determined by the net effect of a set of transactions that are intrinsically associated with that balance and with each other. The persistent linkage among transactions implies an *identity* for the owner of the assets, as the owner of the assets must provide identification to access the balance to conduct a transaction. Conversely, with tokens, all that is needed to conduct a transaction is knowledge of specific tokens or the cryptographic keys that unlock them. A token is not necessarily connected to other tokens, and successive transactions made by the same person might not be linkable on the ledger.

The independence of a user’s transactions is essential for both privacy and control: Whether or not a particular gatekeeper has custody, the requirement to use a balance implies that the balance can be locked as a mechanism for preventing the owner from accessing the assets, or that links among successive transactions can be forcibly discovered as a means of surveillance, as is the case with the development of e-CNY system in China [31]. Unfortunately, the design described in the Consultation Paper uses balances rather than tokens, and the implications for the rights of asset owners are not explored or justified.

5. **Role of the ledger.** The CBDC design described in the Consultation Paper makes use of a “core ledger” that records the assets held by individuals. This design has several implications. Independently of the privacy considerations and the question of tokens versus balances, the choice to rely upon the core ledger to record assets in this way implies that all transactions must be recorded on the core ledger. This has two problematic consequences.

The first consequence of relying upon the core ledger to store transactions directly is that users must involve the core ledger in every transaction. Because a transaction cannot be consummated until the core ledger is consulted, the scalability of the system is significantly limited. Transacting

parties must have network connectivity to the core ledger, and they must wait for any system level delays resulting from other transactions taking place at the same time.

The second consequence of relying upon the core ledger to store transactions directly is that the ledger grows as a function of the number of transactions, which implies that increasing the number of transactions will introduce stress on the mechanism that maintains the core ledger, creating the opportunity for denial of service by adversarial actors. Cryptocurrency systems with this design, such as Ethereum, typically address this vulnerability by introducing a transaction charge (also known as a “gas fee”), which introduces additional economic frictions as well as fairness considerations related to the question of whose transactions have precedence and whether there should be implicit subsidy for users who might otherwise not be able to afford such charges.

A better design would not rely upon the representation of assets (tokens or balances) directly on the core ledger (distributed or centralised).

6. ***Role of the issuer.*** The CBDC design described in the Consultation Paper has an outsized role for the central bank, which not only issues tokens but also processes transactions, sets the rules, and maintains the historical record. This highly centralised design is unlike any general-purpose payment system that has ever existed before in the United Kingdom. Cash payments are naturally decentralised; any two counterparties can consummate a transaction without involving the issuer by exchanging a physical token. Modern electronic payments are also decentralised; they are carried out by networks of private-sector actors overseen by regulators [32, 33]. The design implied by the Consultation Paper implies that the issuer is required to process transactions directly, introducing a tremendous operational, technical, and legal burden upon the central bank.

Trusting the central bank to operate the ledger is fundamentally different from trusting the central bank to oversee a transaction infrastructure as a regulator [34]. Because the role of the central bank described in the Consultation Paper also includes the singular responsibility for maintaining the core ledger, there is no technical mechanism to stop this central actor from changing the historical record. The best we might expect is for changes to historical data on the ledger to be observable by periodic reconciliation activities among third parties with read access to the ledger, followed by a legal challenge wherein the authoritativeness of the ledger records would be determined by indexing the intentions of the record maintainer in some juridical context. In the absence of a clear procedure for determining which version of history is true, all parties are forced to accept the state of the ledger declared by the ledger operator. Even if we assume that the ledger operator is not corrupt, all participants in the system must depend upon the integrity of its agents and the effectiveness of its security practices. Recent history teaches us that such dependence is a risky proposition [35].

Finally, when the party that processes transactions also sets the rules, there is nothing to prevent the rules from changing without warning. Given how many retail consumers would rely upon a future retail CBDC infrastructure, this risk is too much to bear. In distributed models for the operation of best-execution networks, such as the National Market System in the United States [36], the regulator sets the rules but requires participating private-sector actors to operate the system. Changes must be proposed, requested by the regulator, and implemented by all participating actors before they can take effect. This procedural approach protects the system from hazards and is possible only because the system is decentralised in practice. Because the system proposed in the Consultation Paper is highly centralised, it is exposed to risks that decentralised systems can hope to avoid.

Many of the items in this list are similar to points that were made by respondents in consultations associated with the earlier Consultation Papers but were not addressed in the most recent Consultation Paper. The Bank of England and His Majesty’s Treasury are strongly encouraged to revisit the earlier consultation responses and consider whether the current approach described in the most recent Consultation Paper reflects adequate consideration of the points introduced in those responses.

2 Detailed response to the Consultation Paper

Next, we address some specific items of concern implicit in the Consultation Paper [1], grouped by category:

2.1 Motivation and process

1. *Page 5: “a digital pound... would sit aside, not replace, cash”*. Although the intention is honourable, this objective may be difficult to achieve in practice, given the decline of cash, which the Consultation Paper acknowledges as “being used less frequently by households and businesses”. The variable revenues associated with operating cash infrastructure are rapidly falling below the fixed costs, particularly in the built environment, wherein cash is commonly refused by merchants already. Whilst we agree that CBDC should not be seen as a substitute for cash, it can be viewed as a way to achieve most of the benefits of cash without the corresponding infrastructure costs. The orchestration of an appropriate response to the decline of cash is a key motivation for institutions in the UK, and indeed for institutions throughout the world, to establish CBDC.
2. *Page 6: “seeks to begin to build that foundation of public trust”*. However, the involvement of the general public, including technology experts and community stakeholders, has been limited to initiatives such as the CBDC Engagement Forum and CBDC Technology Forum, and there has not yet been a meaningful public debate about the requirements for CBDC in the UK and policy implications of the various technical design features.
3. *Page 7: “we will work with the private sector to explore potential technology solutions”*. Of course, the private sector should be involved in implementing CBDC and the infrastructure upon which it relies. However, involving the private sector in preference to the broader public during the design phase is a mistake. The best solution for the British public, and indeed for the private sector over the long run, might involve a design that is inconsistent with the (short-term) interests of economic incumbents, and the process for finding such a solution involves a process that Schumpeter described as “creative destruction” [39], often involving forcible disruption to prevailing business models. Such disruption is an unlikely consequence of design recommendations promoted by incumbent private-sector businesses.
4. *Page 10: “If current trends continue... the monetary system could become fragmented”*. Fragmentation is already here, with the decline of cash use. Some UK vendors refuse cash, and consequently, they accept only bank deposits, and not central bank money, as a means of payment. It is not inconceivable that some vendors have determined that the costs associated with accepting cash outweigh the benefits, and consumers with only cash do not have access to goods and services provided by such vendors. The fact that vendors have the option to refuse cash means that some transactions do not take place as a consequence of the choice of payment mechanism alone. It also means, *de facto*, that vendors can choose to accept payments only from banks and not directly from retail consumers.
5. *Page 10: “The digital pound would complement banknotes”*. See Item 1. Note that banknotes no longer serve the function for which they were designed, leaving a gap in utility for consumers and businesses. The digital pound should complement banknotes indeed, but it should also fill that gap.
6. *Page 13: “The digital pound would be used like a digital banknote... [and would be] useful for everyday payments”*. This is an important acknowledgement of the need for digital cash as a means by which consumers can make retail payments, particularly with the migration of retail payments to the digital economy. This need also implies a responsibility to consider the risk of forfeiture of human rights to privacy, possession, and control of money that is intrinsic to the methods by which retail consumers engage with the digital economy, and the need for a public payment infrastructure that preserves those rights.
7. *Page 14: “By the end of the design phase we will have... supported business model innovation through knowledge sharing and collaboration between the private and public sectors”*. It is imperative that the process for pursuing engagement with the private sector does not systematically exclude

the voices of the public sector, including other financial regulators, as well as the general public, including technology experts, civil society, and community stakeholders, not only in the forthcoming “design phase” but also in the process for establishing policy and technology requirements of the sort that are detailed in the Consultation Paper. See Item 3. In particular, we are concerned that the Bank or HM Treasury might be influenced by designs that support the prevailing business models of incumbents, or methods that satisfy objectives that have not been agreed by public consensus, to the detriment of the public interest. Going forward, all procurement processes involving design proposals must have full public transparency and reporting. But transparency is not enough: To be equitable, such processes must be matched with corresponding public engagement on matters of policy and technology design more generally.

8. *Page 15: “Support the development of the broader UK digital currency technology industry”.* Such support is important, although the Bank and HM Treasury must be careful to avoid choosing a specific “winning” model without full public engagement. See Items 3 and 7.
9. *Page 16: “After the design phase, there will be a decision on whether to build a digital pound”.* The decision about whether to have a CBDC in the UK should be made in the context of alternatives that can address the concomitant problems of privacy, possession, and control that accompany the migration of retail payments to the digital economy. One possible alternative is the issuance of stablecoins by private-sector banks; such stablecoins could be backed by central bank reserves and supported by mechanisms similar to those that underpin deposit insurance. Another possible alternative is legislation to compel retail vendors, including e-commerce vendors, to accept cash, combined with appropriate procedures to incentivise the use of cash as needed, including the acceptance of cash by brick-and-mortar institutions and businesses, perhaps post offices or the offices of wire transfer service providers, on behalf of Internet-based vendors.
10. *Page 18: “We will engage stakeholders extensively and be transparent about our work”.* The design must not be led by a set of private-sector “winners” that are in a position to set the agenda for consideration by the CBDC Engagement and Technology Forums and the general public. See Item 8.
11. *Page 22: “unbacked cryptoassets do not provide holders with a safe or stable store of value or a reliable unit of account”.* Unbacked cryptoassets are sometimes used as money nonetheless, perhaps because of a desire for digital cash with cash-like properties of privacy, property, and custody, and the lack of more suitable alternatives. Unbacked cryptoassets could become more popular, and indeed dangerous, if suitable instruments with cash-like properties are not institutionally supported and regulated.
12. *Page 24: “Promoting innovation, choice and efficiency in payments as our payment habits and economy become more digital”.* The migration of retail payments to the digital economy also means that an intervention is required if we desire to affirm and preserve the rights of consumers to privacy, possession, and control with respect to their payments. Cash is a fundamental building block for private property. In particular, we ask: What use is money if it inherently belongs to someone else? See Item 6.
13. *Page 24: “For the digital pound to play the role that cash plays in anchoring the monetary system”.* It is certainly reasonable for CBDC to share its key functional features, including consumer affordances, with cash. This choice of language seems to suggest or acknowledge that there is an expectation that cash will at some point be phased out. Despite the insistence by the Bank of England in previous Consultation Papers that cash will continue to be manufactured, deployed, and used, the increasing preponderance of vendors in the UK who refuse cash offers a preview of a possible future scenario wherein cash is seldom used for payments in the UK. If the variable revenues associated with accepting cash or operating components of cash infrastructure fall below the fixed costs, then who will provide subsidy to ensure that cash continues to be useful? See Item 1.

For this reason, this sentence highlights a challenge of great importance. There is a non-negligible chance that we could need CBDC to provide the functions that cash provides, including not only continuing to ensure that consumers have verifiable privacy, possession, and control with respect to their money and how they use it, but also continuing to ensure that consumers can directly own obligations of the central bank rather than banks that might fail, a means by which consumers

can know in advance that their chosen payment method will be accepted, and continuing to ensure that money is available for consumers to use independently of their relationships with private-sector service providers. Market fragmentation has already begun. Establishing a CBDC might not be the only way to solve this problem, but options are few. The time to act is now.

14. *Page 25: “supporting financial inclusion and improving domestic payments resilience”*. We note that both financial inclusion and payments resilience have been undermined by the migration of retail payments to the digital economy, since the current digital economy does not provide a public payment option that preserves the right of consumers to verifiable privacy, control, and possession of their assets.
15. *Page 25: “Access to public money... and the uniformity of money are critical for the smooth functioning of the economy”*. Certainly true, and the disappearance of cash undermines both access and uniformity. See Item 14.
16. *Page 27: “The decline in the use of cash is expected to continue... even though UK authorities are committed to keeping cash available as long as there is demand for it”*. It is not obvious that supporting cash for general-purpose use will be sustainable in the long-term, if the variable revenues fall below the fixed costs of accepting cash and operating the infrastructure. Who will compel merchants to accept cash, and by what authority? Who will compel banks to furnish cash to consumers, and by what authority? We note the increasing preponderance of “reverse ATMs” and similar mechanisms in foreign cities, such as New York, that require vendors to accept cash [40]; is this a plausible future? See Items 1, 5, and 13.

Although the option to refuse cash is often, *de facto*, exercised in the UK by vendors who require payments at the point of sale before goods or services are provided to consumers, certain kinds of payments, for example restaurant meals, generally take place after the goods or services are provided. Can a consumer seeking to settle such an obligation using legal tender be refused?
17. *Page 27: “Fragmentation may arise if holders of one form of money can only interact with others using the same system”*. Thanks to vendors that accept only electronic payments, fragmentation is already here. See Item 4.
18. *Page 29: “Recent innovations... have opened up the payments market... resulting in improved user experience”*. Recent innovations are at best a mixed blessing; they have also enabled exclusion (for example, by the refusal of cash) and profiling (“personalisation” as a euphemism for surveillance).
19. *Page 31: “network effects”, “economies of scale and scope”, “data advantages”*. Control points, anti-competitive business practices, and surveillance capitalism are hallmarks of the digital payments industry as it exists today. Consumers and businesses are not so much choosing to use digital payment methods as they are being forced to do so because platforms benefit from data harvesting and the reality of being “the only game in town”.
20. *Page 31: “The success of a small number of firms can reflect the fact they offer more innovative products, integration that benefits consumers, or greater efficiency”*. This assessment of providers of payment services is unjustified. In the case of payments, success is the result of the factors described in Item 19.
21. *Page 31: “Big Tech firms’ entry in financial services could benefit many consumers at least in the short-term”*. This is a matter of perceived versus real benefits. Consider, by analogy, the choice of individuals and businesses to submit to surveillance as a way to reduce insurance costs. Although opting for surveillance might indeed reduce costs relative to resisting surveillance, it is not clear that surveillance reduces costs to individuals and businesses in the aggregate. Instead, the proceeds of market differentiation accrue to the insurance providers.
22. *Page 32: “the digital pound should not crowd out or prevent other forms of digital innovation by the private sector”*. Although enabling private sector innovation is important, CBDC must not be designed to intrinsically favour or encourage the use of non-public payment infrastructure to the exclusion of public payment infrastructure, or to support incumbent business models. See Items 3 and 7. It is also important to acknowledge the dangers of certain private sector payment options, particularly those that rely upon user surveillance or credit provision, that involve the exercise of control and introduce negative externalities.

23. *Page 34: “UK authorities are committed to ensuring continued access to cash for those who wish to use it”.* Access to cash is not enough to ensure that consumers are able to use it. Specifically, continued access to cash is not particularly useful in the absence of assurance that cash will continue to be accepted. In the UK, some merchants refuse cash at the point of sale. If UK authorities are committed to ensuring access to an effective public payment option with the properties of cash, then they must ensure that it will be accepted by vendors. It might be possible to accomplish this goal with policy to require brick-and-mortar retail vendors to accept cash and to compel e-commerce retail vendors to provide a cash payment option. CBDC might make such a policy more palatable, if merchants could satisfy the requirement by accepting CBDC. See Items 1 and 9.
24. *Page 38: “the transition in particular could affect some bank business models”.* The real issue is that, after years of low interest rates, some consumer-facing banks have come to depend upon payments, with their associated transaction fees and data benefits, for a significant share of their revenue. These functions are not the same as banking, with questionable benefit to the public from having banks play this role.
25. *Page 38: “introduction of the digital pound would result in households and businesses switching some of their bank deposits to digital pounds”.* This is true by definition. However, there is no justification provided for the implicit assumption that the steady-state withdrawal and use of digital pounds would be significantly greater than the steady-state withdrawal and use of cash two decades ago, prior to the migration of retail payments to the digital economy. By this token, it might be more appropriate to view the era of card payments as an anomaly.
26. *Page 41: “effective lower bound (ELB)”.* As long as cash exists, the deployment of CBDC cannot lead to a negative ELB. Even if cash were to be expunged, a negative ELB would still be unlikely, given the great preponderance of alternative assets that can be used as money, such as foreign cash, cryptocurrencies, precious metals, and so on.
27. *Page 43: “disintermediation could lead to higher lending rates as banks experience higher funding costs”.* It seems unlikely that the economy has become dependent upon consumers never owning their own money, even for a brief moment. See Item 118.
28. *Page 49: “An important cause of the ELB is the existence of cash”.* See Item 26.
29. *Page 52: “One of the digital pound’s principal aims is to support payments innovation by the private sector”.* Supporting payments innovation requires active public engagement and debate in the process of determining requirements and must not favour incumbent business models to the exclusion of alternatives. See Items 3 and 7.
30. *Page 54: “the platform model we have proposed best meets our criteria”.* We have not determined by consensus that the set of criteria established by the Bank is the right set of criteria to use. We encourage the Bank to consider the criteria identified in this response document.
31. *Page 65: “the creation of a new sandbox for firms”.* An important limitation of sandboxes is that they intrinsically favour incumbents and others with the ability to commit substantial resources to a project, in contrast to requests for proposals for academic research funding as well as platforms for open, public engagement. For some reason, mention of approaches such as these, which fundamentally enable debate, co-design, and consensus about requirements, have been absent from the Consultation Paper. Debate, co-design, and consensus are instrumental for reaching a good outcome that serves the public interest.
32. *Page 77: “Users would be likely to make digital payments using smartphones or cards”.* Certainly the option to use smartphones or cards might be desirable, although cards and smartphones have serious security weaknesses worth considering. For example, cards as currently implemented require users to accept the potential for misbehaviour on the part of POS devices, since what POS devices display on their screens might not match what they are actually doing. (It is certainly possible to augment cards to have better security, although this would require interaction between the user and the card, perhaps via a display.) In contrast, smartphones are sufficiently powerful to avoid requiring users to trust POS devices, although their Internet connectivity makes them susceptible to compromise via Internet-enabled software and services, and they are known to serve the interests of third parties, such as manufacturers or operating system distributors, in lieu of their owners.

33. *Page 77: “Not everyone has a smartphone, and some people find them difficult to use”*. An open architecture that allows a plethora of non-custodial wallet implementations will provide essential support for special CBDC use cases and for users with special accessibility needs.
34. *Page 85: “Financial inclusion means that everyone... has access to useful and affordable financial products and services”*. It is more foundational, and more important, for all individuals to have access to a means of payment than it is for all individuals to have access to credit or insurance products. Financial inclusion means that individuals will be able to engage with the economy via a public payment option, without relying upon a persistent relationship with a financial custodian. Furthermore, arguments that access to credit and insurance hold the answers to fundamental challenges of social justice, such as poverty, homelessness, or statelessness, are dubious at best.
35. *Page 86: “millions of people continue to use cash across the UK, particularly those in vulnerable groups”*. To address financial exclusion, it is important to ensure that a public payment option is available for all payments. This is not currently the case for vendors that refuse cash, including most e-commerce vendors. See items 4 and 6. Note also that payment methods involving cards and smartphones are not options for persons with special accessibility needs, such as those with limited vision.
36. *Page 86: “Digital inclusion needs to be promoted alongside financial inclusion”*. One might believe that the fact that not everyone has a card or a smartphone constitutes a problem that must be solved, and that can be solved by giving everyone cards or smartphones. This is a dangerous misconception. Importantly, we cannot force individuals to establish persistent relationships with service providers, or to agree to the terms and conditions of the services they provide. Providing low-cost tools, such as devices that can directly hold CBDC, might be a suitable alternative.
37. *Page 88: “Cash is expected to continue to play a role in society... for some time”*. The need for a means by which individual persons can directly possess and control their own assets and engage with the economy without fear of profiling or discrimination is foundational, and this need will never disappear. Currently, cash is the only general-purpose instrument recognised by governments for use in this capacity. Hence, the case for digital cash is strong.
38. *Page 88: “The digital pound would not seek to replace cash”*. It is critical that CBDC must not be designed to supplant or eliminate cash, and CBDC should not be used to justify the expungement of cash, which for some people and in some circumstances is intrinsically more suitable than any digital payment option, including CBDC. Every payment method has its own unique set of costs and risks, and not all use cases served by cash can be served by CBDC, however it is designed or implemented. See Item 1.
- Importantly, wallets are not accounts; see Items 70 and 71. Apropos financial exclusion, the question should really be whether and how service providers should be able to transfer digital pounds into the possession and control of individuals with limited identification documentation. Note that limited requirements for identification does not imply improved privacy; see Item 122.
39. *Page 89: “vulnerable groups... could be at risk when using a new payment method”*. The privacy risk that can lead to discrimination and profiling is especially dangerous to vulnerable groups, such as victims of abuse; witnesses to crime; refugees; stateless persons; persons who are members of protected categories, such as those related to race, religion, or sexual orientation; persons with pre-existing medical conditions; persons who have been blacklisted as a result of a history of criminal convictions or financial default; persons in abusive personal, domestic, or business relationships; and so on.
40. *Page 89: “not necessarily the only way to tackle financial exclusion”*. Another way to tackle financial exclusion might be to provide assurance that cash will continue to function as a means of engaging with the economy. This can be achieved by establishing law or regulatory policy to require its acceptance by brick-and-mortar vendors at the point of sale, as well as by e-commerce vendors, many of which currently do not have a means to accept cash as a means of payment. See Item 9.
41. *Page 90: “sceptical about the current need for a retail CBDC in the UK, which they considered to already have an efficient payments system”*. The efficiency of payments in the UK is limited by the lack of a public payment option suited to the increasingly digital economy, as well as by the

pernicious refusal of cash by vendors, which causes some transactions that would otherwise occur to not occur, an direct example of inefficiency.

2.2 Privacy

42. *Page 11: “Privacy protected like cards and bank accounts”*. But cards and bank accounts are not private at all. Data consumers such as providers of credit and insurance, as well as law enforcement organisations, routinely have access to transaction data, including the identities of payers and payees. In addition, data breaches by criminal organisations and state actors are not uncommon. So, a goal to deliver a comparable level of privacy to cards and bank accounts is a goal to not deliver privacy.
43. *Page 11: “but not anonymous”*. The Consultation Paper fails to distinguish between transactions that are entirely beyond the view of regulators and transactions that are broadly visible to regulators except that some information about the transactions are not visible. The Consultation Paper also fails to distinguish between “fully anonymous” transactions in which authorities know none of the details about the transacting parties, and “semi-anonymous” transactions in which only one party (for example, the payer) is anonymous.
44. *Page 11: “BOE/government would not see any personal data”*. With the design proposed in the Consultation Paper, this claim is not true, since the linkages among transactions are visible, and collections of transactions known to belong to the same person are indeed PII. Also, if profile data (combinations of account-holder identifiers collected via KYC procedures, “alternative data” such as what can be gleaned from smartphone apps and websites, transaction metadata such as timing and location, transaction linkages via pseudonymous identifiers, and so on), are discoverable, then there is no way for a user to verify that they have not been discovered and used, for example in the controversial practice of parallel construction [41].
45. *Page 11: “to safeguard their privacy”*. But parties with access to PII can collude to determine the owner, so privacy is not assured. In particular, with the design described in the Consultation Paper, the central bank still sees assets through its management of the core ledger and can collude with other parties to help them determine how individual consumers spend their money, as well as other private information such as their movement, social networks, financial circumstances, and more. The likelihood of surveillance introduces a chilling effect to their free engagement with the economy [42, 43].
46. *Page 12: “Digital payments account for the majority of transactions today.”* The lack of privacy in digital payments today is an important motivation for deploying CBDC that is private by design, and it does not constitute a valid argument for why it would be acceptable for CBDC to have a similar level of privacy to existing digital payment mechanisms. The fact that digital payments constitute an increasing share of all payments indicates that the right to privacy is being eroded by the migration of retail payments to the digital economy. CBDC can be part of the solution, but only if it adopts privacy by design for consumers.
47. *Page 12: “the digital pound would not be anonymous because the ability to identify and verify users is needed to prevent financial crime”*. If CBDC is to be used as a digital form of cash that is obtained via regulated institutions with AML/KYC procedures, then it should have similar privacy features for consumers who obtain physical cash from regulated financial institutions with AML/KYC procedures and subsequently spend the cash without linking their identities to the transactions wherein they spend the cash. The ability to identify and verify users when they receive CBDC does not imply the ability to link users to their payments. A system that allows users to make payments without the risk of profiling does not imply that users who receive cash would not be identified and verified when they receive CBDC, either by making a withdrawal of CBDC, or by receiving a payment in CBDC.
48. *Page 12: “the digital pound would be at least as private as current forms of digital money, such as bank accounts”*. See Item 42.
49. *Page 12: “except for law enforcement agencies under limited circumstances prescribed in law”*. This implies an exceptional access mechanism, otherwise known as a “backdoor”, of the sort that is

considered dangerous and untenable by the security community [17, 18, 19]. Procedures for gaining exceptional access to private data would not be established if there were no expectation that they would be used from time to time. Exceptional access mechanisms introduce the likelihood that data will be abused without consequence, not only by legitimate authorities, but also by other authorities who request access, unscrupulous insiders who abuse their position, businesses that operate the infrastructure, criminal attackers or foreign state actors who compromise the infrastructure, and more. See Item 44.

50. *Page 12: “on the same basis as currently with other digital payments and bank accounts more generally”.* Consumers cannot trust what they cannot verify. With cash, privacy for consumers is self-evident. Currently, what consumers have with digital payments is better described as “privacy by promise”: there is no option for consumers but to accept that service providers will have a great preponderance of their personal transaction data in their databases. Considering that many retail vendors in the UK, including e-commerce vendors as well as brick-and-mortar vendors at the point of sale, refuse cash, this is not so much a matter of trust as it is a matter of coercion; see Item 42. Also, the argument that it must be suitable to assume a similar privacy model to current digital payments because digital payments are commonplace implicitly relies upon the assumption that a one-size-fits-all approach to privacy is appropriate, which it is not; see Item 46. The lack of privacy by design is particularly harmful to vulnerable consumers, such as those in precarious domestic relationships, victims of abuse, witnesses to crime, refugees, and others. Privacy is a public good [44], and intrinsic respect for privacy, as opposed to a demand to accept panopticon-like surveillance, should be a requirement for public infrastructure in general. Although it can be selectively taken away from a system that is private by design, privacy cannot be added to a system that is not private by design.
51. *Page 13: “providing the same privacy as most of the money we use”.* It might be true that most retail transactions are digital, but not everyone uses digital payments for most of their retail transactions. Persons who prefer or depend upon physical cash today risk being coerced into accepting the privacy model underpinning current digital payments, which is inadequate. See Items 42, 46, and 50.
52. *Page 14: “The Bank and HM Treasury would welcome views on this approach to privacy”.* Privacy by promise is not real privacy, and the privacy model for current digital payments used by retail consumers is not appropriate for CBDC. Consumers deserve affirmation of their right to make payments without being associated with every payment they make, a right that has existed for thousands of years and that is undermined by the migration to the current set of digital payments. Consumers in particular deserve a payment system design that does not demand that consumers accept paternalistic collection of data that offer insight into their individual habits, locations, decisions, and modes of life. As Paul Armer warned a half-century ago, “If you wanted to build an unobtrusive system for surveillance, you couldn’t do much better than an EFTS [electronic funds transfer system]” [43].
53. *Page 46: “data advantages”.* The benefit of surveillance to well-resourced firms, and deleterious effect on competition, can be mitigated through privacy by design.
54. *Page 51: “Our proposed model... safeguards data protection and privacy”.* The privacy model proposed in the Consultation Paper is privacy by promise, not privacy by design. See Items 44 and 50.
55. *Page 53: “The Bank... would not know the identity of the payer”.* The privacy risk is not mostly about the Bank, but parties other than the Bank, such as authorities who compel access, criminals who seize access, and businesses who operate the system, using exceptional access mechanisms to determine, access profiling information. See Item 44.
56. *Page 57: “PIPs might use transaction data to improve existing operations or to offer new customer-facing services”.* Functions involving the collection and use of transaction data are similar to bank accounts, with all of the same implications for privacy. See Items 42, 50, and 18.
57. *Page 57: “Cross-subsidisation [can potentially lead to] dependence on associated non-payments activities for the provision of critical digital pound services”.* Cross-subsidy is particularly risky given the opportunity to collect data revenues from credit, insurance, and blocklisting services, or

from data brokers more generally. Data revenues may be a significant contributor to revenue for businesses that engage in narrow banking. See Item 82.

58. *Page 67: “Transparency and clear understanding of the rights and tools around personal data will promote good data use”.* No quantity of cajoling or process transparency can convince the public that data collectors will keep their promises to keep data secure and to not misuse data, to say nothing of the fact that they are not promising to not share data with authorities who also might fail to keep data secure and not misuse data. “Privacy by promise” is no substitute for privacy by design. No one believes that government authorities would not have access to the transaction data of individual consumers if they were to ask in the right way, just as no one believes that the systems that store and process data would be impervious to malicious attackers, accidental or deliberate data breaches, signals intelligence capabilities of foreign state actors, and the quotidian business interests of the private-sector businesses that will ultimately own and operate much of this infrastructure. To expect otherwise is fanciful at best, and to employ coercion to compel consumers to share information about how they spend their money undermines their fundamental right to use the money as they wish, which is to say that it would undermine their right to ownership of money in general.
59. *Page 68: “Digital transactions account for the majority of transactions in the UK today”.* The primary motivation for retail CBDC is the decline of the use and acceptance of cash, which implies the lack of a public payment option in practice. Today, consumers in the UK are rapidly losing the option to use cash for their ordinary purchases. To argue that consumers must simply accept the same lack of privacy that applies to card payments and bank transfers is tantamount to arguing that the level of privacy offered by modern retail payment systems does not create negative externalities, which it does, and is good enough for everyone in every circumstance, which it is not. See Item 46.
60. *Page 68: “Personal data from bank account transactions is used and stored by firms to comply with legal and regulatory data capture requirements”.* The privacy threat of personal data capture results from the assumption that consumers cannot have custody of their own money. Legal and regulatory data capture requirements that associate consumers with transactions apply to transfers from custodial accounts. Such requirements apply to the custodians and do not apply that the identity of a consumer must be associated with all of the economic transactions that the consumer makes. Consider that with cash transactions, consumers have the right to engage with the economy without revealing their identities when they do. This right should be affirmed, not curtailed, by lawmakers and regulators. Although the CBDC architecture does not permit consumers to possess and control their own CBDC assets, alternative architectures that do so should be considered instead. Architectures that allow users to possess and control their own assets would enable users to transact their own assets privately without violating rules related to the disclosure obligations of regulated custodians.
61. *Page 68: “firms also have to comply with UK data protection laws”.* Law cannot prevent data breaches, does not stop government authorities from misusing the data to which they have legal access, and does not stop insiders from accessing the data to which they have technical access. Regulations such as GDPR have not been effective in preventing such misuses of data [27], and users cannot trust what they cannot verify. See Items 42 and 44.
62. *Page 69: “the UK GDPR requires that firms must be satisfied that sharing personal data with a law enforcement authority is lawful”.* Regulations that compel regulated businesses to cooperate with authorities do not necessarily mean that consumers must be subject to profiling. It is not that businesses that facilitate transactions should be uncooperative, but that the design of the system should not generate data that makes it possible to connect consumers to their payments. In particular, if consumers are able to possess and control their own assets, then it will be possible for them to transact without involving custodians who know their identities. See Items 70 and 71.
63. *Page 69: “at least as private as current forms of digital money”.* Current forms of digital money are not private, and a central motivation for the exploration of CBDC is the disappearance and refusal of cash, which is more private. See Items 46 and 50.
64. *Page 69: “exert greater user control of personal data”.* The only way for users to be in control of their transaction data is to not associate their identities with the transactions in the first instance,

which also implies that users must have a way to avoid associating their transactions with each other.

65. *Page 70: “except for law enforcement agencies under limited circumstances”*. This describes an “exceptional access mechanism”; see Item 44.
66. *Page 70: “the ability to identify and verify users is needed to prevent financial crime”*. Identifying and verifying users does not imply associating payers with their transactions. See Item 47.
67. *Page 70: “greater benefits from sharing their personal data”*. The potential for consumers to benefit do not justify compulsory revelation of all spending habits and patterns, as is often the case with digital payments today, as payment service providers have business models that depend upon the potential, for themselves or for customers of their data, to analyse the behaviour of their customers. Also, there is no evidence offered to support the proposition that users actually do benefit from sharing their data; the proposition may be valid but unsound.
68. *Page 74: “There is public appetite for trading personal information for access to products and services”*. The argument that personal information can be monetised for the benefit of data subjects is valid but not sound. An individual’s data is generally more relevant, and thus more valuable, to the data subject than to other recipients. Additionally, effective data brokers generally amass such large datasets that the marginal value of additional data related to a single individual is usually close to zero (submodularity). Finally, encouraging people to reduce their privacy by revealing their data creates negative externalities by reducing the size of the set of parties who have not chosen to do the same, thus reducing their privacy as well.
69. *Page 87: “understanding and trust among the public is crucial”*. Trust is not achieved by requiring people to provide their identities in every transaction, or to require them to store their assets with custodians as a condition of being able to make a payment. See Item 58.

2.3 Custody

70. *Page 11: “Wallets to hold digital pounds offered by the private sector”*. If users are forced to engage with custodians in the course of owning digital assets, then they do not really have the degree of possession or control suggested by the use of the term “wallet”. It should be possible for owners of CBDC to use open-source tools, not just services, that allow them to possess and control CBDC directly.
71. *Page 11: “Accessed by users through smartphones or cards”*. The word “accessed” suggests that the tokens must be stored by some custodian, which controls access; actually, it must be possible for tokens to be stored directly on the devices, not merely accessed. It may be that users will be able to access CBDC using smartphones or cards, although it must be possible for users to use unregistered devices as well. In addition, smartphones and cards usually important security weaknesses. Smartphones usually have a large attack surface and remote-access vulnerabilities that result from being connected to the Internet, while cards usually lack a display or input mechanisms, meaning that users are required to trust third-party hardware such as ATMs and point of sale devices.
72. *Page 11: “Limited amount per user”*. Limiting the amount of CBDC that a user can hold implies that either a representation of the amount of CBDC that a user has is effectively stored in a ledger somewhere, making it functionally not different from an account, or the wallets that hold CBDC are not really under the control of their owners, since they must enforce rules contrary to the desires of their owners. Both scenarios imply that users do not really have control of their money.
73. *Page 13: “a digital pound... would be available to non-UK residents too”*. Visitors require a way to access the UK digital economy as well, and it is appropriate to expect that they would own digital pounds just as visitors own physical pounds. However, it is less obvious that such visitors would need to establish persistent relationships with UK banks, as is an implicit requirement of the design described in the Consultation Paper. A better approach would be to allow owners of CBDC to hold the assets directly, as they do with physical cash. Correspondingly, it would be reasonable for visitors who exchange foreign currency (or CBDC) for UK CBDC to avoid the requirement

to provide personal information for AML/KYC purposes, provided that they exchange the assets in-person and that the service provider that offers the exchange strictly enforces limits, as is done with travel money exchanges (bureaux de change).

74. *Page 13: “personal details would be known to their private sector wallet provider”.* Consumers must have a way to directly possess and control the CBDC directly, using tools rather than services. Otherwise, the money is not really theirs but rather something that they are only conditionally privileged to use, subject to the conditions and decisions of their service providers. See Item 70.
75. *Page 14: “Unlike cash, the amount of digital pounds an individual or business could hold would be subject to some restrictions... to ensure a smooth introduction without unintended consequences for monetary or financial stability”.* The goal of avoiding unintended consequences can be realised by imposing restrictions on withdrawals of CBDC from banks, just as it can be realised by imposing restrictions on withdrawals of cash from banks. Applying a limit to withdrawals rather than holdings is more direct and appropriate mechanism to safeguard against bank runs, since it is really the withdrawals by consumers and businesses, not the total holdings by consumers and businesses, that potentially introduce strain on the balance sheets of banks. The choice to impose the restriction on holdings rather than withdrawals is therefore not justified.

We note also that limits on receipt or withdrawals can implicitly be used to implement limits on total holdings. For example, a regulator, or private-sector bank through its risk management practice, might decide to limit aggregate CBDC receipt or withdrawals to some amount each day, or each month, and the issuer might establish an expiration date for a particular CBDC vintage [34]. These mechanisms can be used to mitigate the risk of bank runs without managing the holdings of individual consumers.

Restrictions on the amount of CBDC an individual or business can receive or withdraw are different from restrictions on the amount of CBDC an individual or business can hold. In particular, restrictions on receipt or withdrawals can be imposed by banks or other service providers involved in distributing and redeeming CBDC, whereas restrictions on total holdings imply either the implementation of an account-like structure for the owner, which would be managed by the central bank or a private-sector business, or the reliance upon “wallets” to enforce rules about what they can hold, for example by using a wallet registration system or trusted hardware, against the interests of the owners of the CBDC. This design choice is somewhat bizarre, since it suggests a deliberate protection of the current business models of incumbent providers of services that provide custody.

76. *Page 14: “It would be for a further decision, in the light of experience, whether those restrictions should be made permanent”.* It is certainly prudent to make a decision following some introductory period, although we imagine that there should be some permanent restrictions, accounting for factors such as inflation and distribution of wealth, although the restrictions should be like cash: on receipt and withdrawal of CBDC, not aggregate holdings. Restrictions on receipt and withdrawal of CBDC are sufficient to protect against exigent threats such as bank runs.

We also note that as retail payments migrate from cash to the digital economy, the right to hold an unlimited amount of physical cash might be undermined, as physical cash becomes less useful. So, we will need a way to preserve this right in the digital economy, by explicitly not imposing a limit on total holdings.

77. *Page 19: “DeFi applications... enable users to buy, swap, sell and settle crypto products without reliance on central intermediaries or institutions.”* Arguably, the purpose of DeFi is to enable the direct exchange of value without requiring transacting parties to make use of custodians or accounts. This concept is akin to digital cash and is worthy of support. Note that it is possible to avoid imposing a requirement for consumers to invoke custodians or accounts in digital retail transactions without decentralised issuance and without undermining regulatory compliance requirements.
78. *Page 25: “financially risk-free money widely accepted for transactions in the UK will be available in both stress and normal times”.* Centralised approaches wherein users are not directly in possession and control of their assets are vulnerable to shocks wherein centralised system operators are damaged or disabled, or when communication links between transacting parties and centralised system operators are severed.

79. *Page 28: “giving households the security that they could exit the banking sector or private payment platforms to a digital, financially risk-free asset”.* Another critical aspect of this security is knowledge that users cannot be blocked by asset custodians. Consider the case of protesting Canadian lorry drivers [28], whose bank accounts were blocked by authorities. The proposed architecture does not address this risk, because of the role of “wallet” service providers as intermediaries.
80. *Page 29: Contactless card payments, mobile payment apps, payment facilitators, Open Banking.* The mechanisms listed all facilitate and promote the use of custodial accounts as a means of payment rather than cash. Although Open Banking was promoted as a way to disintermediate retail payments, the use of card payments have only increased since the introduction of Open Banking. Although Open Banking might have reduced costs of card operations or the total cost of interbank transactions, interchange fees have remained high, demonstrating the weakness of the supply-side argument that transacting parties (consumers and vendors) would benefit.
81. *Page 32: “smart contracts, which carry out specific actions based on pre-defined terms and conditions”.* In principle, CBDC can interoperate with a rich framework for smart contracts. However, smart contracts that serve to bind a user to an agreement with a third party, or to impose other conditions on the use of the assets in question, necessarily require the user to not be in possession or control of the assets. See Items 70 and 71. Since the ability for consumers to directly possess and control digital assets is an essential design feature, execution of smart contracts that enforce rules or impose conditions or restrictions are perhaps best handled by the use of an escrow agent.
82. *Page 34: “includes the potential for... narrow banks”.* Deposits at narrow banks are generally expected to be backed by liquid sovereign debt rather than risky securities, and the primary function of such banks is to manage deposits and facilitate payments rather than to engage in credit creation. However, given that financial intermediation is the traditional role of commercial banks, it is worth considering the implications of narrow banking as a business model. It is not obvious that consumer-facing banks should have a role in retail transactions, for which there are important negative externalities. When consumers use cash, their banks are not involved; the rise of narrow banking suggests an increasing role of the custodial accounts of consumers in retail commerce, with a concomitant deleterious impact on the rights of consumers to privacy, possession, and control (see Item 13) and a concomitant deleterious impact on financial inclusion and payments resilience (see Item 14).
83. *Page 34: “whether new forms of private digital money display adequate interoperability”.* New forms of private digital money often drive fragmentation. See Item 4.
84. *Page 36: “offline payments... could be valuable in remote areas”.* If, by the term “offline payment”, what is meant is a payment wherein neither party has a data connection at all, then it is natural to consider solutions that involve trusted hardware. However, although trusted hardware may be a valid option for transacting parties who freely choose to trust the hardware manufacturer, in such cases, the hardware manufacturer becomes a *de facto* custodian, despite the fact that the owner of the assets might have possession of the device holding the assets. Establishing CBDC that *requires* certified hardware, including hardware with “secure enclaves”, introduces many problems and negative externalities [25].

Alternatively, if “offline payment” means only that the transacting parties do not have access to the Internet, then it is technically possible for the transacting parties to trust a local third party, rather than a system-wide “core ledger”, to memorialise some record of the transaction [23]. However, this requires some measure of decentralisation, whereas the system proposed in the Consultation Paper seems to assume that the effect of all transactions must be recorded in the core ledger.

Finally, it is worth considering whether it is actually necessary for a CBDC to provide support for offline payments of either type. The payment technologies that have supplanted cash in recent years usually rely upon fully functioning network connections. Today, there are many different payment mechanisms, including cash, and each mechanism carries its own set of costs and benefits. Even in the long-term, it is unreasonable to expect that CBDC will outperform or replace every payment solution in all circumstances, including cash, which performs well as a robust offline payment solution.

85. *Page 40: “Limits on holdings of the digital pound... would constrain the extent of outflows from bank deposits”.* The statement is true, although limits on holdings is not the only way or the

best way to constrain the extent of outflows from bank deposits. The extent of outflows from bank deposits can be constrained directly, by limiting the rate at which individuals can withdraw or receive CBDC. Most importantly, by limiting receipt and withdrawals rather than limiting holdings, users can possess and control their own wallets, which is a necessary prerequisite to possessing and controlling their own money. See Item 75.

86. *Page 40: “there would be uncertainty about... banks’ ability to replace lost retail funding with wholesale funding”.* There are two issues here: the effect of having current accounts that are smaller by the amount of cash that individual consumers would have carried with them prior to the burgeoning popularity of card payments over the past decade, and the effect of lost revenue associated with transaction fees and data harvesting associated with payment processing activities. The former can be expected to be modest; the latter is about banks relying upon an activity other than banking as a critical source of revenue. See Item 25.
87. *Page 46: “new forms of digital money... could cause commercial banks to lose some of their retail deposits”.* See Items 25 and 118.
88. *Page 47: “commercial incentives... could favour the creation of ‘walled gardens’ with low interoperability”.* Walled gardens, including not only card payment networks but also their principal competitors, such as mobile payment apps, also undermine consumer privacy and control. See Item 53.
89. *Page 49: “Relative to cash, the digital pound would have negligible storage costs”.* Although it might seem that because a simple USB stick can store an arbitrarily large quantity of digital assets or the keys that control them, this statement is not justified. For example, the cost of a security safe is generally a function of the value, and not the physical size, of what is stored inside [34]. The operational cost of managing backups and securing digital devices against theft is not trivial, and not obviously less than managing and protecting cash.
90. *Page 49: “an unremunerated digital pound could make it more difficult or banks to charge negative deposit rates without losing deposits”.* See Item 26.
91. *Page 51: “Our proposed model... promotes accessibility”.* A better way to promote accessibility is to allow a means for owners of CBDC to possess and control it directly, rather than to require it to be “provided”. See Item 70.
92. *Page 53: “The private sector would never be in possession of end users’ digital pound funds”.* With assets represented directly on the core ledger, managed and discoverable by core ledger operators or those with the power to compromise or compel access to the information on the ledger, end users would never be in possession of their own CBDC funds, either.
93. *Page 55: “PIPs, and the wallets they provide, would never be in possession of end users’ digital pound funds”.* But PIPs can dictate terms in which wallets operate. See Item 92.
94. *Page 61: (delegated model) “the PIP... has a record of a user’s holdings of digital pounds”.* A user’s holdings must not be subject to surveillance of this kind. With the “delegated model” described in the Consultation Paper, the user must have an account with the PIP, which intermediates a consumer’s transactions, not unlike electronic payments using traditional bank deposits. See Item 135. Unfortunately, this architecture, like the primary architecture proposed in the Consultation Paper, implies that users are not really in possession or control of their own assets, and they cannot really transact privately. A better approach would allow PIPs to monitor withdrawals of CBDC into non-custodial wallets in the possession and under the control of a consumer. Once in the non-custodial wallet, the PIP no longer has visibility of the assets and does not learn when they are spent. Thus, the PIP would have record of deposits and withdrawals but would not have knowledge of aggregate holdings, because the PIP would not know whether or when assets are spent.
95. *Page 61: (delegated model) “greater technical and operational requirements on PIPs”.* In principle, there is a design choice concerning whether a PIP would maintain its own ledger or not. Having PIPs maintain their own ledgers, as in the “distributed model”, would improve scalability, and is more consistent with models based on self-validating tokens and oblivious transfers, wherein neither the ledger trusted by the issuer nor the ledger maintained by a PIP actually store representations of tokens on a ledger at all.

96. *Page 61: (bearer instrument model) “no trusted intermediary... could give rise to ‘double spend risk’”*. The “bearer instrument model” described in the Consultation Paper is a straw man. It is theoretically impossible to have fair exchange without a trusted third party [45], and the “double spend risk” referenced in the Consultation Paper is not inherent to the requirement for users to possess and control their own assets. Specifically, an asset can reference (implicitly or explicitly) a specific trusted intermediary or network that must be used to facilitate its next transaction. This method allows users to have fair exchange whilst possessing and controlling their own assets.
97. *Page 61: (bearer instrument model) “a bearer instrument approach... would lead to completely anonymous payments”*. As noted in Item 96, the “bearer instrument model” described in the Consultation Paper is a straw man; there are other models for bearer instruments that are not considered by the Consultation Paper. The Consultation Paper seems to assume that if a consumer is able to have possession and control of a CBDC asset, then it must be possible:
- (a) to have peer-to-peer transactions without any involvement of third parties;
 - (b) to have a transaction without reporting the transaction to regulators; and
 - (c) for both counterparties in a transaction to be anonymous.

In fact, none of these assumptions are true. It has been shown that an architecture with self-validating tokens and oblivious transfers can be built to allow consumers to directly possess the tokens that they use, while also using Chaumian blind signatures [46, 47] to make the sender anonymous. In a system of this type, which is not considered in the discussion paper, payers are anonymous and payees are not. The asset is absolutely a “bearer instrument” in the sense that the payer holds a fungible asset directly, does not provide identity information during transactions, and is not subject to the rules of a custodian.

However, regulators could specify rules to ensure that payments are not completely anonymous, for example, by requiring identifying information of the recipient to be embedded into the asset with each transaction and requiring that tokens can be transacted only once before being converted into bank deposit or exchanged by a regulated intermediary for a new asset.

98. *Page 61: (bearer instrument model) “There is additional complexity for conducting transactions between two individuals over distance”*. The assumption that having bearer instruments implies conducting transactions between individual consumers is false. Transactions can be facilitated by third parties without requiring those third parties to be custodians. The Consultation Paper should not have dismissed direct possession and control by end users outright, simply because of the shortcomings of a specific payment architecture described as using “bearer instruments”. See Item 97.
99. *Page 64: “based on open standards (including ISO 20022 for messages)”*. When ISO 20022 was introduced, most consumer retail payments in the UK still used cash, and it was assumed that all legitimate electronic transactions would have custodians on both sides of the transaction,. However, digital currency introduces the prospect of electronic bearer instruments and the possibility that digital tokens could be held outside accounts. ISO 20022, therefore, is not built for digital currency and would require refreshing if it is to be used for that purpose..
100. *Page 72: “identity verification would be required when opening a digital pound wallet”*. The architecture described in this Consultation Paper seems to conflate “wallets” with accounts. Wallets are tools to hold digital assets; see Items 70 and 71. A better way to enforce identity verification is to require identification at the point of withdrawal or receipt of CBDC from a regulated bank or service provider into a digital wallet, as is done with bank withdrawals in which cash is received. This is not the same as requiring the wallet itself to be identified.
101. *Page 72: “PIPs would require identity information of wallet account holders”*. Wallets are not the same as accounts; consumers should have the option to hold assets directly. See Items 70 and 71. Having PIPs collect information about their customers does not imply involving PIPs in the transactions wherein consumers make payments. See Item 100.
102. *Page 72: “the UK AML and CFT Regime dictates that additional information about the payer must be collected for large-value transactions made in cash”*. However, AML/CFT regulation does not require payer information for small-value transactions. To preserve this right, it is necessary for

consumers to have a way to make small-value transactions without associating payer information with the transaction, as it is for payments with cash. Unlike with cash, a CBDC system could ensure that the recipient is fully monitored, thus offering a greater degree of compliance enforcement on the transaction without compromising the privacy of the consumer. A risk-based approach would entail requiring recipients of CBDC to explicitly collect payer information under some circumstances, including but not limited to high-value payments.

103. *Page 72: “The digital pound would have lower frictions than physical cash, so carries higher risks of abetting crime”.* This statement is false. Frictions depend upon the design of the system. For example, if it is possible to monitor all of the recipients without revealing the identities of the payers, it is possible to both see all transactions and impose frictions in a way that is not possible with cash. Also, transactions can be monitored for structuring via a risk-based approach based upon analysing receipts and withdrawals of CBDC. See Item 89.
104. *Page 80: “risks largely stem from any large and rapid outflows into digital pounds... [a] limit on individual holdings would be intended to manage those risks by constraining the degree to which deposits could flow out of the banking system”.* The risk of financial instability resulting from large and rapid outflows from bank deposits is a reasonable concern, although a limit on individual holdings is neither necessary nor sufficient to address that concern. A limit on holdings is not sufficient, because a limit on holdings does not mean that it will be possible to prevent many users from making maximum-sized withdrawals during a crisis. A limit on holdings is not necessary, because there are other, better ways to limit withdrawals during a crisis, including limiting the size or rate of withdrawals directly. Such approaches can also be introduced rapidly during times of crisis, as they have been with cash [49]. See Item 117.
105. *Page 80: “users may want to use their digital pound wallet to receive their salary”.* Although this may be possible, it might not be appropriate in most cases. Employees and service providers commonly want third-party proof that employers have paid them, and this function is usually performed by the provider of an account, not a tool for holding assets. In addition, consumers might also prefer receiving money into a bank account because they will have an opportunity to earn interest, receive consolidated reports for tax compliance purposes, or conveniently invest in securities. Accounts offer many benefits, but proper wallets are not accounts. The Consultation Paper seems to implicitly assume that CBDC wallets would substitute for bank accounts. CBDC wallets are not a substitute for bank accounts, which serve a critical role in financial intermediation, nor are they a substitute for cash, which is intrinsically more effective than digital payment mechanisms in certain use cases and situations. See Items 70 and 71.
106. *Page 80: “We seek feedback on the proposed holding limit”.* There should be limits on receipt and withdrawal of CBDC, not holding limits. Please see the response to Question 7 in Section 3.
107. *Page 82: “Limits would be in place at least during transition”.* Any limits should be imposed on the receipt or withdrawal of CBDC, rather than upon aggregate CBDC holdings. The system must not treat CBDC wallets as a kind of account, but as a digital asset that can be possessed and controlled in a manner similar to how a physical assets can be possessed and controlled. See Items 70, 71, and 104.
108. *Page 83: “How many digital pounds should corporates be able to hold”.* Corporate persons are different from human persons, and do not have human rights. Nevertheless, compared to limits on *withdrawals*, limits on *holdings* are inappropriate and less well-suited to the problem of addressing financial instability. Also, it might be reasonable to assume that different corporations should have different limits, which can be imposed at a specific level for each business by requiring enforcement by custodians and money services businesses that transfer money to the business in question. See Item 104.
109. *Page 83: “holdings above the level of the limit might be automatically ‘swept’ into a nominated bank account”.* The Consultation Paper assumes that a CBDC wallet is essentially a kind of account, with actual custody of the assets under the control of a party other than the beneficial owner. This is problematic for several reasons; see Items 70 and 71. In this case, the Consultation Paper also assumes that CBDC wallets must be online with full connectivity to the designated bank account in question.

Nevertheless, non-custodial CBDC wallets under the direct possession and control of users can still be used in conjunction with accounts that enforce certain rules, such as a limit on the quantity of CBDC withdrawn net of the quantity of CBDC deposited. The wallets can function as practical tools that allow their users to manage their acceptance of CBDC, their deposits of CBDC, and their withdrawals of CBDC in anticipation of enforcement of the rules by the accounts with which they interact.

110. *Page 84: “distinguishing which type of business should or should not have access to the digital pound”*. It is certainly possible to prevent certain businesses from withdrawing or accepting digital pounds. It is also possible for a regulator to specify the conditions in which a recipient of CBDC will be able to redeem it. For example, a regulator may stipulate that a consumer must embed the identity of the recipient or even a valid bank account of the recipient, into some or substantially all transactions. A regulator might also specify that the recipient must deposit the CBDC into a bank account within a certain period of time, or even that the recipient must receive CBDC directly into its nominated bank account, as a condition of business.
111. *Page 87: “for those without the internet or smartphones, offline capabilities and other solutions are being explored”*. The set of general-purpose solutions under consideration should include those under investigation by the Future Infrastructure for Retail Remittances (FIRE) Project, which is being led by University College London and the University of Edinburgh.
112. *Page 87: “need to be designed to help people access services”*. CBDC wallets are not the same as basic bank accounts and should not be evaluated in such terms. Access points and means of identification should be subject to regulation and managed by banks and other regulated money services businesses, and they should be designed to help people receive money in the absence of a persistent relationship with a bank or other asset custodian. See Items 70 and 71.
113. *Page 89: “we discussed the possibility of civil society groups becoming wallet providers”*. It must not be a requirement that wallets would be “provided” by some custodian or service provider; see Items 70 and 71. The main issue with respect to service providers in the context of civil society is the matter of cajoling people to accept the authority of a custodian or other gatekeeper as a prerequisite for engaging with the economy. Such custodians and gatekeepers are not necessary for the use of cash, since it is directly possessed and controlled. Provided that there is a means for individual persons to possess and control CBDC directly, then this potential tussle with civil society groups and those they represent can be avoided.

2.4 Role of identity

114. *Page 11: “digital pounds are recorded anonymously on the Bank’s core ledger”*. If the owner of digital assets is able to find them on the ledger, then those assets must be linked to the identity of the owner. Even if they are recorded anonymously, the fact that the user can find them on the ledger must reveal, either to the “wallet” service provider or to the ledger operator, information linking the user to those assets.
115. *Page 12: “using their wallet to see their balance”*. Is the balance recorded as a balance, rather than tokens? If there is a balance on the ledger that is updated during a transaction and accessed again in the following transaction, then those two transactions are linked. If two or more transactions are linked, then information that can be used to identify the owner is revealed.
116. *Page 32: “improved functionality for users, such as programmability”*. The examples given in the Consultation Paper of user-specified rules to limit their own spending on certain products or to facilitate saving are certainly achievable with a CBDC. However, there are important limits to programmability. Rules that serve to bind a user to an agreement with a third party, as well as rules that serve to restrict a user from conducting certain kinds of transactions, must necessarily index the identity of the user, implicitly or explicitly, for example via an account-like custodial relationship or by embedding identity information, and thus accountability, into individual tokens. Such use cases undermine both consumer privacy and the fungibility of the assets in question, and expose consumers to human rights abuses akin to those that characterised the Australian cashless welfare card [26].

117. *Page 40: “In periods of banking or financial stress... demand for digital pounds could be particularly strong”.* During such periods, the availability of digital pounds can be managed on a per-user basis, just as the availability of cash can be managed, by limiting the rate of receipt or withdrawals [49]. With a suitable system design, it is likely that digital pounds can be managed even more easily.
118. *Page 41: “increased risks... from banks becoming more reliant on wholesale funding and less on deposits”.* It is possible to limit withdrawals per unit time on a per-user basis, in a manner that mitigates the risk that individual users would convert large volumes of bank deposits to CBDC. See Item 75. However, a banking system that implicitly requires consumers to not hold cash directly, because it depends upon consumers to hold all of their current assets in custodial accounts, is not particularly robust or sustainable.
119. *Page 44: “more susceptible to more frequent inflows and outflows because it could be easier to switch into digital pounds than into cash”.* The argument that the digital nature of CBDC implies that CBDC is harder to control is false. The rate of outflows can be managed by imposing user-based restrictions on receipt and withdrawal of CBDC, which can be combined with expiration policies and managed more efficiently than cash. See Item 75.
120. *Page 70: “these data would be anonymised and not be considered personal data”.* It is not possible to anonymise personal data associated with transactions without unlinking the transactions and assets from each other. Depending upon how the core ledger is implemented, including the question of whether assets are represented as tokens or balances, unlinking the transactions and assets from each other might not be possible.
121. *Page 71: “law enforcement agencies and competent authorities could only access digital pound data where there is a fair and lawful basis”.* This describes an “exceptional access mechanism”; see Item 44. Presumably, authorities would request data from regulated service providers, although if the CBDC were a token rather than a balance and the consumer were to have direct possession and control, then the consumer could (using privacy-enhancing technology such as blind signatures or ZKP) furnish it to a vendor without revealing his or her identity. Although the payer would be anonymous, the recipient would be transparent.
122. *Page 72: “tiered identity verification”.* The essence of tiered identity verification is substantively similar to a design described by the People’s Bank of China in 2021, wherein different categories of accounts are associated with different degrees of identity assurance [48]. Unfortunately, a lower degree of identity assurance does not imply a higher degree of privacy. The PBOC proposal for tiered accounts is tantamount to a proposal for pre-paid debit cards with varying information requirements [31]. Unfortunately, consumers still lack privacy, since their transactions are linked through the repeated use of the same account. As a result, such an architecture not only fails to deliver privacy but also encumbers regulatory compliance [23].
123. *Page 73: “providers must collect the data that is required for legal purposes”.* Irrespective of the level of identity assurance for the data used to establish an account, the data associated with multiple uses of an account will reveal information that can be used to expose consumers to the risk of profiling on the basis of the of the account. See Item 122.
124. *Page 76: “Non-resident access”.* In a system wherein one party must be transparent in every transaction, it is possible to allow a sponsor to associate his or her identity with the CBDC asset in exchange for furnishing the asset to an unidentified second party. The second party can then conduct transactions without revealing his or her identity, as the sponsor normally would have done, except that the identity of the sponsor would be associated with the payment transaction as the payer. This can be used to ensure accountability while allowing parties without identification credentials suitable for AML/KYC procedures to receive and use CBDC.
125. *Page 76: “ensure that UK standards of resilience, consumer protection, AML, KYC and any other legal requirements are upheld”.* In most circumstances, it makes sense that consumers would be required to satisfy AML/KYC requirements to receive or withdraw CBDC in the first instance, thus ensuring that CBDC is not commonly received or used by parties subject to sanctions or conditions. However in-person money changing services and cash points with human operators could be permitted to waive the requirement to provide documentation for small-value exchanges.

2.5 Role of the ledger

126. *Page 11: “Private sector companies [would offer] digital ‘pass-through’ wallets to end users”.* Functionally, a “pass-through” wallet seems to be a tool for accessing CBDC “on the Bank’s core ledger”, rather than a device for storing digital assets. This contrasts with the definition of the term *wallet* established by experts [24], and it implies that users do not really have possession of their money. The use of a core ledger to store digital assets also implies that banks do not have possession of their money, either. Possession is centralised, even whilst the mechanism for accessing the tokens is intermediated.
127. *Page 13: “the digital pound would... not make use of the same energy-intensive technologies that underpin some cryptoassets”.* Some cryptoassets certainly make use of energy-intensive technologies. For example, cryptocurrencies that use permissionless ledgers often rely upon computationally expensive mechanisms, such as proof of work, to defend against Sybil attacks, and cryptocurrencies that make use of multiparty computation, such as those implemented on the Ethereum platform, often entail computationally expensive smart contracts. However, the fact that some cryptoassets that use distributed ledgers are environmentally harmful does not imply that the use of a distributed ledger would necessarily be environmentally harmful. In particular, permissioned distributed ledgers that avoid multiparty computation have a much smaller energy footprint, and models that avoid recording every asset or transaction directly on the ledger are even more energy-efficient.
128. *Page 19: “Blockchain technology... introduced digital assets supported and distributed in a peer-to-peer fashion, backed by cryptography alone”.* The purpose of Blockchain technology is to establish an immutable ledger via consensus among independent actors. Blockchain technology can also support the validation of transactions involving assets that are not distributed (or redeemed) in a peer-to-peer fashion. In addition, it is more accurate to say that cryptocurrencies are *enabled*, not *backed*, by cryptography; the “backing” is implicit to the willingness of marketplaces (or specific traders) to accept cryptocurrencies as a means of exchange.
129. *Page 23: “unbacked cryptoassets... are not considered an efficient medium of exchange”.* Inefficiency as a medium of exchange is not intrinsic to unbacked cryptoassets; cryptocurrencies with this characteristic typically either (a) use permissionless ledgers, which require computationally expensive security measures to protect the integrity of the ledger; (b) manage tokens directly on the ledger, thereby introducing substantial computational, network, and storage overhead; (c) rely upon multiparty computation, for example to execute smart contracts; or (d) some combination thereof. Unbacked cryptoassets of the future are likely to be more efficient, particularly with oblivious transfers and self-validating assets, which dramatically reduce the requisite communication and storage requirements; privacy-enhancing technologies such as blind signatures and anonymising proxies can make it easier to run a permissioned network without being shut down; and scalable architectures that separate transaction processing from issuance, allowing a broad base of issuers that can avoid direct involvement in transactions [23].
130. *Page 24: “a public digital pound infrastructure available to all eligible private-sector firms that wish to develop new payment services”.* There are several questions here. First, what is the process for expressing a wish to develop new payment services? Second, what will delineate the infrastructure from consumer-facing services? We could imagine that infrastructure might refer to distribution and redemption channels through banks and other money service businesses, although we could also imagine that the infrastructure refers to the operation of the ledger itself. In this system design, must retail users interact directly with the regulated operators of a “core ledger”, or can they also satisfy the requirements to execute transactions by interacting with the ledger only indirectly, through an unregulated service provider that interacts with a regulated operator of the “core ledger”? The distinction is important, because accountability for system operators is non-negotiable. See Item 138.
131. *Page 53: “a payment made in digital pounds between two users would be processed and settled by a transfer on the Bank’s core ledger”.* The assumption that assets should be directly recorded on the ledger is not justified. The assumption that the ledger should be controlled by a central operator, which can exercise the option to equivocate or change the rules without warning, is not justified. See Item 138.

132. *Page 53: “The private sector... would provide digital pass-through wallets”.* For users to have possession and control of their own money, wallets must not be “provided”. See Item 126.
133. *Page 53: “the core ledger operated by the Bank... might use distributed ledger technology”.* The core ledger should indeed use distributed ledger technology, but mainly to enforce accountability of system operators, to prevent equivocation, and to prevent a central operator from changing the rules or history without warning. See Item 138.
134. *Page 56: “pass-through wallets would allow users to hold and use the digital pound”.* This is not true with the architecture proposed in the Consultation Paper, wherein the assets are held on the ledger and accessed only via PIPs. See Item 126.
135. *Page 56: access to digital pounds, make payments, view balances and transaction history, mobility.* The functions of “wallets” listed in the Consultation Paper are really the functions of *accounts*, and the use of the term “wallet” is misleading. The Consultation Paper seems to envision a “wallet” as a kind of account. See Items 70 and 71.
136. *Page 59: “Activities of Payment Interface Providers might need to be restricted to safeguard system resilience”.* Presumably, PIPs operating a DLT system trusted by the central bank would be subject to regulations and restrictions, just as regulators oversee the operation of decentralised best-execution networks. However, this does not imply that every PIP must participate in the DLT system. For example, with architectures that use self-validating tokens, some consumer-facing PIPs could send updates to regulated PIPs without handling private data or participating in ledger consensus.

2.6 Role of the issuer

137. *Page 11: “the wallet simply passes instructions from the user to the [Bank’s] core ledger”.* In this design, the Bank of England operates a platform. No justification is provided for requiring the Bank to *operate* the ledger rather than to *oversee* a ledger operated by private-sector businesses. In addition to more closely resembling the manner in which electronic payments are processed today, a decentralised network would provide critical advantages in terms of security, availability, and trust.
138. *Page 11: “The Bank would provide... central infrastructure”.* Because the core ledger is not decentralised, its operator can change the rules without asking, or substitute one version of history for another. This design characteristic also implies a tremendous incentive for attackers to seize this point of control.
139. *Page 21: “stablecoins used as a money-like instrument should have... the ability to redeem at par in fiat”.* It is possible to extend protections similar to deposit insurance to privacy-respecting, identity-unlinked stablecoins using a self-validating token architecture [23]. In the event of default by the issuer, consumers holding stablecoins would be able to link their unblinded tokens to the blinded token associated with their withdrawal transaction. Recipients holding stablecoins have their identities embedded into the tokens. Recipients without bank accounts with the issuer should opt to receive its stablecoins directly into its bank account, which would be able to immediately redeem them in exchange for a regulated bank transfer from the issuer.
140. *Page 28: “the digital pound would reduce the incentive to use such non-sterling money”.* The incentive to use non-sterling money might be strong if users cannot possess or control sterling money directly.
141. *Page 36: “the digital pound would be exposed to risks of electricity outages and cyber-attacks”.* Risks to availability are amplified by a design that requires direct involvement of the issuer or its services in the payment channel. See Item 137.
142. *Page 45: “systemic stablecoin issuance would need to be fully backed with high-quality and liquid assets”.* See Item 139.

143. *Page 53: “the digital pound should be designed as a platform model, as originally set out in the Bank’s 2020 Discussion Paper”.* The architecture described in the most recent (2023) Consultation Paper introduces few fundamental changes relative to the architecture proposed in earlier Consultation Papers, despite preponderant criticism of the platform model and the proposition that the Bank should build and operate a “core ledger”. See Item 137.
144. *Page 54: “Given the possible single point of failure risk with the platform model, it would be necessary to ensure the infrastructure is protected to the very highest standards”.* The single point of failure in the proposed model indeed represents a major weakness that can be avoided. The core ledger is a high-value target that will be expensive, perhaps impossible, to adequately protect, and critical infrastructure can easily be compromised without detection. A far better approach would be to oversee a decentralised network without operating it directly. The model wherein a decentralised network is overseen by a regulator is already used in financial infrastructure in the context of best-execution networks [36] and works well. See Item 137. It is dangerous for a single party to be in control of the *de facto* history of all transactions. This has never been the case before and is unjustified.
145. *Page 55: “The core ledger would be a single piece of infrastructure”.* It would be better from a security, availability, and accountability perspective for the core ledger to be a network of service providers and should not record individual assets directly, either in the form of UTXO systems, such as Bitcoin, or multiparty computation systems, such as Ethereum. See Item 137.

3 Responses to consultation questions

1. *Do you have comments on how trends in payments may evolve and the opportunities and risks that they may entail?*

The following scenarios are possible and somewhat likely to emerge as the payments landscape continues to devolve over the next decade:

- (a) increasing exclusion of cash-paying consumers in many circumstances;
- (b) an economic and regulatory context that favours and incentivises data collection and surveillance by custodians;
- (c) continued support for custodial models for consumer money by governments in preference to privately-held money, particularly in response to lobbying efforts by incumbent stakeholders;
- (d) support from governments for public payments infrastructure that enables data harvesting, using the implicit data subsidy as a means to reduce costs;
- (e) over-compliance with AML/CTF rules, leading to unnecessary surveillance and deepening links between consumer purchases and personal data belonging to consumers, thus increasing the commercial value of the data harvesting opportunity;
- (f) an increasing use of money laundering techniques that do not rely upon the use of regulated payment systems at all, coupled with continued high cost and low benefit to the use of suspicious activity reports;
- (g) the emergence of alternative payment solutions operated by the private sector, both domestically and internationally, for use in the UK;
- (h) the emergence and proliferation of “outside solutions” allowing consumers to make digital payments using assets that they possess and control, outside custodial relationships, with revenues for operating the infrastructure used by such solutions accruing to criminal organisations in case they are not supported by national governments;
- (i) self-certifying assets, including non-fungible tokens, that are not stored or managed directly on a ledger but instead make use of the ledger for verifying integrity and validity; and
- (j) oblivious transfers, wherein service providers that facilitate transactions know nothing about the contents or parties to the transactions themselves.

2. *Do you have comments on our proposition for the roles and responsibilities of private sector digital wallets as set out in the platform model? Do you agree that private sector digital wallet providers should not hold end users' funds directly on their balance sheets?*

The concepts “wallet”, “account”, and “address” are often confused. A wallet is not something that is or can be “provided”, or that wallets are containers that are held or controlled by a third party on behalf of their users. Something fitting that description might be more accurately described as an “account”.

It is a dangerous mistake to think of a wallet in such terms. A wallet is correctly defined not as a service, but as an “*application or mechanism* used to generate, manage, store or use” digital assets [24] (emphasis added). They are intended to operate at the behest of their users, and there is no reason for users to be limited to the type or number of wallets that they use.

Wallets do not operate at the behest of their users if they are created by third parties, or registered with third parties, or are recognisable across multiple transactions, all of which imply that third parties can link the various actions taken by users of the same wallet over time, which implies that the wallet serves those parties, not their users.

So, for users to have privacy, as well as possession and control of their assets, their wallets:

- (a) must not contain private keys issued by an authority, since such keys would be under the control of the authority;
- (b) must not be registered with an authority, since wallet identification across multiple transactions allows the user to be profiled;
- (c) must not be identifiable across multiple transactions, since a profile can be built by counterparties or other observers even without the involvement of an authority;
- (d) must not be required to contain ‘trusted computing’ modules or ‘secure enclaves’ that can perform remote attestations, thus constraining what the user can do with assets in the wallet; and
- (e) should not normally be held by custodians, lest the custodians engage in profiling, discrimination, or gatekeeping against the interests of their users.

Wallet identification in the general case is dangerous, since it can be used to restrict how users use their assets. A true digital wallet, like a true physical wallet, is completely under the control of its user and reveals nothing during transactions of the assets it contains other than the assets themselves.

3. *Do you agree that the Bank should not have access to users' personal data, but instead see anonymised transaction data and aggregated system-wide data for the running of the core ledger? What views do you have on a privacy-enhancing digital pound?*

The bank should not have access to users' personal data, although the personal data that are most important to avoid collecting concern the payer associated with a particular transaction, or the set of transactions associated with some particular payer. Personal data may be required in the process of receiving or withdrawing CBDC to satisfy AML/KYC requirements, and such data may be collected by money services businesses and shared with regulators and authorities. However, the main risk to the privacy of individual persons results from the use of transaction information to create profiles of consumers, for example as “alternative data” in the analysis or categorisation of an individual on the basis of individual habits, location, decisions, and modes of life. Since there is no way for consumers to verify that data are not used once collected, consumer privacy critically depends upon not linking consumers to transactions that reveal how they spend their money. Specifically, individual payers must have some form of technical guarantee that their transactions can never be linked to them, by any party, including not only the Bank, but also system operators and authorities, without both their specific authorisation and unforced consent.

Regulators and authorities should have technical access to all of the information to which they legitimately have access, which does not generally include the identity of payers in transactions. There are valid reasons, including tax and anti-fraud regulations, for which at least one party to every transaction should be known to regulators and authorities, and some proposed CBDC architectures achieve this without exposing the identity of the consumer in the general case [22, 23]. We envision that most consumers would be known to regulators and authorities when they receive

or withdraw CBDC, but their identities would not be linkable to their spending transactions. We also envision that regulators and authorities would have access to the identity of the recipient of most CBDC payments.

The Bank should certainly have access to aggregated system-wide data, as well as anonymised transaction data. (Authorities and regulators would generally have access to the identity of the recipient in most transactions, but the Bank would not require access to that information.) It is less obvious, however, that this information should be stored on a core ledger; storing the data with the CBDC assets themselves would make the operation of the payment system more scalable [23].

CBDC in the UK must be privacy-enhancing, and we expect that this means that it would make use of privacy-enhancing technologies such as Chaumian blind signatures [46] or zero-knowledge proofs to prevent retail consumers from being linked to their payments against their wishes. “Privacy by promise” is no substitute for privacy by design.

4. *What are your views on the provision and utility of tiered access to the digital pound that is linked to user identity information?*

The proposal of “tiered access” is substantively similar to a proposal by the People’s Bank of China in its 2021 discussion paper [48]. For our view on the proposal in the 2023 Consultation Paper by the Bank of England and HM Treasury, we reference a contemporaneous analysis of the 2021 PBOC paper:

“Consumers have a right to conduct low-risk transactions with merchants, vendors, and other providers of retail goods and services, without revealing personal information that can be used to associate themselves with the transaction.” [31]

“To the extent that successive transactions with the same account constitute linked attributes about a user, the user is pseudonymous and not anonymous... We believe that the salient question is how much privacy we want ordinary persons to have, and with ‘managed anonymity’, the answer is not much. Inasmuch as transactions use accounts, which might be described as ‘wallets’ (in contrast to non-custodial wallets), the successive transactions that pseudonymous users make using such accounts would be linked to each other, hence the author’s reference to a ‘loosely-coupled account linkage’. So, while a consumer could in principle use an anonymous account to make a single payment, liquidating the entire account, most typical use cases would see consumers acting as price-takers, so an exact match between the price of an item and the value in an account would be unlikely. The user of an account, having completed a purchase of value less than the value of the account, would then either use the account again for a subsequent transaction or forfeit the difference between the agreed price and the value of the account. As a result, we might conclude that while malicious actors could use anonymous accounts to achieve a reasonable level of anonymity, anonymous accounts would afford much less privacy to ordinary, non-nefarious users.” [31]

“The authors of the PBOC report lightly touch on this final issue through their discussion of ‘managed anonymity’ whereby ‘the PBOC sets up a firewall for e-CNY-related information, and strictly implements information security and privacy protocols, such as designating special personnel to manage information, separating e-CNY from other businesses, applying a tiered authorization system, putting in place checks and balances, and conducting internal audits’ [48]. Presumably, the objective of such processes would be to discourage ‘arbitrary’ access to that information by ‘authorized operators’, which it identifies as primarily comprising ‘commercial banks and licensed non-bank payment institutions’ [48] that circulate the e-CNY to the public. However, as the entities that the authors call ‘wallets’ are essentially accounts, it is not obvious that the data protection mechanisms recommended by the authors can achieve their stated goals, and, given the system-level implications highlighted, the role of system operators as arbiters of such mechanisms underscores the trade-off that is inherently being made among the guiding principles.” [31]

A better approach to privacy would focus on the discoverability of links among transactions or between transactions and user data, since those links form the basis for identification and the potential for profiling a user on the basis of payments. Low-value, relatively safe transactions should be fully unlinked, wherein no identity information is provided for the payer. For high-value

transactions, or transactions that are considered sensitive because of their nature, the recipient may be required to demand identification as a condition for redemption of the CBDC asset. It may be expected that consumers would be required to provide identification when receiving direct CBDC payments or when withdrawing CBDC assets from bank accounts, which would presumably also require routine AML/KYC procedures. It may be expected that consumers would not be required to provide identification when exchanging limited amounts of cash for CBDC, and perhaps also when exchanging the CBDC issued by one central bank for the CBDC issued by another central bank.

5. *What views do you have on the embedding of privacy-enhancing techniques to give users more control of the level of privacy that they can ascribe to their personal transactions data?*

Techniques that afford users more control over the collection of their data are certainly useful. It is indeed promising that the proposal specifies the use of privacy by design rather than requiring users to accept data collection, after which claims about the storage and use of data cannot be verified.

However, we note that the primary concern for users is less about extent of the personal data required to satisfy AML/KYC requirements, and more about the use of transaction information that associates consumers with how they spend their money. It is not clear that the proposal described in the Consultation Paper offers sufficient protection (i.e., privacy by design) to prevent the ability to link a transaction to an individual payer or to link a set of multiple transactions to the same payer. We argue that it is necessary to first affirm the right of individual persons to freely engage in the digital economy, with privacy by default and without requiring the consumer to be linked to the transaction in most small-value payments. We imagine that privacy-enhancing technologies, such as blind signatures and zero-knowledge proofs, will be necessary to achieve this property, along with common-sense mechanisms, such as leveraging the network connectivity of the recipient and not requiring wallets to be identified, to reduce the risk of metadata leakage.

6. *Do you have comments on our proposal that in-store, online and person-to-person payments should be highest priority payments in scope? Are any other payments in scope which need further work?*

Yes, in-store, online, and person-to-person payments should have the highest priority, since these payments generally form the basis of consumer transactions. Nevertheless, there are some other payment types that should be considered important as well, including but not limited to:

- (a) *Payments from businesses to individuals.* Notwithstanding the fact that most consumers would probably prefer to receive payments into a bank account rather than a wallet (Item 105), it should be possible for individuals to receive salaries, wages, or tips from businesses into their non-custodial wallets. Under such circumstances, a business would most likely be expected to embed information identifying itself into the transaction, and the consumer might be expected to deposit the CBDC into a bank account before spending it.
- (b) *Transfers to sponsored recipients.* In situations wherein a consumer is unable to provide sufficient documentation to satisfy AML/KYC criteria necessary to receive CBDC, it should be possible for a sponsor to transfer CBDC to this consumer by embedding information identifying the sponsor into the transaction. See Item 124. Note that this case differs from the case of payments from businesses to individuals in that sponsored consumers would be expected to spend the CBDC that they receive via a sponsoring transaction.
- (c) *Exchanges of cash or foreign CBDC for domestic CBDC.* Consumers should be able to exchange small quantities of cash or foreign CBDC for domestic CBDC in-person, without providing documentation or identity information.
- (d) *Exchanges of domestic CBDC for cash or foreign CBDC.* Consumers should be able to exchange small quantities of domestic CBDC for cash or foreign CBDC, without providing documentation or identity information. (Additional requirements related to receiving foreign CBDC might be specified by the foreign issuer.)

7. *What do you consider to be the appropriate level of limits on individual's holdings in transition? Do you agree with our proposed limits within the £10,000–£20,000 range? Do you have views on the benefits and risks of a lower limit, such as £5,000?*

There should not be a limit on the aggregate holdings of individual consumers. Note that there is no limit on how much cash a consumer can own, and to protect this right for the digital age,

we must ensure that there is no *explicit* limit on the aggregate volume of digital cash that a consumer can own. Instead, there should be a limit on *withdrawals*, implemented by requiring banks and money services businesses to enforce the limit. A limit on withdrawals can be used in conjunction with expiration rules to define an *implicit* limit on the aggregate volume of CBDC that a consumer can own, although the limit on withdrawals is likely to be more flexible and more effective in mitigating the risk of financial instability (see Item 104). Limits can be imposed as a maximum quantity that a consumer can receive or withdraw over some period of time, or as a maximum quantity that a consumer can withdraw without correspondingly making deposits, or both. Limits can also be proposed on a per-user basis; some consumers might have more restrictive limits than others. Finally, limits can be dynamically adjusted in response to market conditions or circumstances.

In all cases, to avoid curtailing the right of consumers to privacy, we must ensure that the limit for the quantity of CBDC that a consumer can spend without providing identifying information must be not less than the quantity of cash that a consumer can spend without providing identifying information, and this quantity must increase with inflation to prevent a *de facto* curtailment of the right to privacy over time. Since private payments implicitly require users to hold money in non-custodial CBDC wallets, non-custodial CBDC wallets must be capable of receiving and holding at least this quantity. Ultimately, however, authorities should not impose restrictions on the wallets themselves, even as they may impose certain restrictions on receipt and withdrawal of funds into wallets.

8. *Considering our proposal for limits on individual holdings, what views do you have on how corporates' use of digital pounds should be managed in transition? Should all corporates be able to hold digital pounds, or should some corporates be restricted?*

There are several salient aspects to the question of how the use of CBDC by corporations should be limited:

- (a) whether there should be limits on how much CBDC corporations can receive in the form of payments;
- (b) whether there should be limits on how much CBDC corporations can withdraw;
- (c) how limits should be implemented; and
- (d) whether the same limits should apply to all corporations.

We imagine that limitations on the receipt and withdrawal of CBDC can apply to corporations, just as it can apply to individual persons. The limitations can take the form of restrictions on how much CBDC a corporation can receive or withdraw over a period of time, restrictions on the quantity of CBDC that a corporation can receive or withdraw net of the quantity of CBDC that a corporation has deposited, or both. We imagine that different limitations, as well as different restrictions on conditions for accepting deposits of CBDC, might apply to different corporations. We also imagine that some corporations might be allowed to receive CBDC directly into non-custodial wallets, whereas others might be required to receive CBDC into custodial accounts managed by regulated intermediaries such as banks.

9. *Do you have comments on our proposal that non-UK residents should have access to the digital pound, on the same basis as UK residents?*

Non-UK residents should have access to the digital pound for several reasons, including but not limited to the following:

- (a) *Non-UK residents visit the UK from time to time.* Visitors will need a public payment option to engage with the digital economy, just as residents do, particularly for use cases in which cash payments are discouraged, refused, or considered impractical.
- (b) *Non-UK residents seek to purchase goods and services from UK vendors.* Under normal circumstances, non-UK residents require a public payment option to purchase goods and services from UK vendors via the Internet or over the phone, whether or not they are visiting the UK. UK-issued CBDC can facilitate such transactions.
- (c) *UK vendors seek to market goods and services to non-UK residents.* UK vendors might require or prefer a public payment option for receiving payments, including from non-UK residents.

So, we conclude that non-UK residents should have a means to receive CBDC into non-custodial wallets, just as UK residents should have a means to do so. Nevertheless, it is not entirely obvious that UK residents and non-UK residents would share the same user journey for UK-issued CBDC. For example, non-UK residents might have a different set of requirements for furnishing AML/KYC documentation, or in certain circumstances they might require sponsorship (see Item 124). If their use of CBDC mainly concerns purchasing goods and services from UK e-commerce vendors, then a means of acquiring UK-issued CBDC might be facilitated by other e-commerce service providers.

10. *Given our primary motivations, does our proposed design for the digital pound meet its objectives?*
Unfortunately, no. Sections 1 and 2 explain why.

11. *Which design choices should we consider in order to support financial inclusion?*

Financial inclusion depends upon many factors. Design choices supporting financial inclusion include:

- (a) *True privacy by design*, wherein consumer transactions are not linkable to the identity of the payer or to each other in the general case, most likely requiring privacy-enhancing technologies such as blind signatures;
- (b) *Non-custodial wallets*, offering true possession and control to owners of CBDC assets, without technical limits on aggregate holdings, and which can be held directly by the owners without the involvement of third parties;
- (c) *The use of tokens rather than balances*, to avoid implicit identity as an emergent property of the use of balances;
- (d) *Self-validating assets*, which can be held off-ledger and use the ledger only to ensure their validity and integrity, to minimise the role of gatekeepers; and
- (e) *A decentralised ledger*, operated by a set of independent private-sector businesses overseen by the central bank, rather than a centralised ledger directly operated by the central bank, to ensure that access is not limited by the technical or practical limitations of the central bank.

Sections 1 and 2 offer a detailed explanation in support of these design choices.

12. *The Bank and HM Treasury will have due regard to the public sector equality duty, including considering the impact of proposals for the design of the digital pound on those who share protected characteristics, as provided by the Equality Act 2010. Please indicate if you believe any of the proposals in this Consultation Paper are likely to impact persons who share such protected characteristics and, if so, please explain which groups of persons, what the impact on such groups might be and if you have any views on how impact could be mitigated.*

The proposals described in the Consultation Paper are likely to impact persons with protected characteristics for reasons related to privacy and accessibility. Specifically, because the proposed system is not private by design, the following groups of individuals could be exposed to the risk of profiling, discrimination, blackmail, or violence:

- (a) victims of abuse;
- (b) witnesses to crime;
- (c) refugees;
- (d) stateless persons;
- (e) persons who are members of protected groups;
- (f) persons who are exposed to discrimination on the basis of protected traits, such as race, gender, religion, disability, age, sexual orientation, veteran status, and so on;
- (g) persons with pre-existing medical conditions;
- (h) persons who have been blacklisted as a result of a history of criminal convictions or financial default; and
- (i) persons in abusive personal, domestic, or business relationships.

In addition, because the proposed system relies upon service provision by third parties and does not offer an open architecture for non-custodial wallets, there is a risk that third-party business models might not provide adequate support for certain groups, such as:

- (a) persons with vision impairment;
- (b) persons who cannot afford smartphones;
- (c) undocumented persons;
- (d) homeless persons; and
- (e) persons whose possessions are under the control of another person.

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