RESERVE BANK OF AUSTRALIA

Submission to the Inquiry into Digital Currency

Senate Economics References Committee

November 2014

Summary

The Reserve Bank of Australia has prepared this Submission for the Senate Economics References Committee's inquiry into Digital Currency. The Bank recognises that the concept of a decentralised ledger is an innovation with potentially broad applications for a modern economy, and that digital currencies represent an interesting development in the payments and financial system landscape. Accordingly, the Bank takes an interest in digital currencies and monitors developments in this area.

This Submission outlines the key concepts underlying digital currencies and their associated financial and payment intermediaries; particular focus is given to Bitcoin as it is the most prominent digital currency at present. Digital currencies offer a range of potential benefits to users; however they also give rise to a number of risks.

Digital currencies may raise immediate concerns for other regulators regarding issues such as taxation, money laundering and terrorist financing, and consumer protection. However, given that digital currencies are not widely used or accepted in Australia, it does not appear that there are currently any issues for the Reserve Bank to address from the payments system, monetary policy or financial stability perspectives. The Bank will continue to assess whether any policy response might be appropriate, including whether any policy issues might be best approached on a coordinated basis internationally.

Digital Currencies and Associated Intermediaries

Digital Currencies

'Digital currencies' are often defined in the negative. For example, paraphrasing the definition of the European Banking Association, a digital currency might be defined as a digital representation of value that is neither issued by a central bank or a public authority, nor necessarily attached to a national currency, but may be accepted by some parties as a means of payment and can be transferred, stored or traded electronically.[1]

Bitcoin is one of the first and most prominent implementations of a decentralised 'cryptocurrency' protocol, where the supply of bitcoin units and the system of transferring these are protected by

1 See European Banking Authority (2014).

cryptography instead of the rules of a central operator or administrator.[2] Many other digital currencies – there are now over five hundred, most of them with minuscule use – are copies or modified copies of Bitcoin.[3] The open source nature of the code means that the barriers to entry are low for promoting a new digital currency, though network effects are relevant for adoption.

To transfer bitcoins, participants interact directly with each other across a peer-to-peer network, verifying transactions themselves. Bitcoin is in essence a public ledger (called the 'block chain') which records where each bitcoin unit is located and a history of all transfers in ownership.[4] That is, a key innovation of Bitcoin relative to many existing payment systems is that transactions are processed in a decentralised manner and recorded in a distributed public ledger rather than being processed by a central entity and recorded in a private ledger. The Bank notes that the innovation offered by protocols that provide secure and reliable distributed ledgers may, in the longer term, have significant implications for a wide range of systems that currently rely on a central entity to maintain trust.

Bitcoin's decentralised transaction verification occurs through a process known as 'mining'. In this process, network participants compete to solve complex cryptographic puzzles as part of validating batches (or blocks) of transactions and incorporating these batches into the block chain. The first participant to reach a solution then broadcasts it to the network for others to confirm that it is correct. If this is the case – solutions, though hard to arrive at, are easily verified – participants then move on to the next batch of transactions, building from this latest entry in the shared public ledger. As a reward for their contribution to the verification process, the miner that reached the solution first is credited a fixed amount of new bitcoins (currently 25 bitcoins per block) and any fees paid by the senders of the transactions just verified. The reward of new bitcoins for mining is how bitcoins enter circulation. There are currently around 13½ million bitcoins in circulation (Graph 1); the market value of the outstanding stock in late November 2014 was US$2.8 billion. The reward for transaction verification is scheduled to eventually be reduced to zero since the protocol specifies that the supply of bitcoins will eventually be capped at 21 million bitcoins.

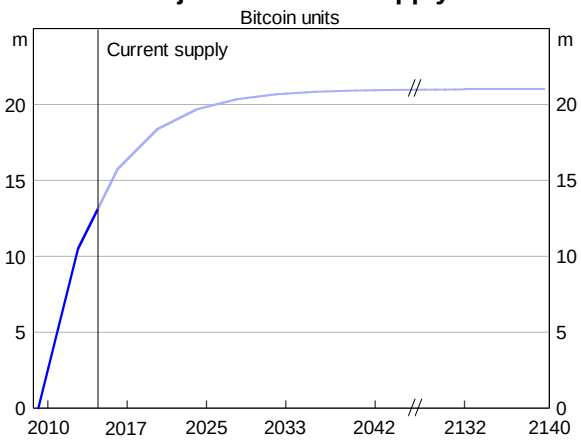
2 Bitcoin was originally proposed by Nakamoto (2008). The Bitcoin Foundation has been established to maintain and further develop the protocol, and to promote Bitcoin. In this submission, the convention followed is for Bitcoin the protocol to be capitalised while the units (bitcoins) are lower-case.

3 At time of writing, some 533 digital currencies were listed by the monitoring website http://coinmarketcap.com/. It has been suggested that some new digital currencies serve as vehicles to test out new technology or rules before they are incorporated into more established digital currencies.

4 Bitcoins are located at 'addresses' in the ledger, and the system offers pseudo-anonymity as addresses are not linked to the holder's real-world identity. Bitcoin wallets are used by participants to store their bitcoin address(es) and to generate messages to transfer bitcoins from one address to another. A user can only transfer bitcoins if they have the unique private key for the address at which the bitcoins are located.

Graph 1

Projected Bitcoin Supply



* Supply to November 2014 sourced from Blockchain.info.
Sources: Blockchain.info; RBA

Digital Currency Intermediaries

Users of digital currencies may use intermediaries to help manage their holdings and facilitate transactions. In the case of Bitcoin, users have several types of services available to them and a number of intermediaries providing these services (Table 1).

Table 1: Bitcoin Intermediaries

Intermediary Service	Description
Bitcoin wallets	Store users' bitcoin address(es) to which their bitcoins are tied and generate messages to transfer bitcoins from one address to another. A user may also choose to store their private keys needed to access their bitcoin addresses in a wallet.
Exchanges and trading platforms	Provide a market for the exchange of bitcoins for national currencies (or other digital currencies); these intermediaries are the main entry and exit points for the Bitcoin system. Exchanges operate order books, matching buyers and sellers of bitcoins and the price (in national currencies or other digital currencies) at which they are willing to trade.
Payments processing for merchants	Provide guaranteed-rate-conversion facilities. Some also offer point-of-sale infrastructure and applications that allow merchants to accept payments in bitcoin.
Intermediation for consumers	Act as an intermediary between users and Bitcoin exchanges or trading platforms, buying and/or selling bitcoins on behalf of the user. Some also provide an interface to facilitate retail payments and/or retain users' private keys.
Bitcoin ATMs	Operate ATMs that allow users to buy bitcoins using cash or sell their bitcoins for cash.

Some Bitcoin service providers offer products that bundle intermediation services. A common combination is wallet provision and payments processing for merchants and/or bitcoin intermediation for consumers (these services involve buying and/or selling bitcoins on behalf of the user and/or providing an interface to facilitate retail payments). In this set-up, the wallet provider may retain users' private keys and thus ultimate control over any bitcoins users store with them (this is termed, a 'hosted' wallet service).[5] Some Bitcoin exchanges also provide hosted-wallet services. Of the various

5 In public key cryptography, a 'private key' can be used to encrypt a message with a digital signature. This message can be broadcast to the network, along with its associated 'public key'. Anyone can use the public key to verify that the message was signed by the holder of the private key. The mathematical properties of public and private keys

intermediation services provided to Australian users, some are provided by firms based in Australia while others are located overseas.

Benefits and Risks of Digital Currencies

Digital currencies offer a range of potential benefits to users; however they also give rise to a number of risks. This section outlines some of the key benefits of using digital currencies, and distributed public ledgers more broadly. It then goes on to discuss some of the more prominent risks to users, digital currency systems and their intermediaries.

Benefits

- **A distributed ledger, combined with cryptographic processes to verify transactions, avoids the need for a 'trusted third party'** – The use of cryptography establishes a means for participants in the network to achieve consensus on changes to the ledger and to maintain a single version of the block chain, preventing the potential 'double-spending' of funds that can be a problem for any digital asset. The concept of a distributed ledger could potentially be used for a variety of other purposes, including the clearing and settlement of financial instruments such as equity and fixed income securities.[6]

- **Transactions within digital currency systems can be faster than traditional payment channels** – For example, bitcoins can be moved from one address to another within ten minutes (although the risk posed by 'orphan blocks' means that users might wish to wait for 5 or 6 new blocks to be confirmed, taking 50-60 minutes). Other systems – such as Litecoin and Dogecoin – feature faster confirmation times. By comparison, using the Direct Entry system, transfers between accounts at different banks in Australia takes at least a few hours to be completed, while cheque payments typically take three business days; transfers to overseas accounts may take longer. The relative speed advantage of digital currencies may, however, be eroded as fast retail payment systems are developed.

- **Potentially low cost** – At present, transacting in digital currencies can be free for users. This is the case for Bitcoin, although fees may apply, for example, if users want faster verification or to send complex or very small transactions. Across all Bitcoin transactions, fees average around 1 per cent of transaction value.[7] The relative low-cost of transacting in digital currencies may make them particularly attractive as a channel for international remittances, where transaction and exchange fees are generally high (averaging around 8 per cent of the transaction value).[8] However, buying and selling digital currency to make these transactions incurs significant fees (Figure 1), which when coupled with system transaction fees can result in a total cost to users comparable to that of traditional payment methods.[9]

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are such that they are easy to generate, but it is computationally infeasible to determine a user's private key from the broadcast public key.

6 Ali *et al* (2014a) suggest that the 'distributed ledger' is the key innovation of digital currencies.

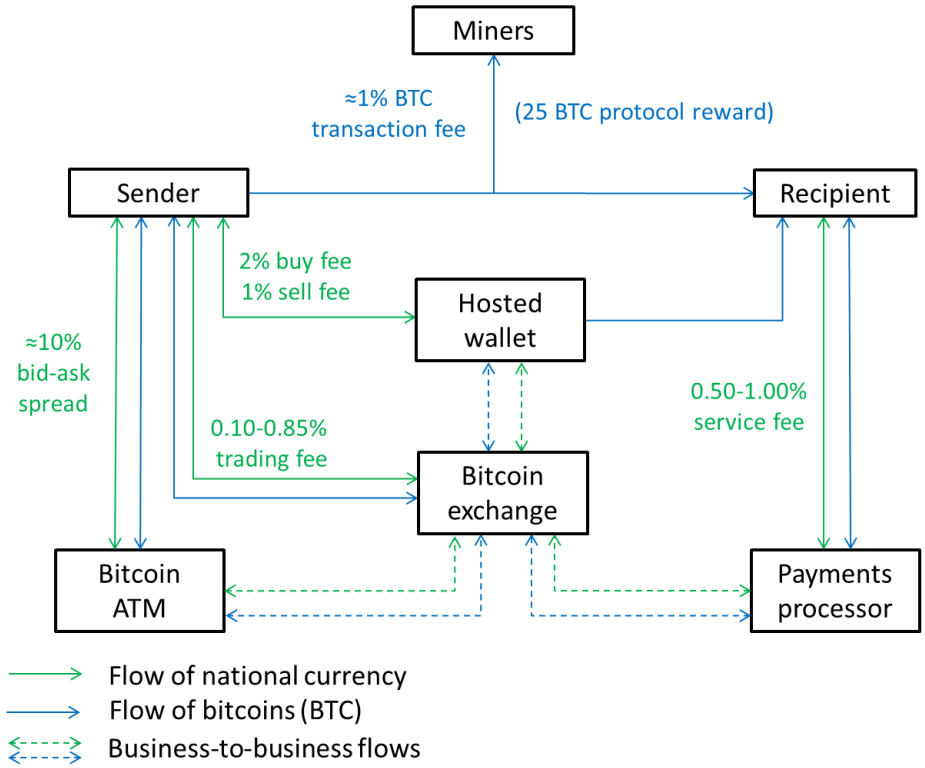
7 Estimate based on calculations using data published by Blockchain.info on the total value of daily transaction fees and the total number of unique transactions.

8 The recent G20 meeting in Brisbane noted that the G20 average cost of remittances was 7.98 per cent – see Group of Twenty (2014). At the time of writing, the website www.sendmoneypacific.org indicated a range of costs for sending $200 from Australia to Fiji of between 3 and 27 per cent.

9 More broadly, from a societal point of view, the competitive verification process in Bitcoin may be viewed as an inefficient use of resources compared with other payment systems. It generates incentives for miners to invest

Figure 1: Illustrative Fees

Indicative fees for Bitcoin transactions and Australian-based intermediation services



Sources: Australian-based Bitcoin intermediary websites.

- **Irrevocability** – Merchants may see the irrevocable nature of transactions (once sufficiently confirmed on the block chain) as decreasing the risk of chargebacks or demands for refunds (although the choice of payment method used is unlikely to modify merchant obligations arising under the Australian Consumer Law).
- **Pseudo-anonymity** – Some users may see benefits in the relative privacy offered by some digital currency systems.[10] However, not all digital currency systems offer pseudo-anonymity -- for example, Ripple aims to form partnerships with established financial institutions and other payments intermediaries which then provide services to identifiable end-users (such as the financial institutions' account holders).

very large amounts in processing power (typically located in jurisdictions with low electricity prices): see Halperin (2013) and Ali *et al* (2014b). As at November 2014, the daily value of bitcoins awarded to successful miners was around US$1.4 million.

10 Bitcoin transactions have been described as 'pseudo-anonymous' rather than necessarily anonymous, since the ledger of all transactions is publicly broadcast to the network and may facilitate the tracing of transactions to particular users. However, without the user publicly confirming their ownership of an address or intermediaries collecting information regarding their users' identity and bitcoin addresses, conclusively linking a particular bitcoin address to a user's identity is difficult, if not impossible.

Risks[11]

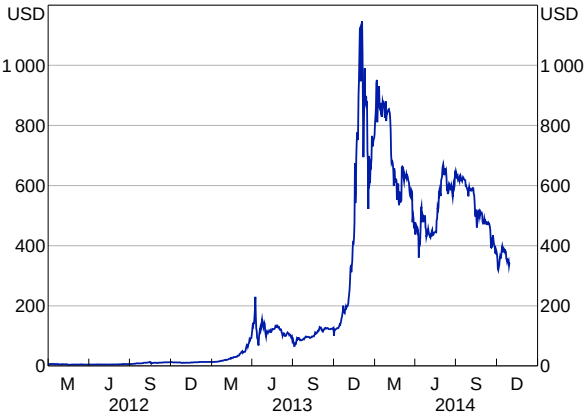
Digital currencies pose a number of risks; some of which are associated with the digital currency system itself, while others are associated with the intermediaries that offer services to users of digital currencies. It is important that users are aware of the risks of using digital currency. These include:

Digital Currency System Risks

- **Price** – Digital currencies have exhibited substantial price volatility and the markets for such currencies are subject to substantial illiquidity. Existing digital currencies are privately created assets with no intrinsic value, so their market price at any time is very sensitive to perceptions about what, if any, value they will have in the future. Over the year to October 2014 the price of bitcoin ranged between US$190 and US$1 200, and the average daily movement in bitcoin/USD was around 29 times larger than movements in AUD/USD (Graph 2 and Graph 3). In contrast to the case for most national currencies, there are not well developed markets to assist users in managing this risk.

Graph 2

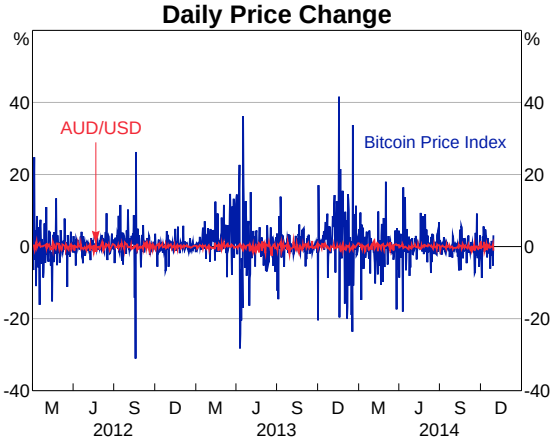
Bitcoin Price Index



Source: CoinDesk.com

Graph 3

Daily Price Change



Sources: CoinDesk.com; RBA

- **Scalability** – Although not currently widely used, there may be challenges for digital currency systems in supporting increases in the volume of transactions. For example, Bitcoin can currently only support around 7 transactions per second due to a hard-coded 1 megabyte limit on the size of each block.[12] In contrast, retail payments systems with wide use are able to process hundreds to thousands of transactions per second.[13]

- **Attacks on the digital currency protocol**

  – **Hacking** – While the cryptographic hash function underlying Bitcoin is generally considered to offer a high level of protection against a successful hacking attack, and the protocol is designed to make it more profitable to confirm transactions for the network than to attack the system, this may change as computing power continues to increase.

11 A comprehensive list of digital currency risks has been compiled by the European Banking Authority (2014).
12 See Andresen (2014) for more information about the scalability of Bitcoin and suggestions to improve it.
13 For example, VisaNet processes almost 12 000 transactions per second during peak season and is capable of processing around 48 000 transactions per second (see Visa Inc. (2014)).

  - **The '51 per cent' issue** – A single miner, or a mining pool, may gain sufficient computing power to manipulate the system. The increasing centralisation of mining operations makes it more likely that a single mining pool may contribute more than 50 per cent of the networks' computing power.[14] If this were to occur, even unintentionally, there could be a loss of confidence in Bitcoin.[15]

- **Irrevocability and permanent loss** – Protections in the case of mistaken transactions (e.g. mis-addressing of account details or 'fat finger' errors) may give consumers additional confidence in using some payment methods. In the case of digital currencies, explicit cooperation of the receiver of funds is required for refunds to occur. In addition, there is often no recourse to recover digital currency from addresses where the private key has been lost.

Intermediaries

- **Fraud** – The involvement of an intermediary in a digital currency transaction involves agency and trust relationships, and thus potential for fraud. In the same way that fraud rates for card transactions are higher for 'card-not-present' than 'card-present' transactions, the use of digital currencies in online environments may generate greater opportunities for, and incidence of, fraud.[16]

- **Intermediary risk** – Some digital currency intermediaries retain control over their users' funds. This can be considered funds at risk, and users should be aware that they may be placing considerable trust in their service provider.[17] An example of this type of intermediation is a Bitcoin hosted wallet service – where a provider assigns each user a bitcoin address but retains control of the private keys and thus any bitcoins held there.

- **Complexity of service offering** – The risks associated with the use of digital currencies are likely to vary across digital currency service providers. These are unlikely to be well understood by many users. Users should make themselves aware of these differences when choosing a service provider.

- **Cost increases** – The cost of transacting in digital currencies could rise. At present, Bitcoin network transaction fees are subsidised by the bitcoin rewards provided to miners to incentivise verification; however, as rewards decline to zero (as specified in the protocol) miners will become increasingly reliant on transaction fees for revenue, with the likely result that these fees will rise. In addition, if Bitcoin intermediaries became subject to the regulatory compliance obligations of traditional payment systems, their costs – and fees – would be likely to increase.

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14 Bitcoin 'mining pools' are arrangements where multiple 'miners' agree to work together to solve the complex cryptographic puzzles required to validate transactions and to share any resulting bitcoin rewards and fees earned.

15 Garratt and Hayes (2014) suggest that at the current level of bitcoin rewards (and with assumptions about electricity prices), the incentive for a mining pool that controls 51 per cent of the network to subvert the block chain remains low. However, as mining rewards periodically halve (as specified in the protocol), the incentives may become larger.

16 For example, in September 2014, a Texas District Court ordered the Bitcoin Savings and Trust and its founder to pay penalties and reimbursement of more than US$40 million for operating a Bitcoin 'Ponzi' scheme, through which he defrauded investors out of more than 700 000 bitcoins.

17 In February 2014, Mt.Gox – which had previously been the most prominent digital currency exchange – suspended trading and filed for bankruptcy protection. It has subsequently indicated that around 650 000 bitcoins belonging to the exchange and its customers had gone missing.

Use of Digital Currencies

The extent to which digital currencies such as bitcoin are widely used and accepted is an important consideration in determining whether the above risks raise issues for policymakers. In this regard, it is clear that the use of bitcoin and other digital currencies is currently limited both in Australia and internationally. From the perspective of the economic definition of money, digital currencies tend only to display the characteristics of money in a limited sense:

- Digital currencies are not widely used as a **means of payment**. For example, recent block chain analysis indicates that less than 10 per cent of all bitcoins in circulation are regularly transacted (i.e. moved more than once a month).[18] Furthermore, while CoinDesk (2014c) reports that worldwide around 76 000 merchants accept bitcoin, CoinMap (2014) identifies only 170 such merchants in Australia.[19]
- Some users may regard digital currencies as a **store of value** – including for speculative reasons with a view that their price will rise. However their significant price volatility is likely to reduce their effectiveness as a store of value more generally (see for example Graph 2 and Graph 3 above).
- Digital currencies are also not used as a **unit of account**. For example, while some merchants may accept bitcoin, prices are generally posted in national currencies. The price in bitcoin will fluctuate in line with the bitcoin exchange rate, and merchants will often contract with an intermediary to convert bitcoins received back into national currency at a guaranteed rate.[20]

In Australia, digital currencies are not legally recognised as a unit of account or means of payment. Sections 9 and 11 of the *Currency Act 1965* require that any contract, transaction or dealing (amongst other things) relating to money or involving the payment of money be done and all payments in Australia be made according to the currency of Australia, unless done or made in the currency of another country.

Overall, although the volume of bitcoin transactions has grown over the past year, transaction levels remain very small in comparison with existing retail payment systems. The Bitcoin public ledger indicates that, on average, 76 000 bitcoin transactions were made globally each day in October 2014, valued at approximately US$55 million (A$64 million).[21] This includes transactions for a variety of purposes, including consolidating or dispersing bitcoin holdings, speculating on the value of bitcoins, and making payments. By comparison, on average there are more than 504 million purchases made globally each day using credit, debit or prepaid cards, with an average daily value of over US$47 billion.[22]

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18 See CoinDesk (2014a).

19 Data on the volume of bitcoin payments made to merchants are not readily available. However, recent block chain analysis discussed by CoinDesk (2014a) has found that the reported growth in merchant acceptance has not resulted in a corresponding increase in bitcoin transaction activity.

20 CoinDesk (2014c) reports that of the estimated 76 000 merchants globally that accept bitcoin roughly 40 000 are registered with Bitpay and another 35 000 registered with Coinbase, both of which are bitcoin intermediaries that offer payments processing services.

21 These figures are sourced from Blockchain.com and are estimated using an algorithm that purports to exclude transactions returning the 'change' component of a bitcoin payment.

22 Figures are for January–June 2014 from data published by HSN Consultants Inc. (2014) in the September issue of 'The Nilson Report'. The data reflect all global transactions for credit, debit and prepaid cards issued by American Express, Diners Club/Discover, JCB, MasterCard, Visa, and UnionPay (but not by domestic networks).

Looking ahead, growth in the use of digital currencies will presumably depend both on the evolution of digital currencies and distributed ledger technologies, and the extent to which digital currencies can better meet the needs of users than the various existing means of payment. One case where digital currencies might gain traction as an attractive alternative to existing payment options is the area of international remittances which can be expensive and subject to delays in the receipt of funds.[23] More broadly, however, many payment attributes of digital currencies are already available in the 'traditional' payments system – or will be available in the case of new services that may be facilitated by the New Payments Platform project[24] – so it remains to be seen what gaps could be filled by digital currencies and hence what would drive their widespread use domestically, particularly in light of the price volatility of digital currencies observed to date.

Considerations for the Reserve Bank

Digital currencies raise some potential policy issues for the Reserve Bank in the areas of the payments system, monetary policy and financial stability. Given the very limited use and acceptance of digital currencies in Australia, it is not apparent that these issues currently warrant action by the Bank. However, issues related to taxation, Anti-Money Laundering and Counter-Terrorism Financing Rules (AML/CTF Rules) and consumer protection may be of more immediate concern for other Australian regulators.[25]

Payments System Considerations

The Reserve Bank is the principal regulator of the payments system. The Bank's approach to the use of its regulatory powers under the *Payment Systems (Regulation) Act 1998* (PSRA) has generally been to rely on industry- and market-driven solutions, only intervening when necessary on the grounds of its statutory mandate under the Act.

Digital currencies are not currently regulated by the Bank or subject to regulatory oversight.[26] In the event that the use of a particular digital currency was to grow very significantly and to raise public interest concerns, the Bank would consider whether it fell within the definition of a payment system under the PSRA as being 'a funds transfer system that facilitates the circulation of money, and includes any instruments and procedures that relate to the system'. Assuming these definitional requirements were met, and if the Bank considered it appropriate to regulate or provide oversight of a digital currency in relation to its payment system characteristics, the Bank could 'designate' a system as subject to regulation. The Bank then has a number of powers available to it under the PSRA including establishing standards and access regimes that apply to a payment system and its

23 Although to the extent that digital currencies are not accepted as a means of payment in the recipient's country, additional difficulties, costs and delays may still arise in exchanging the digital currency for local currency.

24 See Reserve Bank of Australia (2014) and Richards (2014) for discussion of the New Payments Platform.

25 Across other jurisdictions, action in response to digital currencies, where it has occurred, has been predominately in relation to tax, AML/CTF and consumer protection issues, rather than in the areas of the payments system, monetary policy or financial stability. For example, the New York Department of Financial Services noted that its motivation for proposing a virtual currency business 'BitLicense' was the need to set standards for consumer protections, cyber security and anti-money laundering compliance.

26 Accordingly, as far as the payments system is concerned, there are currently no regulatory factors impeding the growth of the digital currency industry. Indeed, more broadly the lack of regulation may well be a factor contributing to the adoption of bitcoin by some users. As Ali *et al* (2014a) note "The foundational motivations for Bitcoin appear to have been largely **ideological**. The digital currency was expressly designed to avoid any centralised control (of either the money supply or the payment system) and to minimise the degree of trust that participants need to place in any third party."

participants. In assessing the merits of imposing payment system regulation on a digital currency, the Bank would have regard to the public interest considerations of section 8 of the PSRA. At present, the Bank's judgement is that digital currencies raise no significant concerns with respect to competition, efficiency or increased risk to the financial system.

While there may be issues with respect to whether digital currencies are 'financially safe for use by participants', the Bank's judgment is that the current very limited use of digital currencies implies that the benefits of regulation would not outweigh the cost. The Bank is also mindful of the risk of misinterpretation of the degree of protection offered by regulation or oversight which may lead users to exercise less caution than warranted when selecting and using service providers.[27]

In the event that the Bank wished to take regulatory action in the payments system aspects of digital currencies, the international character of such systems could place constraints on its ability to act unilaterally, so any action might need to be suitably coordinated. One vehicle for such coordination would be through the Committee on Payments and Market Infrastructure (CPMI) at the Bank for International Settlements, of which the Bank is a member. The CPMI monitors developments in digital currencies.

Monetary Policy and Financial Stability Considerations

In theory, if digital currency gained very widespread acceptance and use in an economy, there would be implications for macroeconomic policy. For example, digital currencies often have a fixed rate of supply meaning that they are unable to respond to changes in demand (e.g. seasonal peaks such as around Christmas and Easter) and have no role for monetary policy. Accordingly, an economy that relied on a digital currency with a fixed supply would be subject to greater volatility in prices and real activity and over the long run would be expected to experience deflation in prices of goods and services.[28]

Given the extremely limited use of digital currencies, these considerations are of course not currently relevant for Australia (or any other economy). Furthermore, provided that monetary policy continues to deliver low and stable inflation and that the Australian dollar remains a trusted store of value, means of exchange and unit of account, it is hard to envisage circumstances where digital currencies would have any significant implications for the Bank's ability to conduct monetary policy.

In addition, the very limited use of digital currencies in the Australian economy means that they currently raise no implications for financial stability. In particular, it is unlikely that significant spillover effects on the broader financial system would arise if users were to suffer financial losses on digital currencies or if a digital currency system or an associated intermediary were compromised.

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27 Some services offered by intermediaries have characteristics like purchased payment facilities (PPFs). Accordingly they may fall under the scope of the PSRA as PPFs, in which case the holder of the 'stored value' would need to be authorised under, or exempted from, the PSRA (assuming that they are not an authorised deposit taking institution) If the holder of the stored value of a PPF is an authorised-deposit taking institution (ADI), it is regulated by the Australian Prudential Regulation Authority and is not required to be authorised or exempt by the Bank under the PSRA.

28 See Ali *et al* (2014b) for a discussion of the extreme case of an economy that was fully based around a digital currency.

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