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# Virtual Money: How Much do Cryptocurrencies Alter the Fundamental Functions of Money?


Policy Department for Economic, Scientific and Quality of Life Policies
Directorate-General for Internal Policies
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# Virtual Money: How Much do Cryptocurrencies Alter the Fundamental Functions of Money?

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**Abstract**

Advanced economies are moving towards a cashless system, with a recent surge in cryptocurrencies, issued by private entities. Although digital currencies may increase welfare, due to a reduction in transaction costs, they introduce risks to monetary and financial stability. Furthermore, they barely serve as money due to their large volatility. To partly overcome these problems, the issuance of a stablecoin would be an intermediate solution between private and central bank issued digital currency.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| **CB** | Central Bank |
| **CBDC** | Central Bank Digital Currency |
| **DLT** | Distributed Ledger Technology |

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# EXECUTIVE SUMMARY


- It is widely agreed that the functions of money can be divided into three layers (primary, secondary, and tertiary), where each layer reflects the descending degree of direct functionality but increasing degree of generality and transcendence that money plays. The primary functions relate to it as a medium of exchange and measure of economic value. The secondary functions reflect its store of value, and standard for payments. The tertiary layer reflects its contingent functions such as basis of credit, liquidity to wealth, distribution of income, and measurement and maximisation of utility.
- The preference for money, in particular fiat currency has increased since the 00's in both the Euro Area and the US, not decreased as one may expect by the emergence of cryptocurrency. This coincides with the launch of the Euro in January 2002, which hints that the issuance of the new currency increased the demand for it and the share of it in broad money.
- By end of 2019, market capitalisation of cryptocurrencies is just under EUR 1 trillion, and of similar magnitude to total currency in circulation in the third quarter of 2019 (at EUR 1.2 trillion).[1] While the growth in total market capitalisation has somewhat slowed down since the latest peak in 2018, in the not-so-distant future, the activity in this market will surpass the size of the traditional Euro currency market, which shows its rapidly growing importance.
- In 2018, Bitcoin amounted to almost 46% of the cryptocurrency market.
- Volatility is another important driver of the price. Given the absence of the underlying sovereign guarantee (which in case of fiat currency comes through the central bank), it is prone to larger speculative activity. This implies that the introduction of a reserve guarantee would also reduce the volatility. Moreover, a regulatory system aimed at safeguarding the currency and preventing it from speculative attacks and Ponzi games would increase its reliability and effectiveness as a monetary alternative. Considering the cross-border nature and usage of cryptocurrency, the regulatory architecture would require an international coordination in compliance as well as supervisory tasks, as advocated by the International Monetary Fund and Bank of England.
- Several benefits of the blockchain technology have been proposed in the literature. Amongst the most prominent is the decentralised nature makes it less prone to corruption and manipulation. Another important benefit is that blockchain transactions are less expensive and quicker than those of normal fiat currency transactions. There are recent developments in blockchain which indicate that it can play a very significant role in the future payment systems. One of the last documented large benefits of blockchain is that payments are validated 24/7.
- Bitcoin and other digital currencies may change the function of money. The limited evidence we can collect so far may suggest that digital currencies are primarily viewed as stores of value and are not typically used as medium of exchange. At present, there is little evidence of digital currencies being used as units of account. Thus, digital currencies do not really function as money in the economy and imply some risks if they were to be widely used in the long run. Therefore, it is not likely that digital currencies, in their current form, replace the traditional form of money in any economy.
- From a macroeconomic point of view, cryptocurrencies could pose a risk to monetary and financial stability. From a microeconomic perspective, they imply a risk to investors, who could lose all their money. However, nowadays, the small size of digital currency schemes makes it unlikely to pose


[1] ECB's Statistical Data Warehouse: http://sdw.ecb.europa.eu/reports.do?node=1000005717.

real risks to financial stability. Risks to monetary stability could, in theory, emerge if a digital currency were to achieve widespread usage, but this is extremely unlikely.

- Private digital instruments possess the following two advantages: First, they introduce the fintech technology to reduce the costs of transacting across different fiat currencies. Second, in countries with underdeveloped financial systems in which many consumers are excluded from the financial system, private digital currencies are potentially contributing to financial inclusion.
- The demand for a stable asset, which uses the DLT has opened the debate about the possibility of issuing a central bank digital currency. Central banks can take advantage of digital currency technology and still make use of monetary policy in its usual way. Digital currencies could be directly converted into cash and notes. However, this may also pose problems, questioning the role of banks in financing economic activity.
- Stablecoins may be seen as an intermediate solution between privately issued cryptocurrencies and central bank digital currency. In view of the volatility of cryptoassets and given the remaining questions surrounding CBDCs, stablecoins have come to the fore as a potential third type of asset that aspires to bring stability to the volatile market for cryptoassets. Nevertheless, stablecoins are still in their infancy, and therefore not a sufficiently secure investment vehicle. Maybe, with time and the refinement of the different models in the future, they could end up replacing the traditional digital currencies like Bitcoin or Ripple.

# 1. THE FUNDAMENTAL ROLE OF MONEY

Before we discuss the evolution of money and the role of digitalisation of cash and cryptocurrencies, we need to first go back to the basics and define money in terms of its role and functions in an economy. Despite a very long literature on money and many heated debates on its fundamental role for the overall economy, there is not a unified and single definition for it. Possibly because money has been at the centre of most battles in economic debates between the various schools of thought over the past century, spanning from no role at all (money neutrality theorem) to being the core ingredient, like an atom of an economic system (Minsky-Keynes, Marxism), this has prevented economists from reaching a unified view of money. Yet, there is some common terrain that (most of the) economic schools would agree on, namely the function of money in modern economic systems. We should spend some time outlining these, and they will be crucial in understanding why money can change form and transaction nature, without fundamentally altering its function or economic role.

It is widely agreed that the functions of money can be divided into three layers (primary, secondary, and tertiary), where each layer reflects the descending degree of direct functionality but increasing degree of generality and transcendence that money plays. The primary functions relate to it as a medium of exchange and measure of economic value. The secondary functions reflect its store of value, and standard for payments. The tertiary layer reflects its contingent functions such as basis of credit, liquidity to wealth, distribution of income, and measurement and maximisation of utility.

## 1.1. Medium of exchange

The most common function attributed to money is as medium of exchange, facilitates the buying and selling of goods, thereby eliminating the need for double coincidence of wants as under barter. A man who wants to sell wheat in exchange for rice can sell it for money and purchase rice.

## 1.2. Measure of value

Money serves also as a common measure of value. The values of various commodities are expressed in terms of money. This measure is universally accepted and standardised. Money as a measure of value has made transactions simple and quick. As such, money also serves as a unit of account.

## 1.3. (Intertemporal) Store of value

Keynesian economists also emphasised the function of money as a store of value. Agents store money for the rainy day and to meet unforeseen contingencies. In addition, according to Keynes, people also store money to take advantage of the changes in the rate of interest. Thus, money preserves value through time and space. Money as a store of value implies postponing consumption to the future and thus the link between current and future times is crucial. In that respect, money becomes an 'asset' because it is a claim. It is the most convenient way of laying claim to such goods and services. Thus, rather than keeping their wealth in the form of non-liquid assets (houses, shares, etc.), people prefer to keep their wealth in the form of money.

Currency (or cash) is the most liquid form of assets, i.e. money can be very cheaply and immediately exchanged for goods and services and its value is stable at least over a short period of time. In fact, all assets like bonds, saving accounts, treasury bills, government securities, inventories and real estate do serve as stores of value, but they differ in the degree of liquidity. In advanced economies, currency is stored in the form of bank deposits.

## 1.4. Standard of (deferred) payments

Money can also be viewed through a standard of deferred payment. This function has boomed over time with an increase in trade based on credit. Hence, a person who purchases on credit agrees to pay in future when his bills become due. As a result of this function, it has also become possible to express future payments in terms of money. A borrower who borrows a certain sum in the present undertakes to pay back the same in future.

## 1.5. Contingent functions

Money makes the distribution of joint production amongst various factors easy. Further, a consumer as well as a producer measures the utilities of different goods and factors of production with the help of money.

In the financial system, money constitutes the basis of credit. Banks create credit with the help of cash/currency reserves. These reserves are not only important for regulatory compliance, but also as a means of counter-payment or off-setting balances during difficult or distressed times.

## 1.6. Money as basis of economic activity

Monetary theory is a branch of economics concerned with explaining how the use of money, in its various forms, affects production, consumption and distribution of goods. For advocates of monetary theory, money is not only a medium to facilitate exchange of goods, but something more vital, which affects the general level of economic activity.

According to them, the existence of a separate monetary sphere of activity is a fact of profound significance; what takes place in the monetary sphere may suddenly and dramatically influence the level and nature of employment, return on capital, and output. Activity in the money market affects the goods market.

At a first glance, the role of money does not seem to have changed with the introduction of virtual money. They still serve the same fundamental functions and remain tightly linked to the goods market. The forces that determine the equilibrium level of money and employment carry on. If those forces come together in a physical or virtual market does not fundamentally alter these. The experience of the stock market, turning from physical to virtual marketplace but without fundamentally altering the process of determining the prices of stocks, proves this. On the other hand, unusual or atypical circumstances such as negative deposit rates and permanently low market rates may fundamentally alter the forces in money markets, and the role of money as a measure of value, store of value, standard of payments, or its contingent functions, if it permanently alters the demand for it.

# 2. THE EVOLUTION OF MONEY IN ADVANCED ECONOMIES

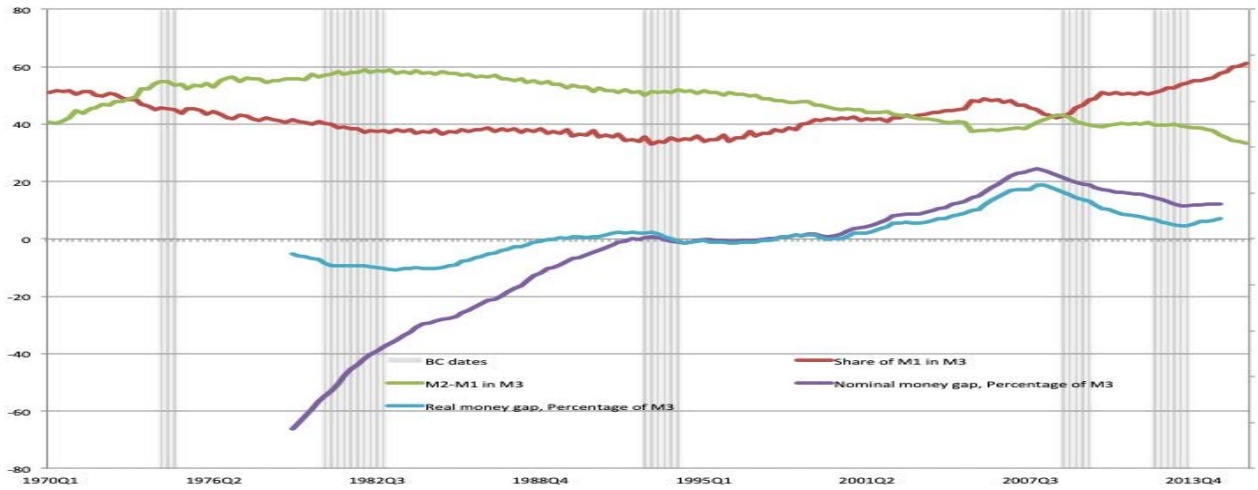
## 2.1. Monetary aggregates in Euro Area

The ECB has put a lot of effort to understand the historical evolution of money in the Euro Area, including backward extrapolating the data on monetary aggregates to 1970. The information included in the monetary aggregates regards the commonly nominated *money* in an economy, with higher aggregates representing narrow and most liquid money, while lower aggregates are broader but include also less liquid money. In a recent paper, Gerba *et al* (2018) analysed the historical evolution of the various aggregates. According to the official statistics of the ECB:[2]

- **M1** = sum of currency in circulation + overnight deposits;
- **M2** = M1 + term deposits with a maturity of up to 2 years + deposits redeemable of up to 3 months;
- **M3** = M2 + repurchase agreement + money market fund shares + debt securities with a maturity of up to 2 years.

Figure 1 reports the evolution of monetary aggregates and the money gaps over a period of almost 45 years. While the share of M2 in M3 has decreased over time, in parallel the share of M1 has increased since early 2000's. Taking into account that the Euro was officially launched in January 2002, this means that the importance of currency has just increased since its launch, landing at above 60% at the end of the sample (2014). Not only is this historically the highest share since 1970, but it is also elevated by international standards. Moreover, the money gap has been positive during the same period, implying an excess liquidity above the equilibrium level. Taken together, this means that the preference for money, in particular fiat currency has increased since the 00's in the Euro Area.

**Figure 1: Monetary aggregate ratios – evolution over time since 1970**



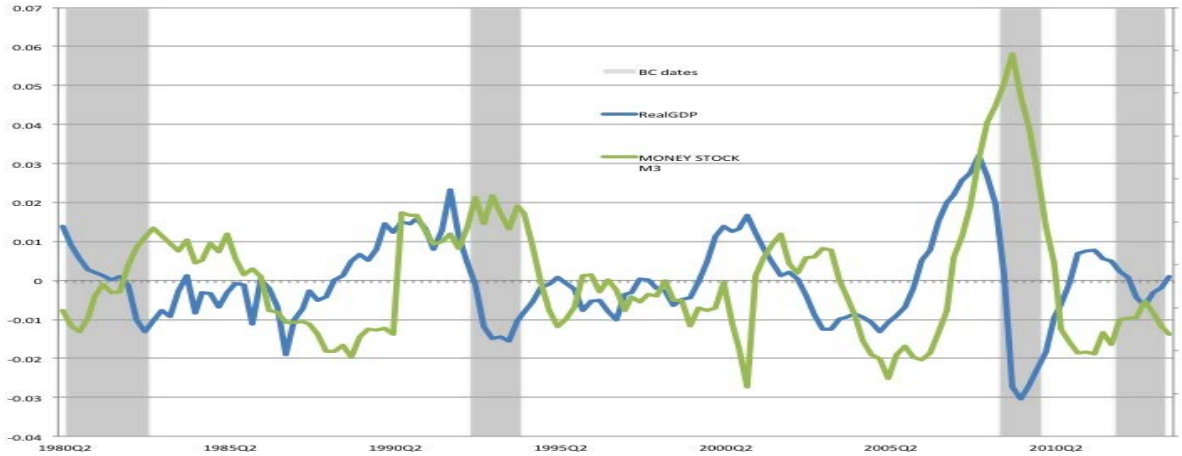

Source: Gerba et al (2018a).

If we then turn to the evolution of money through the business cycle since 1980 in Figures 2-4, we see some very interesting patterns. While liquid money (M1) follows very neatly the business cycle, and

[2] https://www.ecb.europa.eu/stats/money_credit_banking/monetary_aggregates/html/index.en.html.

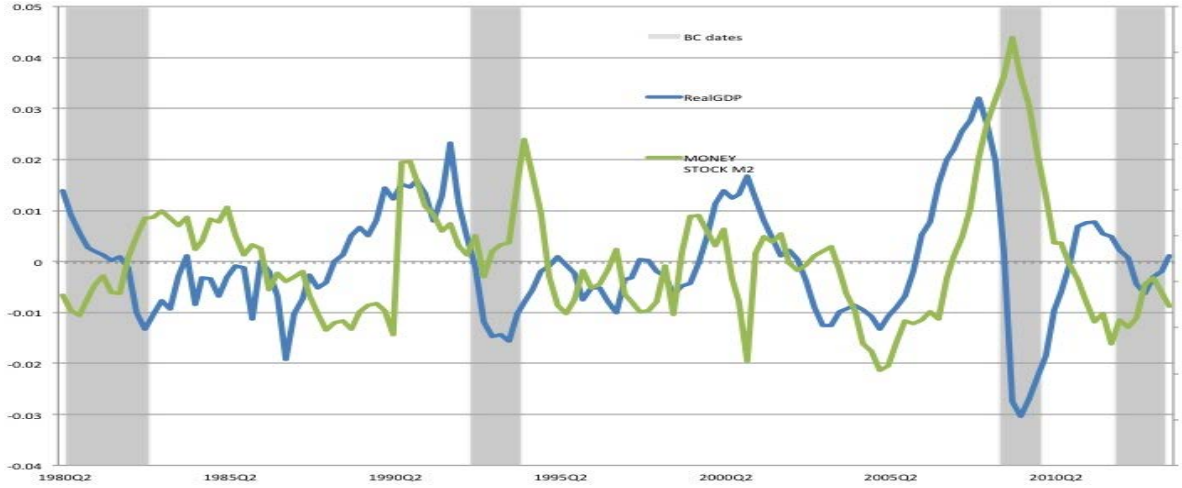
actually leads it a bit, less liquid money, in particular M3 is countercyclical and actually increases (decreases) during recessions (expansions). It seems that preferences for broader and less liquid money dominate in low-growth and contractionary environments. Yet in expansions, the desire to spend increases and hence more liquid money. If we imagine for a moment that preference for liquid money had vanished or the circulation of money had dropped, then monetary aggregates would be acyclical. Both analyses point towards the same conclusion: Quantity of currency and preference for liquid money has only increased over time, in particular during expansions. In contractions, on the other hand, preference for less liquid money (but with higher returns) dominates. Yet, there may be some link between the current low-growth environment with negative interest rates and the demand for (alternative) virtual money as the relations between economic activity and liquidity preferences could be undergoing fundamental alterations.

**Figure 2: Business cycle component of M3 since 1980 – comparison to GDP**



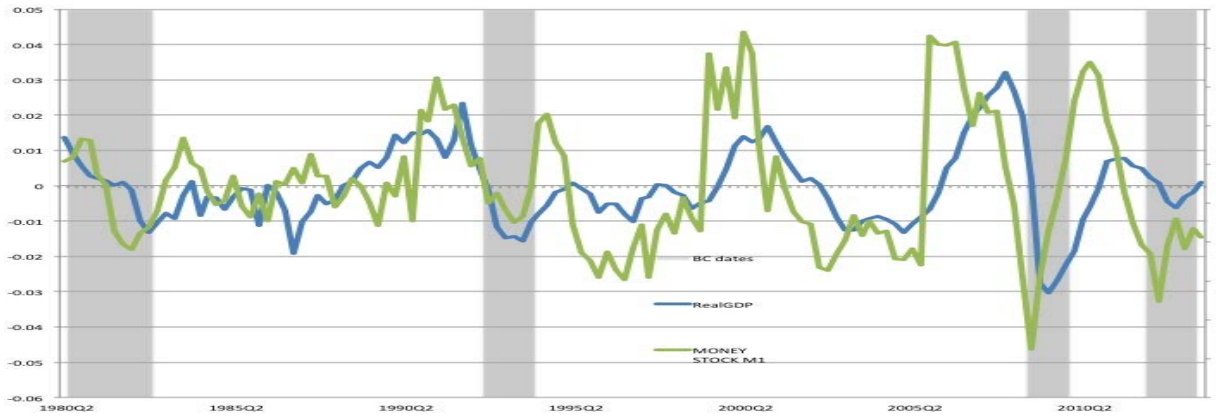

Source: Gerba et al (2018b).

**Figure 3: Business cycle component of M2 since 1980 – comparison to GDP**




Source: Gerba et al (2018b).

**Figure 4: Business cycle component of M1 since 1980 – comparison to GDP**



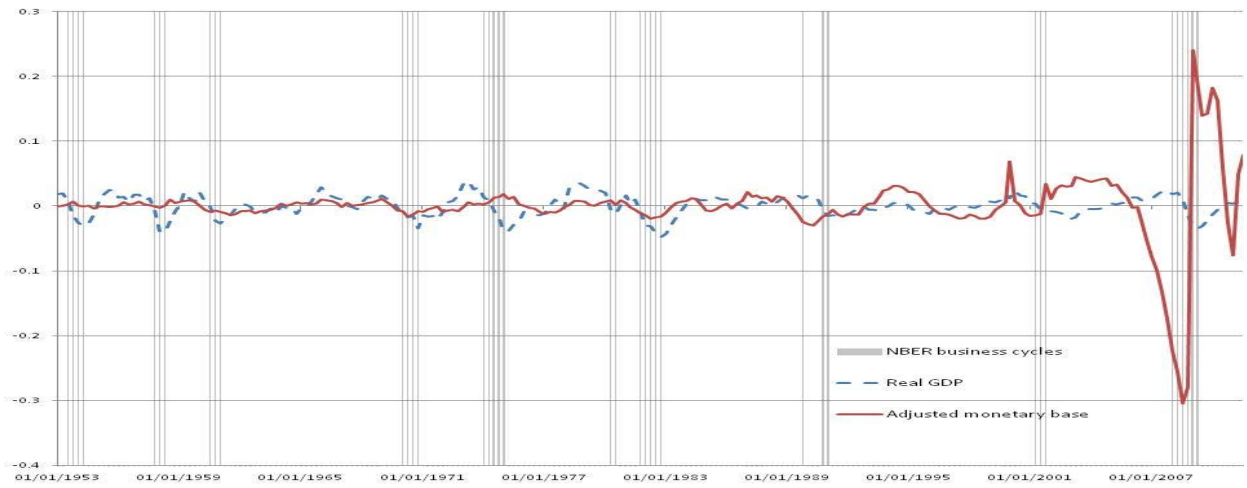

Source: Gerba et al (2018b).

## 2.2. Monetary aggregates in the US

The availability of longer time series for the US allows us to examine the evolution of money from a much broader perspective. In particular, considering 1953 as a starting date for reliable financial statistics, in an extensive empirical paper, Gerba (2015) examined the evolution of money supply and monetary aggregates during 6 decades, from 1953 to 2013, in quarterly frequency.

The first striking fact from Figure 5 is that for most of the post-war history, money supply has closely followed the business cycle. Unlike the Euro Area, it slightly lags the cycle, yet has a high correlation with it. However, since early 2000, it has intensified, and become up to ten times more responsive. In particular, the contraction in money supply just prior to the 2007-08 crisis, and the subsequent readjustment are notably historically the highest. Thus, there is evidence, even for the US, that the importance of currency and liquid (physical) money has just increased over the past two decades.

**Figure 5: Money supply in the US since 1953 – business cycle component compared to GDP**




Source: Gerba (2015).

We turn our attention to money in circulation, reported in Gerba (2015).[3] Similar to the Euro Area, we find that M1 follows closely the business cycle, while M2 is broadly countercyclical. Also, cyclical fluctuations of M1 have intensified since 1990's, becoming much more responsive to changes in the general economic environment. Yet the same evolution is not observed in M2, implying that it is currency, through the money supply, that is most responsive to business cycle conditions over the past 3 decades.

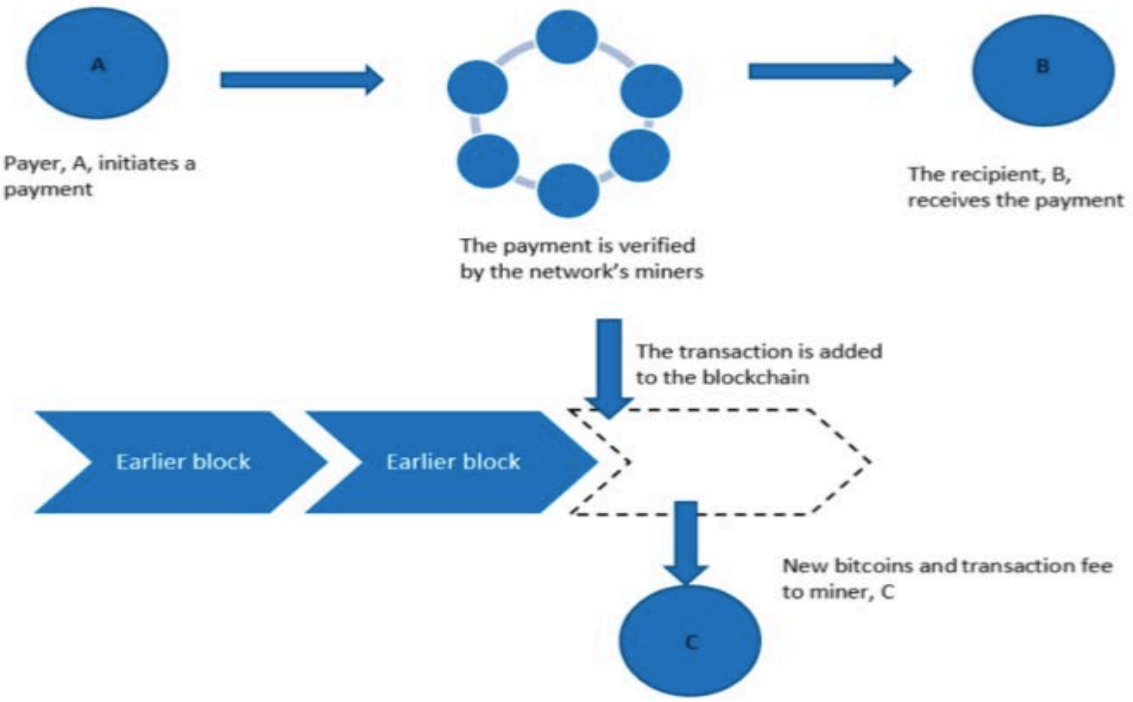
On the money demand side, the evidence is even stronger. Demand for currency has become twice as large as to the pre-00's period. Yet, for demand of less liquid money (M2), this change has not occurred. Summarising the evidence, we observe the same pattern in US money market as in the Euro Area. Demand and supply of M1 (currency) has increased over the past two decades and is very much following the evolution of the business cycle. Considering that, at the same time, money supply has largely intensified, it means that the preference and use of currency has simply risen.

## 2.3. Cryptocurrency: risks and opportunities

A cryptocurrency is: "a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community" (European Central Bank, 2012). It makes use of cryptography to secure and verify transactions as well as to control the creation of new units of cryptocurrency (Franco, 2015). A bitcoin is essentially an entry into a public ledger shared by all the participants in a network. Once an owner wants to transfer his bitcoin (or a part thereof) to a third party, in order to avoid double spending, the message is transmitted to all the nodes in the network. It has to be confirmed by a certain number of nodes that the bitcoin is registered against the name of the owner before the transaction is executed and then the ownership is transferred to the new entry through an entry into the same public ledger (Powell, 2015). It adds as a block to the chain. Hence the name *blockchain*. Figure 10 explains the blockchain process. The entry, once confirmed and amended by the public ledger accordingly, is irreversible (Narayanan, 2015).

[3] Because of the size of images, we abstain from reporting the Figures here.

**Figure 6: Overview of the blockchain process**

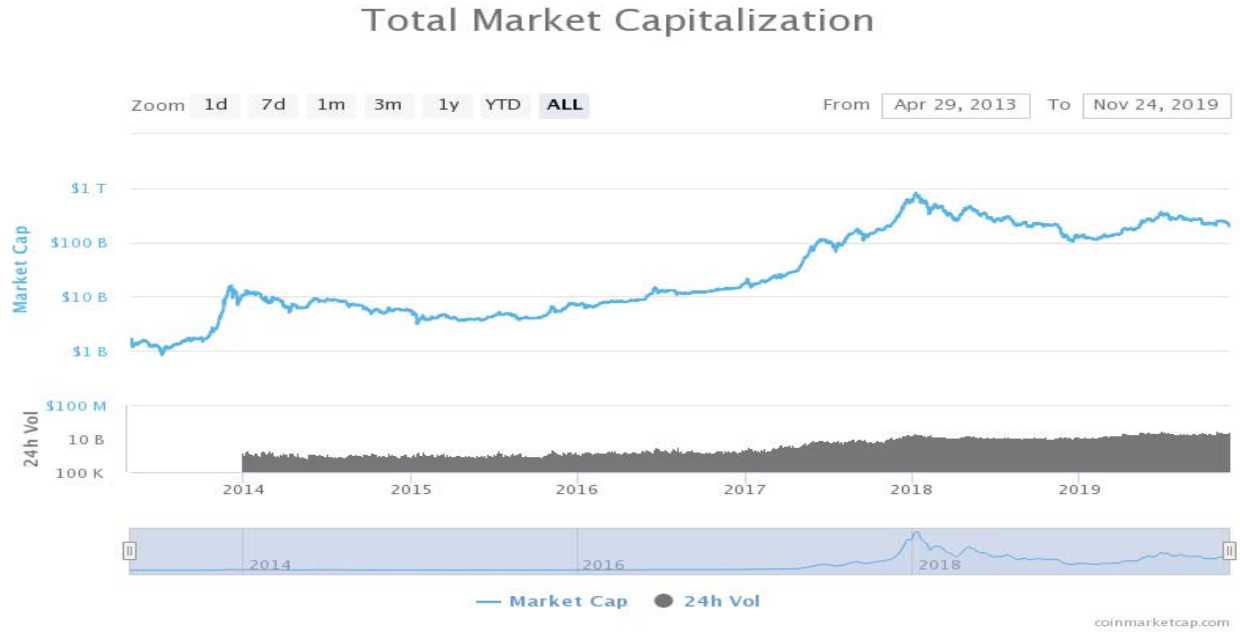



Source: Soderberg (2018).

Total capitalisation of the cryptocurrency market has dramatically grown since 2014, as depicted in Figure 11. It grew by 1000 times in less than 6 years. By end of 2019, it is just under EUR 1 trillion, and of similar magnitude to total currency in circulation in the third quarter of 2019 (at EUR 1.2 trillion).[4] While the growth in total market capitalisation has somewhat slowed down since the latest peak in 2018, in the not so distant future, the activity in this market will surpass the size of the traditional Euro currency market, which shows its rapid growing importance.

[4] ECB's Statistical Data Warehouse: http://sdw.ecb.europa.eu/reports.do?node=1000005717.

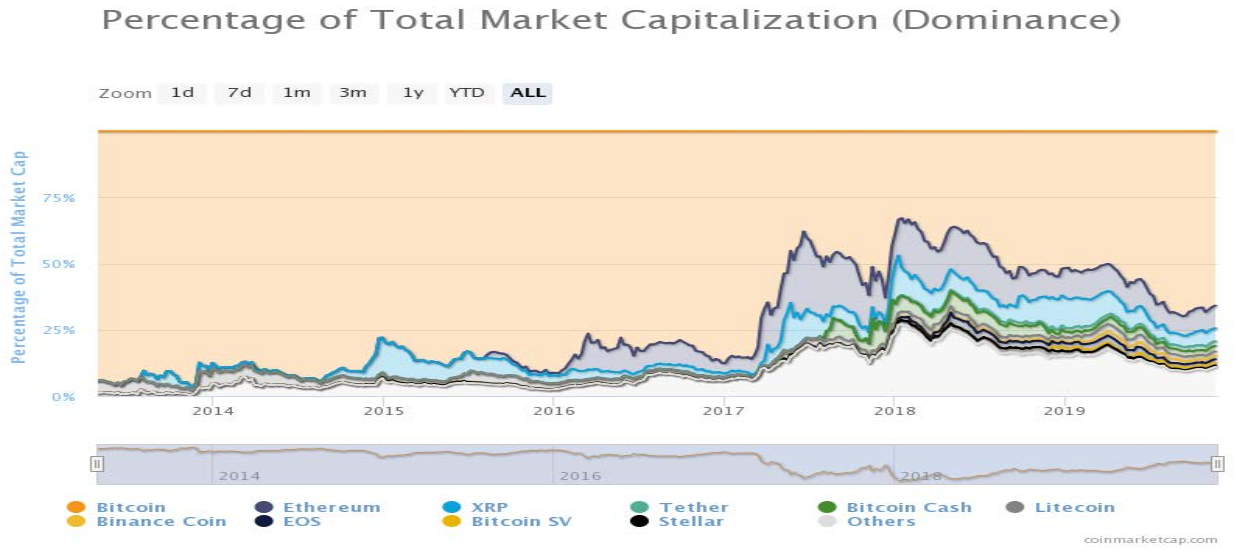
**Figure 7: Total capitalization of the cryptocurrency market (in EUR)**




Source: Coinmarketcap.com.

In 2018, Bitcoin amounted to almost 46% of the market, or USD 133 billion (Suberg, 2018). Although its dominant position has been somewhat weakened since the early days of cryptocurrency in 2012, it is still the largest and most traded virtual currency on the market, as shown in Figure 8. Because of its apparent leading position, and the permanence in the foreseeable future, it is reasonable to focus on it to better understand the dynamics on that market.

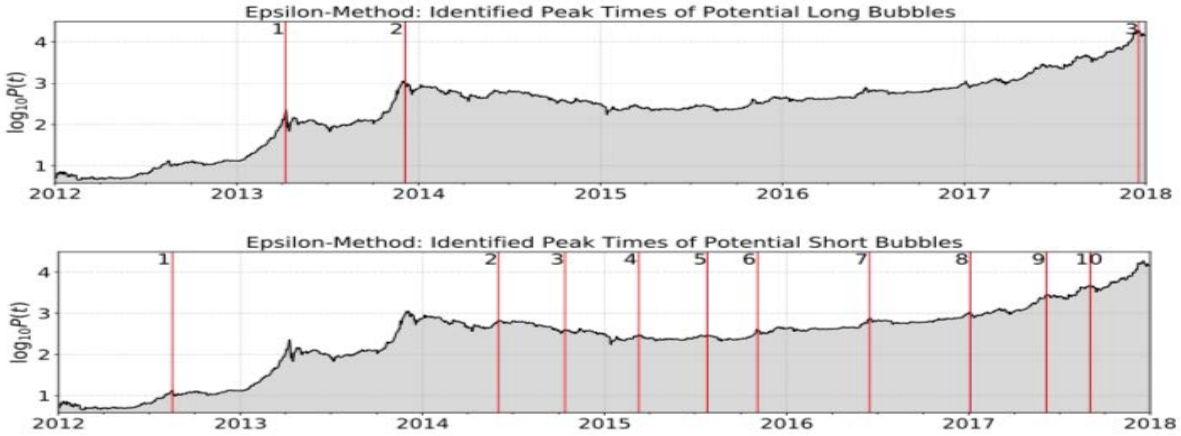
**Figure 8: Composition of the cryptocurrency market**




Source: Coinmarketcap.com.

Gerlach et al. (2018) have traced the history of bitcoin bubbles from 2012 to 2018. They used a robust automatic peak detection method classifying the price time series into periods of uninterrupted growth on the one hand, and uninterrupted market contractions on the other. Moreover, they used the Lagrange Regularisation Method to detect the start and end of a bubble episode. Within this approach, draw-up is defined as the succession of positive returns interrupted by negative returns no larger in amplitude than a previously defined tolerance level. Similarly, a draw-down is the succession of negative returns that may be interrupted positive returns no larger than a previously determined tolerance level (Harras and Sornette, 2011). The authors conclude that during a period of 6 years, between January 2012 and February 2018, there were three larger (in 2013, 2014 and 2018) and ten smaller peaks, as illustrated in Figure 13.

**Figure 9: Bubbles and crashes using alternative dating**




Source: Gerlach et al (2018).

Gerlach et al (2018) found that bubbles in the bitcoin market are a result of the search for safe assets, especially during period of high uncertainty, which also explains the positive correlation between the VIX index and gold price. In particular, given the low return offered by the alternative safe assets (e.g. US Treasury bonds), investors have been encouraged to diversify and invest in other assets, which has also contributed to increased demand for bitcoin. Ciaian et al. (2016), on the other hand, find that advancements in technology and the increased computing power has been an important driver for investors, resulting in an increased demand and price for bitcoin.

Volatility is another important driver of the price. Lahmiri et al. (2018) argue that the underlying nature of bitcoin as a digital (and not a fiat) currency means it is vulnerable to higher volatility. Given the absence of the underlying sovereign guarantee (which in case of a fiat currency comes through the central bank), it is prone to larger speculative activity. The value of bitcoin depends on the self-fulfilling expectations of the private agents regarding its tradability (Blau, 2017). This implies that the introduction of a reserve guarantee would also reduce the volatility. Moreover, a regulatory system aimed at safeguarding the currency and preventing it from speculative attacks and Ponzi games would increase its reliability and effectiveness as a monetary alternative. Considering the cross-border nature and usage of cryptocurrency, the regulatory architecture would require an international coordination in compliance as well as supervisory tasks, as advocated by the International Monetary Fund and Bank of England.

## 2.4. Blockchain technology

Several benefits of the blockchain technology have been proposed in the literature. Amongst the most prominent is the decentralised nature that makes it less prone to corruption and manipulation (Fanning and Centers, 2016). This is very much unlike the currency market, where only a few players such as central banks and large commercial banks dominate the market. The system is therefore dependent on trust in the central authorities and it is vulnerable to a single point of failure or susceptible to a single point of attack. An example of such a failure is the Forex scandal in 2015 when a few big banks and financial institutions clubbed together to fix the foreign exchange rates to the detriment of the consumers and businesses and to their own benefit (Baron et al, 2015). According to Ju et al (2016), one reason for the increased power possessed by these institutions and hence their ability to undertake manipulative schemes, is that they are the intermediaries for channelling of funds and their repositories. They control the money and financial assets. However, when the system is decentralised, there is less chance that such manipulation is possible, which clearly indicates a major benefit of blockchains in terms of reducing the monopoly power of the financial institutions.

Another important benefit is that the blockchain transactions are less expensive and quicker than those of the normal fiat currency transactions. For example, PayPal charges up to 3% on currency transactions and transfers. In case of cryptocurrency, these charges are only a fraction of those of PayPal and range from 0.1% to 0.25% (Underwood, 2016). However, it should be noted that the existing lower costs are largely a result of a relative lack of regulatory requirements for blockchain transactions (Yoo, 2017). In case of imposition of regulations in the future, these costs could also increase. This benefit of blockchain technology is also supported by Swan (2017), who concluded that more frequent use of blockchain technology can help to reduce infrastructure-related costs, since it requires relatively smaller human-and technological resources resulting in reduced upfront cost and maintenance. Pieters and Vivanco (2017) argue that blockchain technology is perfect to facilitate efficient payment systems in developing countries, where the existing payment system is less credible and less developed.

There are recent developments in blockchain which indicate that it can play a very significant role in future payment systems. A good example is the issuance of Basis, a cryptocurrency whose tokens can be robustly pegged to a basket of goods or arbitrary assets. This currency has a more stable price than its predecessors (such as Bitcoin), although it has not yet reached the same market capitalisation and reach. In order to make Basis similar to standard central bank currency, one could for instance, peg it to the USD and update the peg to a consumer price index (CPI). This is achieved through an algorithmic adjustment of supply of Basis tokens in response to, for instance, changes in the Basis-USD exchange rate. This allows authorities to implement monetary policy using cryptocurrency similar to that executed by central banks around the world, but through a decentralised protocol-enforced algorithm. Because no direct human judgement and intervention is required, it has also been referred to as an *algorithmic central bank* (Al-Naji et al, 2018).

A good example is that of *Ripple*, a system based on remittance services. TenX, a Singapore based start-up is working with MasterCard and Visa to provide a system in which payments are made to the vendors through company check cards (Yoo, 2017). The vendor receives the dollar tender. In addition, Luther (2017) reports that even the Federal Reserve has looked at the possibility of introducing blockchain as a way to process interbank payments system. However, at the back end, the virtual currency is being converted into the dollar by the company. The issue whether the authorities permit transactions in the cryptocurrency or the vendors accept the cryptocurrency is circumvented.

One of the last documented large benefits with blockchain is that payments are validated 24/7. This is in stark contrast to the traditional payment system that normally clears only few times per day and

excludes weekends and public holidays. Yet, Pieters and Vivanco (2017) state that some countries have already introduced instantaneous payment services for several sovereign currencies, which are faster than blockchain technology in processing the transactions. An example is the TARGET Instant Payment Settlement, launched in the Euro Area in late 2018. It allows firms and individuals to transfer funds within seconds and irrespective of the opening times of their banks. It functions like a non-stop marketplace for institutions that can access central bank money. Thus, the only requirement is that the institution fulfils the same eligibility criteria as for TARGET2 and performs payments directly in central bank money (ECB, 2019).

# 3. THE FUNCTIONS OF MONEY IN A CASHLESS ECONOMY

Advanced economies are moving towards a system in which coins and notes are not needed anymore, i.e. a cashless economy. The recent surge of cryptocurrencies (or cryptoassets) has largely contributed to this trend. Cryptocurrencies constitute new payment systems combined with new currencies that are not issued by the central bank. These new forms of currencies are issued by private authorities. Examples include Bitcoin, LiteCoin, Ethereum and XRP.

Bitcoin and other digital currencies may change the function of money. On the one hand, they may overcome the weaknesses of both fiat and gold-based money, because they function as an algorithmic currency with a deterministic supply and growth rate, based on mathematics. Also, because they are privately issued, governments do not intervene in its supply. Instead, digital currency follows some cryptographic rules, which follow a clear computer code. This is done in a decentralised and transparent manner, which may contribute to the trust in the currency.

Whether new forms of digital currencies should be issued by the central bank is still an open question. If central banks were to issue digital currency, then this new form of currency could serve to store value and make payments in electronic central bank money. This would of course have implications for both monetary policy and financial stability.

## 3.1. Digital currencies and money

The first question that arises is to what extent digital currencies can be considered money. The answer will depend on how they play the different functions that money traditionally plays. And, if they fall in the category of money, how important their use is, so that they can alter the functions of money in the economy? Theoretically, anyone with internet access could use digital currencies as money. However, evidence shows that this function is very limited and only a few people make use of it.

As we know, money plays three roles in the economy; it is (i) a store of value, (ii) a medium of exchange and (iii) a unit of account. In order to assess whether digital currencies can be considered money or not, we would have to analyse how they can fulfil these three different roles. The limited evidence we can collect so far may suggest that digital currencies are primarily viewed as stores of value and are not typically used as medium of exchange. At present, there is little evidence of digital currencies being used as a unit of account.

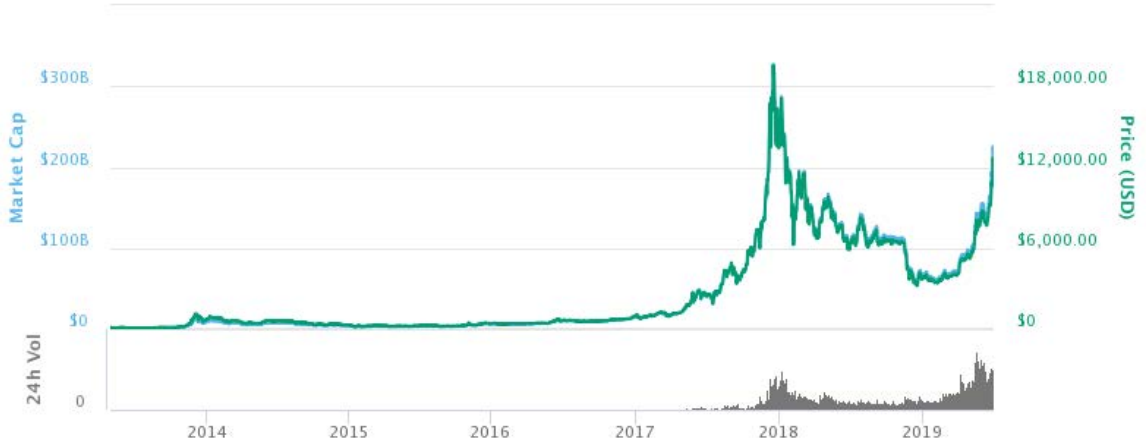
The issue of whether digital currencies are considered to be money or not has been extensively analysed (see for instance Bank of England 2014, Q3 or Yermack, 2013). These studies conclude that in theory, digital currencies could serve as money for anybody with an internet-enabled computer or device. However, in reality, this function occurs only to some extent and only for a small number of people, and always in parallel with users' traditional currencies. Instead, digital currencies resemble a speculative investment similar to the Internet stocks of the late 1990s.

### 3.1.1. Digital currencies as a store of value

We must distinguish between the long and the short run to study the use of digital currencies as a store of value. For an asset to be a store of value in the long run, it is key what people expect about its future supply and demand. Supply of digital currencies is totally assured because of the algorithmic essence of its production. However, demand is more uncertain. Then, the public belief that digital currencies will continue being on demand is crucial for them to function as a store of value. Thus, the worth of digital currencies as a store of value over the long run is directly linked to their demand, and this is connected with what users believe about the future success of the currency.

However, in the short run, it is difficult that digital currencies serve as a store of value. These sorts of currencies have a large volatility in exchange rates compared with traditional currencies (See Figure 10). Managing the risk arising from this exchange volatility is a further problem that makes digital currencies a poor short-term store of value.[5] For instance, bitcoin's daily exchange rate with the U.S. dollar exhibits virtually zero correlation with the dollar's exchange rates against other prominent currencies such as the euro, yen, Swiss franc, or British pound, and also against gold. Therefore, Bitcoin is not a good tool to manage risks. (See Yermack, 2013).

**Figure 10: Bitcoin price since 2009 to 2019**




Source: BitcoinWiki.

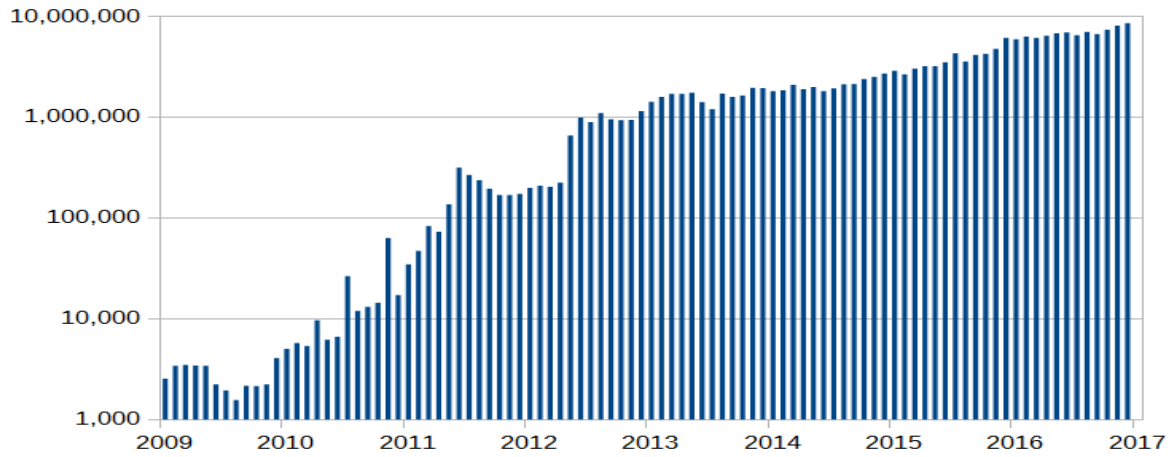
Safety is also an issue when considering digital currency as a store of value. When treating currency as a store of value, protecting it against theft is very important. In the case of digital currency, because the currency is not physical, one cannot literally hide it (for instance under the mattress). Instead, digital currencies must be held in computer accounts known as "digital wallets." Security for these wallets is an important issue for digital currencies. Sometimes, companies contract some insurance. However, the consumer is the one in charge of the cost.

### 3.1.2. Digital currencies as a medium of exchange

A currency can be used as a medium of exchange as long as there are retailers willing to accept it in payment. The number of retailers worldwide that are willing to receive payment in digital currencies is increasing. However, the fact that retailers accept these currencies does not mean automatically that the currency is going to be used widely. In order to know if the digital currency is really a medium of exchange it is important to track the number of transactions made in these currencies over time. Figure 11 shows how this number has been largely increasing over time.

[5] Bitcoin's exchange rate volatility in 2013 was 142%, an order of magnitude higher than the exchange rate volatilities of the other currencies, which fall between 7% and 12%. Gold, which is a plausible alternative to these currencies as a store of value, had volatility of 22% in 2013 based on its dollar-denominated exchange rate. (See Yermack, 2013)

**Figure 11: Number of bitcoin transactions per month since 2009 to 2017**




Source: BitcoinWiki.

One difficulty for digital currencies to be a medium of exchange is its fixed supply. Consumers can only access digital currencies from online exchanges or dealers. Furthermore, one cannot bypass the requirement of possessing digital currencies before procuring goods and services from a merchant. So far, there are no credit cards or consumer loans denominated in digital currency.

### 3.1.3. Digital currencies as a unit of account

There is little evidence of any digital currency being used as a unit of account. The extreme volatility of the digital currencies' exchange rates is also a problem when becoming a useful unit of account. For example, the value of a bitcoin, compared to other currencies changes greatly on a day-to-day basis. Retailers have to recalculate prices very frequently and this can be costly and confusing. The uncertain market value of digital currencies would make it very difficult to use as a valid reference point for setting consumer prices. Table 1 displays the daily bitcoin-USD price and the number of transactions.

**Table 1: Bitcoin-USD Price and Volume of Transactions**

| Date | Open | High | Low | Volume |
|---|---|---|---|---|
| Nov 23, 2019 | 7,298.17 | 7,298.172 | 7,207.51 | 34,342,412,288 |
| Nov 22, 2019 | 7,643.57 | 7,697.38 | 6,936.71 | 34,242,315,784 |
| Nov 21, 2019 | 8,023.64 | 8,110.10 | 7,597.38 | 22,514,243,371 |
| Nov 20, 2019 | 8,203.61 | 8,237.24 | 8,010.51 | 20,764,300,436 |
| Nov 19, 2019 | 8,305.13 | 8,408.52 | 8,099.96 | 21,083,613,815 |

Source: Yahoo Finance.

An additional aspect for the difficulty of digital currencies to become units of account is the fact that merchants quote prices for most goods in four or more decimal places. Although mathematically this should not pose any problem, for consumers these decimal points may be disconcerting. Table 2 shows and example of how cars are priced in bitcoins.

**Table 2: Price of cars in Bitcoins**

| Car | Price in Bitcoin | Price in USD |
|---|---|---|
| Honda Accord | 3.26713809 | 23,570 |
| Ford Fusion | 3.06614742 | 22,120 |
| Toyota Corolla | 2.57129451 | 18,550 |
| Nissan Sentra | 2.35505627 | 16,990 |
| Chevrolet Cruze | 2.35297705 | 16,975 |

Source: carstobtc.com.

## 3.2. Conclusion: Is digital currency money?

According to the analysis above, it seems that digital currencies barely meet the criteria associated with the functions of money.

Thus, digital currencies do not seem to really function as money in the economy and bring about some risks if they were to be widely used in the long run. Then, it is very unlikely that these sorts of currencies, in their current form, would be the main form of money for the economic system. Furthermore, other issues that may appear are related to the fact that people are not really familiar with the technology, applications are not very user-friendly, they are not very safe relative to deposits, and they display great volatility in their exchange rates (see Bank of England, 2014).

Moreover, digital currencies lack some other features that are associated with money in the economy. For instance, digital currencies cannot be stored as bank deposits, they are usually part of "digital wallets," which are exposed to many risks and costs. There is no standard insurance for this wallets, as in the case of deposits. Furthermore, digital currencies are not a unit of account for loans and mortgages. No credit or credit cards are denominated in digital currencies either (see Yermack, 2013).

As opposed to traditional money, digital currencies are not a claim and thus could be somehow considered a commodity. However, they are intangible, not as gold, for instance. Digital currencies can be used only if users agree that they can be used. Not being a liability of the central bank is not an impediment to function as money, but makes them different to cash and notes (see Bank of England 2014).

In some ways, digital currencies are similar to earlier forms of money. For instance, the central bank does not govern their supply and payments are made in a direct way, without any intermediary.

# 4. COSTS AND BENEFITS OF DIGITAL CURRENCIES

The surge of the technologies associated to cryptocurrencies has some implications for the macroeconomy, the money supply, and the financial system. Blockchain technologies reduce transaction costs, and this may be welfare-enhancing. However, they also bring about new risks and problems.

From a macroeconomic point of view, cryptocurrencies could pose a risk to monetary and financial stability. From a microeconomic perspective, they imply a risk to investors, who could lose all their money.

If linkages between cryptoassets and systemically important financial institutions or markets are large enough, this could be a risk for financial stability. However, nowadays, the small size of digital currency schemes makes it unlikely to pose real risks to financial stability. Over time, it seems that problems related to financial stability are not likely. However, they are still more likely than risks to monetary stability. The only way that monetary stability could be affected by the use of digital currencies is if they were widely used. Nevertheless, this is considered to be very unlikely, at least in their current form (see Bank of England, 2014).

## 4.1. Risks to financial stability

Digital currencies pose an additional risk to financial stability. We have seen that their prices are very volatile. If there is a price crash, this may potentially endanger the stability of the financial system. However, currently the total value of digital currencies seems to be too small to pose a real threat to financial stability and, in any case, would be limited to the direct holders of that currency.

According to Bank of England 2014b, there are a number of potential scenarios which would increase the probability of digital currencies affecting financial stability. For instance, if a holder of digital currencies had already borrowed money from someone else. In this scenario, after a price crash, losses would not only impact the direct holder but also lenders. Also, if a systemically important financial institution is directly exposed to cryptocurrencies.

Right now, digital currencies do not play a significant role in the economy because they reach a small number of consumers. However, if this number increases, the possibility of system-wide fraud and disruption arises. Thus, the real risk lies in the digital currency becoming systemically important.

To overcome financial stability risks, it is important to take a close look to financial stability issues related to cryptocurrencies and make sure that the macroprudential regulation is adequate both at national and international level. This calls for international coordination for those cryptoassets that pose new challenges to traditional forms of financial regulation, and fall outside the existing regulatory framework.

## 4.2. Risks to monetary stability

We have already discussed that digital currency supply is predetermined and governed by fixed algorithms. Therefore, the eventual total supply of cryptocurrencies is fixed, there is no discretion in its determination. This could potentially pose a number of problems for monetary stability because this fixed supply could contribute to deflation or volatility in prices and real activity, just because supply cannot adapt to demand.

The greatest risk that could, in theory, be posed by digital currencies to monetary stability is an erosion of the ability of the central bank to influence aggregate demand as part of its remit to achieve its inflation target. Nevertheless, in order to assess if cryptocurrencies are really a risk to monetary stability,

it is important to see to what extent they are used. If their usage is not widespread, then the central bank can still affect aggregate demand and achieve its monetary policy objectives. If the economy became "bitcoinised," that would pose a real risk for monetary policy. However, currently, it does not seem that this is a likely scenario (see Bank of England, 2014).

## 4.3. Other risks

For digital currencies, there is no consumer protection. For instance, there are no refunds if there is a problem between consumers and retailers. Laws may exist but they would be difficult to enforce. Consumer credit, if it were denominated in cryptocurrencies, would be very difficult to secure (see Yermack, 2013).

There could be other potential risks associated with large fluctuations in the price of a digital currency, the lack of transparency about the producers of cryptocurrencies and their motives, the problems of security and potential hacking, and the ease with which a digital currency like bitcoin can be used to finance illegal transactions.

## 4.4. Potential benefits

Cryptocurrencies could also benefit the system. The technologies underlying cryptoassets may potentially create a more distributed and diverse payments system. They use the so-called distributed ledger technology (DLT) (or blockchain). This technology allows a digital currency to be used in a decentralised payment system. Thus, it could happen that the currency is copied and spent several times. Users do not need to trust any government, they just need to trust the DLT. This technology could be used in a similar fashion in other layers of the financial system (See Bank of England, 2014).

Furthermore, the emergence of these additional financial assets is likely to increase aggregate welfare by introducing more variety into the menu of financial assets offered to pension funds, insurance companies, hedge funds, private individuals and other thrift institutions.

# 5. PRIVATELY ISSUED DIGITAL CURRENCY

Private entities issuing digital currency use a DLT. Such technology is a consensus of replicated, shared, and synchronised digital data geographically spread across multiple internet sites, in different countries and institutions with no central administrator or centralised data storage.

At the very least, private digital instruments possess the following two advantages: First, they introduce the fintech technology to reduce the costs of transacting across different fiat currencies. Second, in countries with underdeveloped financial systems, in which many consumers are excluded from the financial system, private digital currencies are potentially contributing to financial inclusion.

However, as is well known, an essential attribute of a good currency is widespread acceptability by economic agents against the supply of goods and services. A precondition for this attribute is trust in the currency. Individuals must trust that the currency has a stable purchasing power, will not be debased by the issuer(s) of the currency and that private ownership of currency is fraud-proof. Thus, trust in the ledger of a fully decentralised currency is crucial for digital currency to be used as money. Trust is achieved by making it extremely hard for one, or a small group, of computers to tamper with the transaction ledger. In addition, the protocol that governs the ledger of a fully decentralised currency must include a built-in provision that limits the creation of new money in order to preserve its purchasing power. Cryptography is the computer technique used to secure transactions and to control the creation of new currency units.

Aizenman (2019) and Auer (2019) argue that privately administered DLT are unlikely to provide the stability and scalability required to efficiently perform the medium of exchange function. A natural candidate to do that would be the central bank. The central bank already possesses the infrastructure for issuing a currency and is backed by the tax collection apparatus of governments. Like cash or checking deposits denominated in fiat currency a central bank digital currency would rely on the trust created by means of the centralised ledger administered by the bank.

Central banks can take advantage of the cost reduction of the technology associated with digital currencies. At the same time, they can still use their monetary policy instrument by issuing a digital currency that can be converted into cash and paper currencies at a given fixed exchange rate. In this way, a central bank digital currency (CBDC) would be a legal tender. Thus, M1 would be expanded to include the CBDC. Then, monetary policy could be conducted in the usual way.

# 6. A CENTRAL BANK ISSUING DIGITAL CURRENCY

People trust that the existing fiat currency issued by a centralised authority has stable value because of stable monetary policies, because the currency can be used to pay taxes to government, and because it is impossible for anyone to spend the same piece of currency more than once.

According to Cukierman (2019), in order to preserve the effectiveness of monetary policy in a world increasingly flooded by private digital currencies, central banks will eventually have to issue their own digital currencies. Although a non-negligible number of central banks (CBs) are actively considering the pros and cons of a central bank digital currency (CBDC) there is yet no CB that has issued such a currency on a full scale.

Thus, the feasibility and desirability of central banks issuing their own fiat versions of digital currencies has been the focus of a growing debate in recent years. Numerous central banks around the world are researching the topic, including the Bank of Canada (2017), the European Central Bank (Mersch, 2017), the People's Bank of China (Qian, 2017), the Sveriges Riksbank (2017) and the Bank of England (2017). For instance, Gupta et. al. (2017) conclude their case in favour of issuing a digital currency by the Fed. They claim that a "Fedcoin" would have many advantages because it would mitigate the risk of attacks and it would be based on the assumptions that the central bank is honest, the protocol's cryptography is secure, and that each transaction is processed by a set of nodes with an honest majority.

Meaning et al. (2018) provide a definition for CBDC as "any electronic, fiat liability of a central bank that can be used to settle payments, or as a store of value." As such, CBDC can be viewed as electronic narrow money and in some senses already exists in the form of central bank reserves.

It is also confusing to think about whether CBDC is a cryptocurrency or not. Cryptocurrencies, in principle, make use of DLT technology. The central bank does not necessarily need to use the same technology because it has its own. This kind of CBDC would not be a cryptocurrency, but would remain a central bank digital currency.

Currently, whether central banks should issue CBDCs is a question open to debate. On the one hand, it would be efficient because it could make use of the new technology. However, it could be the case that CBDCs interfered with the private banking system, especially if the public can hold deposits within the central bank.

Another concern is that if these currencies are not issued by the central bank, at some point these currencies will become the alternative of legal tender. But abstaining from providing a public alternative to privately produced digital currencies carries the risk that sooner or later those currencies will largely replace legal tender. Recognising this risk, most central banks currently research the various options for eventually adopting some form of CBDC. Some like the Dutch central bank and the central bank of Uruguay have started to limitedly use this currency. The Federal Reserve Bank is also thinking about issuing a "Fedcoin."[6]

Based on traditional modelling, Barrdear and Kumhof (2016) assess the potential impact CBDC may have on the macroeconomy. They build a dynamic stochastic general equilibrium model and find that the introduction of a CBDC via purchases of government bonds could increase real GDP by as much as 3%. Bordo and Levin (2017) also analyse the design of CBDC and its implication. They conclude that CBDC could act as a highly effective form of money and promote true price stability, as the real value of CBDC could be easily held stable over time.

[6] A number of CBs have issued reports on this question (Lober and Houben (2018). Barontini and Holden (2019) report limited experiments with CBDC by the central bank of Uruguay and the Riksbank.

# 7. AN INTERMEDIATE SOLUTION: STABLECOINS

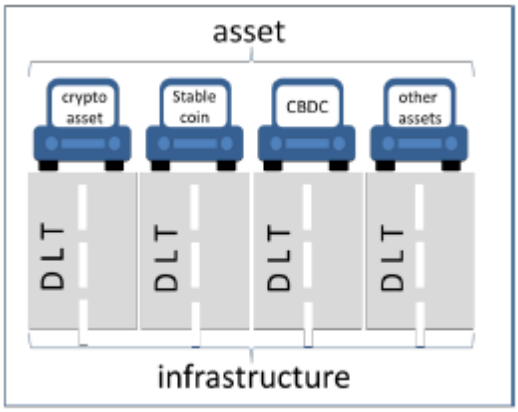
Cryptocurrencies have issues and risks that need to be solved. In order to find a solution, one alternative would be the so-called "stable cryptocurrencies" such as Tether and DAI. These stablecoins could in principle solve the problem of the great volatility that cryptocurrencies such as Bitcoin or Ether display.

This stable cryptocurrency is based on tokens that are pegged to the value of a fiat currency (like the dollar or the euro), to assets (gold, real estate), or to another cryptocurrency. There are also stablecoins that, instead, are governed by algorithms to keep their prices stable. The main reason for creating a stablecoin is to protect investors in times of volatility. Thus, stablecoins have many of the advantages of digital currencies but manage to have a more stable price. Therefore, stablecoins might be more capable of serving as a means of payment and store of value because of their less volatile essence (see BIS, 2019).

There are two distinct types of stablecoins that use different strategies to reduce volatility: (i) the "collateralized" (or "backed") cryptocurrencies, which are tied to the value of an external (stable) asset (fiat currency, a cryptocurrency, gold, and property). The second main group of stablecoins are those that are "non-collateralized" or non-backed, meaning they are not linked to any external value. They follow an algorithm instead, which controls currency volatility.

Stablecoins may be seen as an intermediate solution between cryptocurrencies and CBDC. As we have seen in previous sections, the demand for a stable asset, which uses the DLT has opened the debate about the possibility of issuing a CBDC. However, this may also pose problems, questioning the role of banks in financing economic activities. In view of the volatility of cryptoassets and given the remaining questions surrounding CBDCs, stablecoins have come to the fore as a potential third type of asset that aspires to bring stability to the volatile market for cryptoassets.

**Figure 12: Different assets that use DLT**

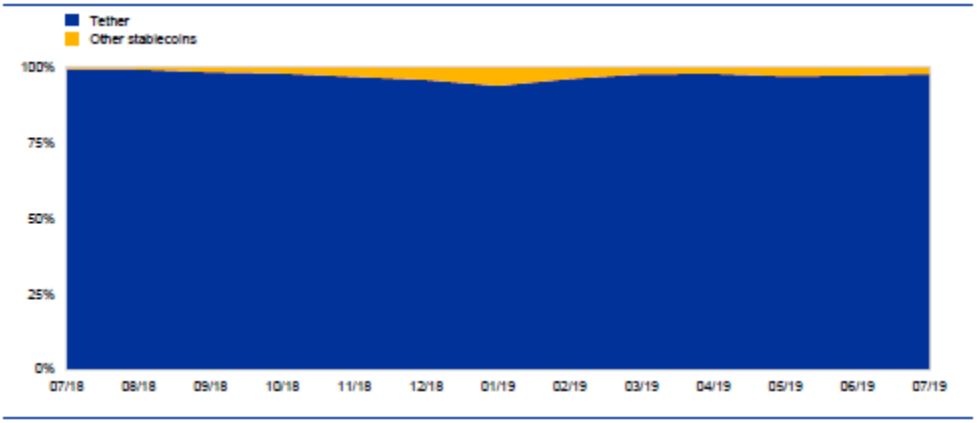



Source: ECB (2019).

Stablecoins aim to provide safety in relation to the major currencies issued by central banks. Cryptocurrencies are characterised by high price volatility, which makes them incapable of performing the three functions of money. Stablecoins, instead, try to solve this problem, and have been introduced as an attempt to overcome this volatility problem. Thus, financial service providers and technology companies have been working towards the development of stablecoins for payment transactions on a global scale. For example, Facebook initiated the Libra project in order to enhance international financial transactions for everyone in a faster and more efficient way (see Bullmann et al., 2019).

Tether currently dominates the stablecoin market in terms of trading volume as well as market capitalisation. While Tether accounted for 99% of the entire market capitalisation of stablecoins in February 2018, its share declined to 81% in July 2019. Tether was among the first stablecoins that appeared and has therefore the advantage of having moved first. While the market has become increasingly competitive, Tether remains the most commonly used stablecoin.

**Figure 13: Trading volume of USD Tether compared to other stable coins**




Source: ECB, 2019.

Nevertheless, stablecoins are still in their infancy, and therefore not a sufficiently secure investment vehicle. Maybe, in the future, they could end up replacing the traditional digital currencies like Bitcoin or Ripple (see BBVA, 2019).

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## QUESTIONS FOR MEPS

- The report issued by London School of Economics shows the demand and supply of currency has increased since 00's, both in the Euro Area and the US. Why are then central banks considering issuing digital currency if preference for liquid money, such as notes and coins, has increased in recent times, including during the Great Recession?
- Do you consider cryptocurrency (or digital money) a monetary or financial claim (or asset), and thus a concern for either monetary- or financial stability?
- Do you believe that issuance and trade of cryptocurrency should be decentralised, or through a single point market?

Advanced economies are moving towards a cashless system, with a recent surge in cryptocurrencies, issued by private entities. Although digital currencies may increase welfare, due to a reduction in transaction costs, they introduce risks to monetary and financial stability. Furthermore, they barely serve as money due to their large volatility. To partly overcome these problems, the issuance of a stablecoin would be an intermediate solution between private and central bank issued digital currency.

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