UNIVERSITY *of* NICOSIA

MSc in Digital Currency

DFIN-511: Introduction to Digital Currencies

Session 8
Cryptocurrency and Central Banking

Introduction to Digital Currencies

UNIVERSITY of NICOSIA

Session Objectives

- Understand the basic functions of Central Banks
- Examine how digital currencies/cryptocurrencies replicate (or do not replicate) the functions of Central Banks and advantages/disadvantages this creates
- Understand the public positions of the Federal Reserve and the ECB towards digital currencies

Agenda

1. Central Banks and their characteristics
2. Comparison of what Cryptocurrencies and Central Banks do differently
3. The European Central Bank and the Federal Reserve System on Bitcoin and Cryptocurrencies
4. State Owned Cryptocurrencies
5. Conclusions
6. Further Reading

1. Central Banks and their characteristics

Some definitions

- **Central** banks are financial entities that are established in all countries to define and support the monetary system of their nation:
  - They create the rules and regulations under which national banks should function
  - They are responsible for monitoring the stability of inflation rates, of the price of money and regulation of the debit and credit framework of the nation
  - They control money issuance and control of money supply
  - They act as "the lender of last resort" for banks or other eligible institutions. In simple terms, when commercial banks cannot cover the needs of the public, central banks are responsible to provide funding support.

- The Bank of International Settlements (BIS) is the Central Bank of Central Banks. Its mission is "to serve central banks in their pursuit of monetary and financial stability, to foster international cooperation in those areas and to act as a bank for central banks."
- *In March 2018, BIS published a report which evaluates central bank-based digital currencies and the potential uses in financial markets and the general public. More on this later in this session.*
- *In June 2018, BIS stated on its annual report that cryptocurrencies are not an ideal substitute for fiat money.*
- *In January 2019, BIS published a report stating that 70% of central banks are studying cryptocurrencies, however the launching of a central bank digital currency is unlikely in the short term.*

Central Banks and their characteristics

- The most common functions handled by Central Banks are Monetary Stability, Financial Stability/Regulation, Policy Operations Management and Financial Infrastructure Provisioning

- **Monetary Stability**
  - Formulating, conducting, implementing and monitoring the proper functionality of the national monetary policy
  - Balancing and managing (to their best of their ability) inflation, interest rates, exchange rates, while being supportive of economic growth.
  - Managing the money supply of a currency

- **Financial Stability/Regulatory Functions**
  - Regulating the banking sector
  - Ensuring a stable financial system for the country they operate
  - Undertaking the role of the lender of last resort

- **Policy Operations Management**
  - Currency intervention
  - Liquidity Management
  - Lender of Last Resort (The provision of liquidity to the banking system to counteract shocks and prevent bank runs from spreading from one institution to another. In a fiat currency system, Central Banks cannot “run out of liquidity”)

- **Financial Infrastructure**
  - Payment and settlement systems
  - Currency Provisions

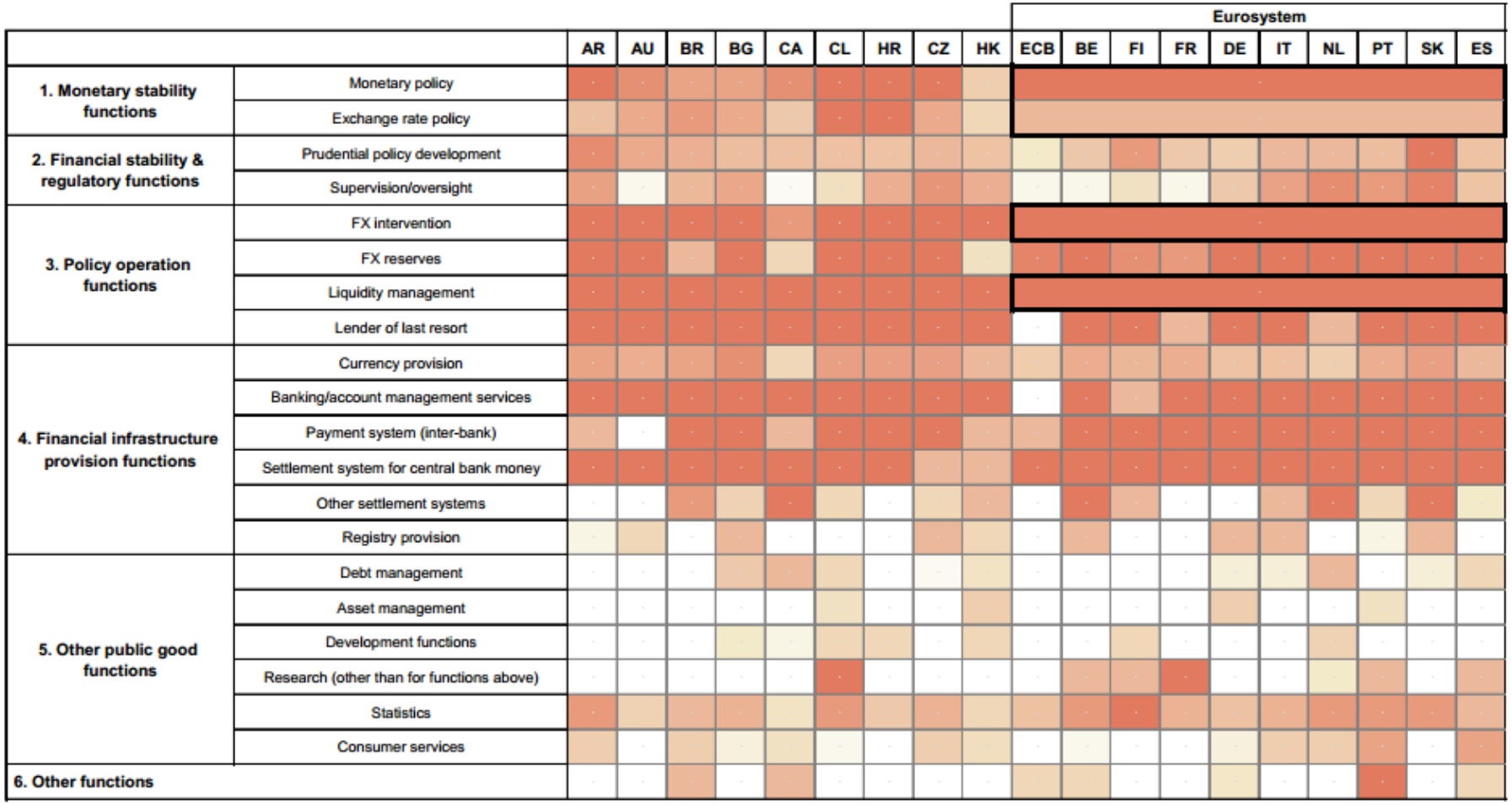
Functions of Central Banks (BIS Survey 2008)

- The tables in the next two pages highlight the functions of central banks across the globe. Source of this information is a BIS Survey conducted in 2009, as published in the report of BIS regarding the roles of modern central banks.

- Colors represent the degree of responsibility that the central bank of each country has undertaken for each respective function and goal (white refers to no responsibility, light orange to partial or shared activity and dark orange refers to full responsibility).

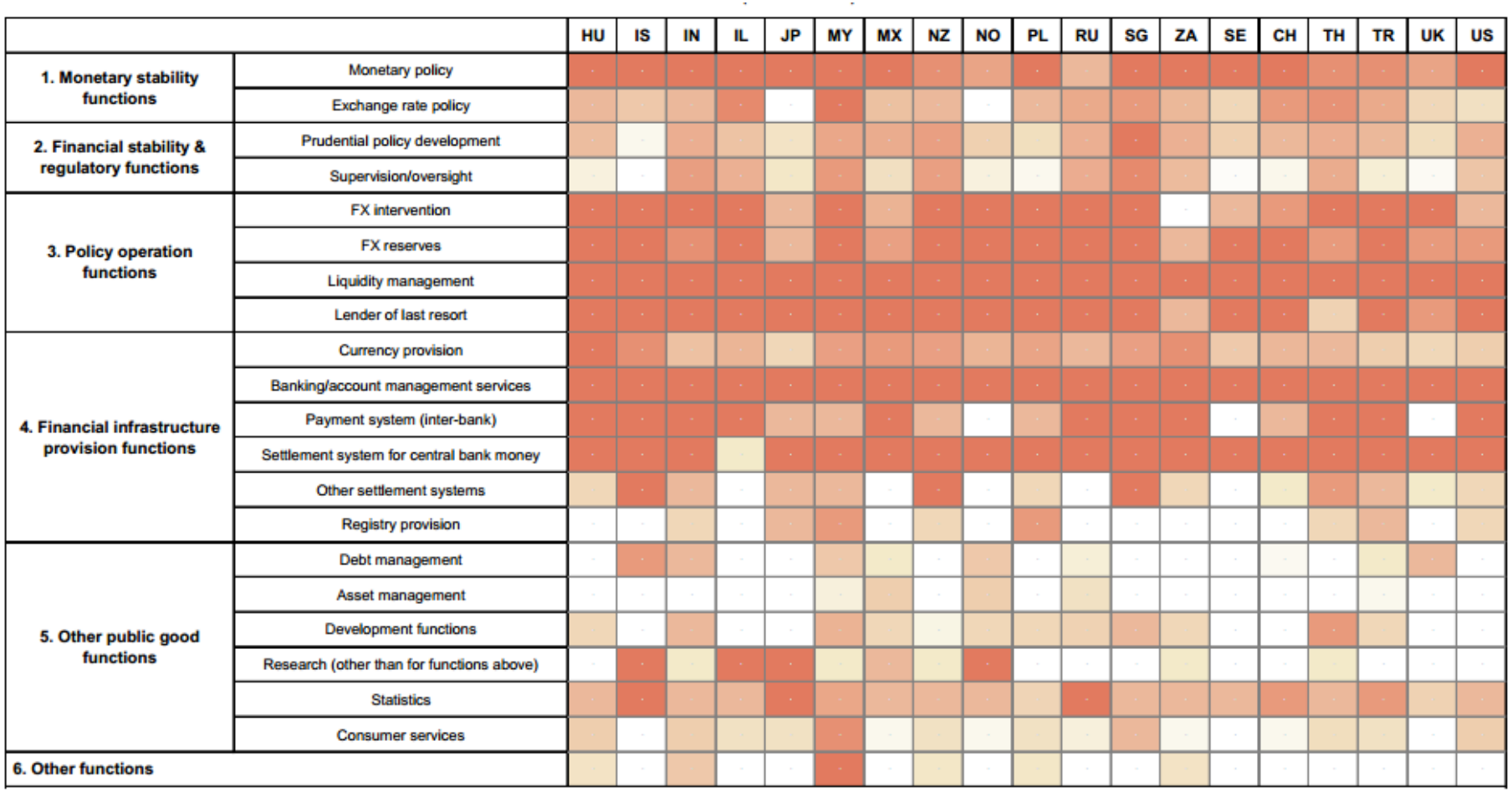
- The survey results show that all central banks take responsibilities when it comes to tasks like monetary and financial stability, regulation and policy operations, and provision of financial infrastructure, whereas they take less action on debt and asset management, research and consumer needs' identification.

Functions of Central Banks (BIS Survey 2008)



Functions of central banks and their coverage in different countries, as defined in the BIS Study, 2008

Functions of Central Banks (BIS Survey 2008)



		HU	IS	IN	IL	JP	MY	MX	NZ	NO	PL	RU	SG	ZA	SE	CH	TH	TR	UK	US
1. Monetary stability functions	Monetary policy																			
	Exchange rate policy																			
2. Financial stability & regulatory functions	Prudential policy development																			
	Supervision/oversight																			
3. Policy operation functions	FX intervention																			
	FX reserves																			
	Liquidity management																			
	Lender of last resort																			
4. Financial infrastructure provision functions	Currency provision																			
	Banking/account management services																			
	Payment system (inter-bank)																			
	Settlement system for central bank money																			
	Other settlement systems																			
	Registry provision																			
5. Other public good functions	Debt management																			
	Asset management																			
	Development functions																			
	Research (other than for functions above)																			
	Statistics																			
	Consumer services																			
6. Other functions																				

Functions of central banks and their coverage in different countries, as defined in the BIS Study, 2008

2. Comparison: Traditional Central Banks and Cryptocurrencies

Central Bank Functions vs. Cryptocurrencies

Central Bank General Functions	Central Bank Detailed Functions	Cryptocurrencies
Monetary Stability Functions	Monetary Policy	Yes. Monetary policy fixed at inception, but can be changed by majority of miners. In the case of Bitcoin, it is mildly inflationary (expansionary) money supply but with the rate of increase dropping rapidly over time
	Exchange Rate Policy	No
Financial Stability & Regulatory Functions	Prudential Policy Supervision	No
	Supervision/Oversight	No
Policy Operation Functions	FX Intervention	No
	FX Reserves *	No
	Lender of Last Resort	No
	Several reports last year indicated the willingness of central banks to hold Bitcoin and Ether sometime in the future but this is still considered a long shot	
Financial Infrastructure and Provision Functions	Currency Provision	Sometimes yes, through block rewards
	Banking/account management services	No
	Payment system (inter-bank)	Yes. Cryptocurrencies have a built in payment system that, from one point of view, merges a variety of traditional payment and settlement systems
	Settlement system of central bank money	
	Other settlement systems	
	Registry Provision	No

Another Central Bank feature is the provision of annual reports and statistics. The trading and circulation of cryptocurrencies in permisionless environments can be considered an equivalent, due to the blockchain immutable and transparent nature.

Note

- Note for previous table:
- *Overall, majority of cryptocurrencies provide a very light set of Central Banking functions relative to traditional Central Banks, primarily setting monetary policy, payment/transfer services and issuance/distribution of new 'coins'/units*

Cryptocurrencies vs Central Banks

Cryptocurrency "Advantages"

- Money supply relatively immune to political interference/pressure. Many proponents of cryptocurrencies are particularly concerned with modifications in money supply / inflation
- Cannot deny access to individual participants (non-permissioned blockchains)
- Seigniorage (the benefits of the issuance of new units) accrues to miners as opposed to political entities in exchange for the costs they incur in providing transaction security
- To the degree that any particular money supply algorithm is desirable or non-desirable, open market competition between private currencies will come to the most efficient outcome

~"Austrian" economics philosophy

Traditional CB "Advantages"

- Supply-side tools / intervention tools to manage price of the currency relative to other currencies
- Ability to manage money supply to balance inflation/deflation with unemployment/economic growth. Most cryptocurrencies would struggle to stimulate economic growth in a recession/depression for example.
- Tools / framework / authority to manage financial / depositary institutions (Potential depository institutions operating with cryptocurrencies could not perform fractional reserve on the same coin, since the network would not accept them as valid. Solutions are offered both by sidechains and off blockchain networks, but these require trust to the issuer)
- Ability to be a lender of last resort

~"Keynesian" economics philosophy

Cryptocurrencies vs Central Banks

Cryptocurrency Point of View

- Most fiat currencies over the history of time have not ended well, due to over-issuance, devaluation or external events (wars, etc.). A limited digital currency will have lasting value and preserve wealth
- Open, auditable records and better models (like multi-sig) will actually reduce fraud in the long run by forcing more transparency
- Ability to control the currency gives significant power to governments that is better devolved to individuals
- Liquidity support and "too big to fail banks" create distortions to incentives and markets
- Protocols are extensible for more advanced uses

Traditional CB Point of View

- Without tools to manage currency supply and be a market maker in the currency, the currency will always be (more) volatile
- Financial institutions will emerge and regulation, as well as the ability to provide backstops will be needed. Most people, in practice, will give up some independence in exchange for less day-to-day personal responsibility for fraud, theft, etc.
- While theoretically decentralized, many cryptocurrencies currently show centralization both in distribution of coins and distribution of hashing power

Both are right. One significant point that might integrate the two views to some degree: To the degree that a cryptocurrency is not the unit of account for a whole economy, some of its disadvantages in CB terms (aka it might be deflationary) become much less important

3. The Federal Reserve System and the European Central Bank on Bitcoin and Cryptocurrencies

Fed on Bitcoin and Cryptocurrencies

The impact of cryptocurrencies is regularly discussed during meetings of the Federal Reserve Advisory Council and the Board of Governors. The key conclusions to date were:

- The banking system is not threatened at this time, primarily because Bitcoin is not yet big enough to be a threat
  - Disintermediation of traditional payment networks: Not enough adoption yet ("a curiosity, not a threat"), due to fluctuation in value, no deposit insurance and security threats
  - Illicit Use: While "rampant", this is not different than sovereign-issued currencies or other precious goods
  - Financial Stability: Bitcoin not at sufficient scale to have systemic economic impact. "In an economy hypothetically dominated by Bitcoin, its finite number (21 million) would prevent the application of traditional monetary policy tools to provide support in downturn or reduce growth during excessive expansion". But, if it scales beyond a certain level…
  - http://bitcoinist.com/us-federal-reserve-issues-bitcoin-warning/

- Bitcoin/Cryptocurrencies could have a longer-term positive impact on payment processors:
  - Able to allow for lower transaction fees
  - Could expand cheap international remittances to developing world and "unbanked"
  - If adoption increases and reputational effects subside, banks will likely start offering more crypto-based services

Fed on Bitcoin and Cryptocurrencies

- Bitcoin/Cryptocurrencies could be a “boon” to economic activity
  - Global transmissibility could open new markets
  - Driving capital flows to developing world could increase consumption
- Regulation should be thoughtful to avoid Balkanization
  - Key areas of focus are: consumer protection, consumer knowledge and addressing illicit use
  - Aiming for standardization across geography and regulators to provide consistent regulatory environment
- *"The Fed doesn't really play any regulatory role with respect to Bitcoin, other than assuring that banking organizations that we do supervise are attentive, that they are appropriately managing any interactions they have with participants in that market, and appropriately monitoring anti-money laundering, bank secrecy act responsibilities that they have.” – Janet Yellen, 2017, Former Chair of the FED 2014-2018*
- Federal Reserve Board Chairman Jerome Powell has highlighted cryptocurrency investor risks
- The St. Louis branch of the US Federal Reserve has added four cryptocurrency (BTC, BCH, ETH, LTC) price trackers to its extensive research database in June 2018.
- Lael Brainard, a Federal Reserve Board governor is still not convinced of the usefulness that a central bank based digital currency could offer even though the infrastructure is mature enough to assist its creation. Even though she praised the technology as one of the most notable recent innovations, this statement has eliminated the discussions of the possible launch of a Fedcoin.

European Central Bank (ECB) on Bitcoin and Cryptocurrencies

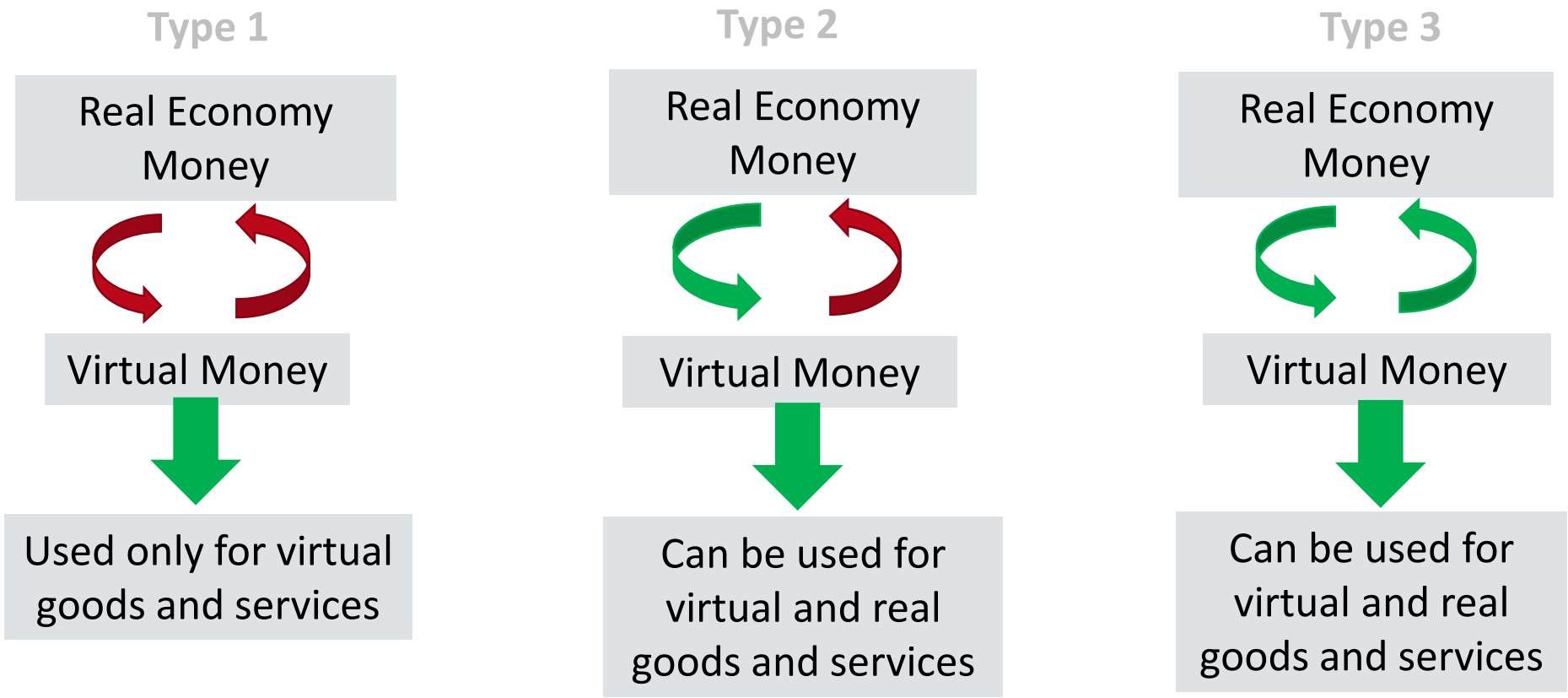
- The ECB has two pronouncements on cryptocurrencies:
  - One older and less specifically oriented to Bitcoin (Oct 2012)
  - A more recent, further analysis (Feb 2015)

  According to the European Central Bank (ECB, 2015) the definition has been updated to "a digital representation of value, not issued by a central bank, credit institution or e-money institution, which in some circumstances can be used as an alternative to money."

- In these papers, the ECB defines and classifies virtual currency schemes based on observed characteristics (which according to the ECB might change in the future affecting therefore its definition). So, "depending on their interaction with traditional, "real" money and the real economy, virtual currency schemes can be classified into three types:
  - *Type 1, which is used to refer to closed virtual currency schemes, basically used in a game*
  - *Type 2, virtual currency schemes which have a unidirectional flow (usually inflow)*
  - *Type 3, virtual currency schemes which have bidirectional flows"*

Virtual Currency Schemes

(Categorization by the ECB)



Note:

Red arrows denote non-allowable function

Green arrows denote allowable functions

Further discussion

- According to the ECB, cryptocurrencies could be a factor when the aim is to enable a company to increase its revenue to support customers by making transactions easier to conduct thereby eliminating the need to spread personal information each time they want to purchase goods or services.

- The market is discussed in a sense that no reliable data could indicate the real size of it. According to the papers, innovation in this area is growing and spreading significantly fast, making it difficult, if not impossible, to collect accurate and reliable information to provide a complete and comprehensive picture of the virtual communities and the virtual currencies that exist.

- Bitcoin is discussed as a related case study, providing information for its basic features, a technical description of how a transaction is conducted as well as its monetary aspects. Distinct reference is made to security issues and negative press and criticism that Bitcoin has found itself subject to from its infancy.

Further discussion

- ECB considers the extent to which virtual currency schemes might affect a central bank's tasks in the areas of payments systems, regulation, financial stability, monetary policy and price stability.

- Thus, in its paper, the ECB focused, as an attempt to set the basis for further discussion, on the potential impact to the following central bank tasks:
  - Price Stability
  - Financial Stability
  - Payment Stability

Price stability

- With regards to price stability , the greatest challenges identified were:
  - The preservation of the unit of account
  - The risks to the effectiveness of monetary policy and its implementation
  - The possible distortions to the formation of monetary aggregates

- The ways cryptocurrencies could affect price stability are identified as the following:
  - by affecting the money supply
  - by modifying the velocity of money circulation
  - by enabling the interaction between virtual currencies and the real economy, through the substitution effect and the crowding-out effect of virtual on “real” money

- While subject to lack of reliable information, the ECB concludes that cryptocurrencies do not consist a threat for price stability of the “real economy”. Stability in new currency issuance is a sign towards velocity of money not being dramatically affected. Nevertheless, the interaction of virtual and real economy definitely deserves attention.

Financial Stability

- To protect financial stability of a currency, virtual or not, attention should be paid to the factors that can cause price swings and can be a source of potential financial volatility. According to the ECB, factors that have a major role in the financial stability of such schemes are:
  - **The supply of money and the other issuer actions**: For example, market intervention to maintain a fixed or semi-fixed exchange rate
  - **The dimensions of the network**: Virtual currency schemes exhibit network externalities, such as the value of the currency that depends on the number of users and the number of merchants accepting it
  - **Institutional conditions governing the virtual community**
  - **The cryptocurrency issuers' reputation for meeting its commitments**: Since cryptocurrency payments are not settled in central bank money or commercial bank money, nor is there any lender of last resort, a crucial element affecting the cryptocurrency rate is the trust gained by the issuer
  - **Speculation**: Regarding the future value of the currency and history of cyber attacks suffered in the crypto community

Financial Stability

- The ECB notes the high volatility of the value of bitcoin to date and identified “speculation” as the main cause of that volatility

- It further notes that stability of the “real economy” can not yet be affected, since volume of transactions is low and no interface has practically connected the two economies to a great extent.
  - However, ECB identifies the risk of no central authority being able to act as the lender of the last resort and support the monetary system, should adoption of such currencies gain wide acceptance

- If and as adoption of cryptocurrencies increases, this remains an important area to monitor as, in time, they could be a source of financial instability if they reach scale.

Payments System Stability

- The ECB approaches cryptocurrency payment systems as the actual payment arrangements among members of certain digital communities. The major risks faced are categorized as follows:
  - **Credit Risk**: *"Users exposed to this in relation to funds held on virtual accounts (cannot be guaranteed that the settlement institution is able to fully meet its financial obligations when due at any time in the future)"*
  - **Liquidity Risk**: Users may face such risks, if the settlement institution does not meet its commitments to provide them with financial liquidity upon request
  - **Operational Risk**: Both participants in a transaction run the risk of inefficiency and ineffectiveness of the settlement institution, being uncertain of its operational continuity
  - **Legal Risk**: Uncertainty and the lack of a legal framework exacerbate the aforementioned risk factors
- In conclusion, the ECB: (a) identifies cryptocurrency payment systems as valid payment systems within a digital community, (b) believes users face the aforementioned risks, (c) does not believe that they pose a broader threat at this time.

ECB report - Feb 2015

- ECB report expands on the previous material by examining other aspects of the ecosystems that have developed since the first report, also examining the following:

- **Payments related aspects of Virtual Currency Schemes**
  - A renewed view is made on the Key Actors and their Roles in most popular types of currencies existing, including Bitcoin, Ripple and Litecoin
  - Their diversity and the large number of Altcoins is examined, as well as the differentiating elements between them, as we saw in a previous session
  - Emerging business models are examined based on what has been observed so far in the markets
  - Comparisons are made in market capitalization, transaction numbers with established systems like VISA, Mastercard, Paypal and MPESA
  - The potential advantages and risks of using cryptocurrencies are also recouped as in the first report

ECB report - Feb 2015 cont.

- **Cryptocurrencies from the perspective of a Central Bank**
  - Cryptocurrencies do not fit the economic or legal definition of money or currency
  - This means that cryptocurrencies can be used only as contractual money, when there is an agreement between buyer and seller in order to accept cryptocurrency as a means of payment.
  - They should not be bundled into the generic words of money or currency, even though their technical appearance takes a form which has some similarities to scriptural money and/or electronic money.
  - They do not currently pose a risk for price stability in practice, provided that the issuance volume of cryptocurrencu continued to be stable and their usage low.
  - An increase in the usage of cryptocurrencies is conceivable and thus surveillance of the take-up of cryptocurrencies is important from a financial stability perspective.
  - Some elements of the technological set-up of cryptocurrencies could perhaps serve as the inspiration or even basis for traditional PSPs (Payment Service Providers) to offer innovative payment solutions.

ECB report - Feb 2015 cont.

- **Legislative and Regulatory Responses**
- The international interest is examined with mentions of the reports of the following:
  - The World Bank conference and other statements on Virtual Currencies - https://cointelegraph.com/news/world-bank-president-distributed-ledger-technology-has-huge-potential
  - European commission initiatives
  - EUROPOL's virtual currency conference
  - Mario Draghi, president of the ECB, was asked whether a regulatory framework would be issued. He recently stated that regulating cryptocurrencies is "not the ECB's responsibility". Draghi regularly claims that cryptocurrencies are "immature" and highlights the importance of cybersecurity as ECB's primary concern. However he mentions that distributed ledger technology is "quite promising"
  - In September 2018, Draghi also mentioned that the ECB has no plans to issue its own digital currency
  - Further responses from supervisory authorities will be examined in more detail in the session on Regulation.

4. State Owned Cryptocurrencies

Central Bank-based Digital Currencies(CBDCs) – BIS Report 2018

- Some of the main highlights of the report (introduced on slide 6):
  - CBDCs can be a new form of digital central bank money that can be distinguished from reserves or settlement balances held by commercial banks at central banks
  - A CBDC may vary on:
    - access (widely vs restricted) and degree of anonymity (ranging from complete to none);
    - operational availability (ranging from current opening hours to 24 hours a day and seven days a week);
    - interest bearing characteristics (yes or no).
  - CBDCs used in the financial market would limit access to a predefined group of users, while CBDCs used by the general public would be widely accessible
  - Wholesale(to be used in the financial market) CBDCs, combined with the use of distributed ledger technology, may enhance settlement efficiency for securities and derivatives. Experimentation would be required before central banks can safely implement new technologies supporting a wholesale CBDC variant
  - CBDCs could be widely available to the general public and serve as an alternative safe payment instrument. Given the gradual disappearance of cash, the provision of a CBDC could bring substantial benefits
  - The benefits of a widely accessible CBDC may be limited if fast and efficient private retail payment products are already in development
  - A general purpose CBDC can be an alternative to cash in some situations. A central bank introducing such a CBDC, would have to ensure the AML/CFT requirements are fulfilled, as well as ensure that the public policy requirements of other supervisory and tax regimes are satisfied. This is because CBDCs could eventually be used for illegal transactions

Central Bank-based Digital Currencies(CBDCs) – BIS Report 2018

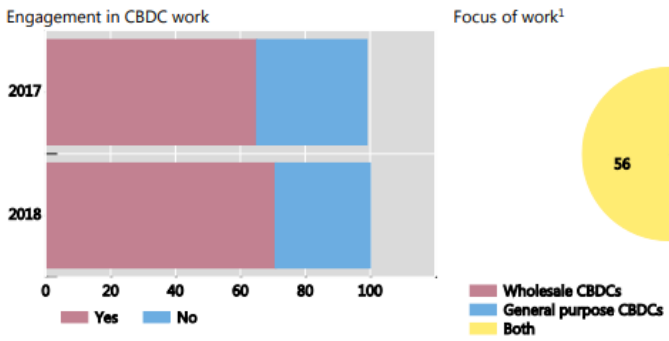
- Some of the main highlights of the report (introduced on slide 6):
  - In certain jurisdictions, central banks may not have the legal authority to issue a CBDC
  - CBDCs demand would need to be accommodated. Central banks would still choose their monetary policy implementation techniques as well as the maturity, liquidity and credit risk of their assets. In a potential mainstream adoption, challenges could arise (such as a need to broaden the assets that the central bank can hold or take on as collateral)
  - CBDCs could add to the options offered by the central bank's monetary policy toolkit, e.g. by allowing for a strengthening of pass-through of policy rate changes to other interest rates or addressing the zero lower bound on interest rates. Higher denomination banknotes would perhaps need to be terminated for this to occur. Such termination would be a costly procedure
  - A wholesale CBDC available to investors could function as a safe asset comparable to short maturity government bills. A general purpose CBDC could compete with guaranteed bank deposits.
  - The introduction of a CBDC would raise fundamental issues beyond payment systems and monetary policy transmission. A general purpose CBDC could give rise to higher instability of commercial bank deposit funding. Even if designed primarily with payment purposes in mind, in periods of stress a flight towards the central bank may occur on a fast and large scale, challenging commercial banks and the central bank to manage such situations
  - Further research on the possible effects on interest rates, the structure of intermediation, financial stability, potential movement in exchange rates and other asset prices as well as financial supervision is needed.

Central Bank-based Digital Currencies(CBDCs) – BIS Report 2019

- Some data from the new report

Central bank CBDC work

Share of respondents — Graph 3

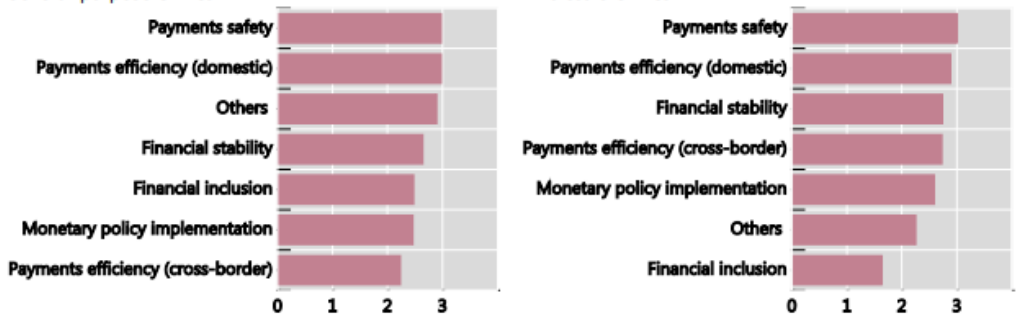


[1] Share of respondents conducting work on CBDCs, 2018 survey.

Source: Central bank survey on CBDCs.

Motivations for issuing a CBDC, ranked in order of importance

Score[1] — Graph 5

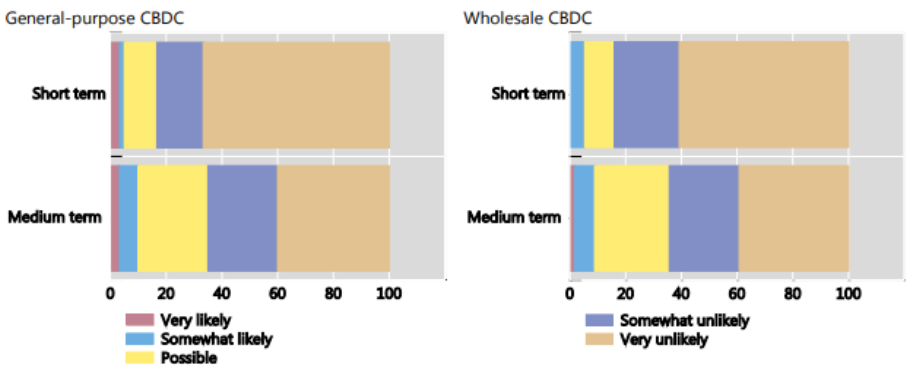


[1] The score is calculated as an average of the options: "Not so important" (1), "Somewhat important" (2), "Important" (3) and "Very important" (4).

Source: Central bank survey on CBDCs.

Likelihood of issuing a CBDC in the short and medium term[1]

Share of respondents — Graph 8



[1] Short term: 1–3 years and medium term: 1–6 years.

Source: Central bank survey on CBDCs.

State Owned Cryptocurrencies

- Initiatives and discussions from Central Banks have surfaced on potential ways that the technology behind Bitcoin could be used to issue government controlled currencies. Some governments are actively exploring this as we'll see in the next slides.
- Government issued currencies should probably not be permissionless and open, as a cryptocurrency would be, for a multitude of reasons (several of which the FED and ECB have addressed).
- But they would potentially allow citizens to hold CB money directly into their digital currency wallets and transact with them directly under the permissioned auspices of the Central Bank.
- This could have some obvious advantages like cost savings, faster clearing and settlement, as well as increased transparency and real-time analytics of the status of payments, credit balances and more.
- If a Central Bank was the issuer and administrator of a digital currency, most e-money companies (PayPal, Alipay, etc) and perhaps even most banks, would perhaps find themselves with new competition.
- China was one of the first nations considering a government-backed virtual currency. See here, here and here for more information.
- Recently, pressures have been applied to local businesses and individuals trading cryptocurrencies.

The Central Bank Blockchain

Notable initiatives and discussions on the topic of Government controlled Crypto Currencies can be found here:

- A 2018 study by IBM on the potential :
  - https://www.omfif.org/media/5415789/ibm-central-bank-digital-currencies.pdf
- Bank of England:
  - http://www0.cs.ucl.ac.uk/staff/G.Danezis/papers/ndss16currencies.pdf
  - https://news.bitcoin.com/central-bank-issued-cryptocurrency-round-up-imf-boe-hong-kong/
- Some thoughts from the Fed and the VP of the Federal Reserve bank of St. Louis on a potential Fedcoin
  - http://andolfatto.blogspot.gr/2015/11/bitcoin-and-central-banking.html
  - https://www.cnbc.com/2017/11/29/federal-reserve-starting-to-think-about-its-own-digital-currency-dudley-says.html
- Dutch Central Bank blockchain trial in securities settlement
  - https://www.coindesk.com/germanys-central-bank-claims-success-in-blockchain-settlement-trial
- Bahamas
  - https://cointelegraph.com/news/bahamas-central-bank-announces-key-tech-providers-for-upcoming-digital-currency-pilot
- South Korea concerns
  - https://www.coindesk.com/korean-central-bank-study-issuing-digital-currency-poses-financial-risk

The Central Bank Blockchain

- Canada
  - https://www.coindesk.com/bank-of-canada-cryptocurrency/
  - https://www.bankofcanada.ca/wp-content/uploads/2017/11/sdp2017-16.pdf
- Venezuela's pre-mined cryptocurrency Petro – claimed to be backed by the country's oil reserves. President Nicolas Maduro, believes Petro will attract international financing while the cryptocurrency is accepted for tax payments
  - https://www.reuters.com/article/venezuela-economy-cryptocurrency/venezuela-oil-backed-cryptocurrency-to-launch-in-days-government-idUSL1N1OS1GY
  - https://www.coindesk.com/venezuela-to-sell-oil-for-petro-cryptocurrency-in-2019-says-maduro
  - https://www.ccn.com/as-petro-launch-looms-venezuelas-bolivar-eyes-1-4-million-percent-inflation/
- Uruguay
  - https://www.coindesk.com/central-bank-of-uruguays-president-announces-digital-currency-pilot-program/
- Norway
  - https://www.norges-bank.no/en/Published/Publications/Norges-Bank-Papers/2018/norges-bank-papers-12018/
- New Zealand
  - https://www.rbnz.govt.nz/-/media/ReserveBank/Files/Publications/Bulletins/2018/2018jun81-07.pdf
- Singapore
  - https://www.coindesk.com/singapores-central-bank-sgx-develop-blockchain-settlement-system

5. Conclusions

Conclusions

- Central Banks play a wide variety of roles in a modern economy, including monetary stability, financial stability / regulatory, policy operations, and financial infrastructure and provisioning
  - Most cryptocurrencies cover some of the monetary policy and financial infrastructure functions of a modern Central Bank but are, overall, much lighter and more laissez-faire models
  - The degree to which the functions “missing” in cryptocurrencies “matter” has a lot to do with how broadly adopted a cryptocurrency is in an economy and if a cryptocurrency is the main unit of account for an economy

- The Federal Reserve and the ECB are both monitoring the development of cryptocurrencies. Currently conclusions are:
  - They are too small at this time to have a systemic impact on the overall economy or banking system. Any further initiatives and regulations imposed should be as less risky as possible in facilitating illicit activities
  - They may offer transaction, efficiency and financial inclusion benefits
  - As they become larger, more regulation and monitoring will be required
  - Several Central Banks are looking into blockchain technology to create similar experiments i.e. fund settlement
  - However, recent statements indicate that the launch of a CBDC is not taking place anytime soon

6. Further Reading

Further Reading

- **Roles and objectives of modern central banks -** A report by the Bank of International Settlements
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- **Going Cashless –** By Stefan Ingves, governor of Sweden's central bank
  - https://www.imf.org/external/pubs/ft/fandd/2018/06/central-banks-and-digital-currencies/point.htm
- **Virtual currency schemes – a further analysis, Februrary 2015 and October 2012**
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- **US Feds on bitcoin, crypto and DLT**
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  - https://www.federalreserve.gov/newsevents/speech/brainard20180515a.htm
- **Speech by Yves Mersch, Member of the Executive Board of the ECB**
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