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CRYPTOCURRENCIES, MONETARY STABILITY AND REGULATION:

GERMANY'S NINETEENTH CENTURY PRIVATE BANKS OF ISSUE

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Germany's nineteenth century private banks of issue

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Introduction

The present paper classifies bitcoins and other cryptocurrencies as money, reviews their possible economic impact and proposes a regulatory approach based on Germany's nineteenth century private banks of issue. Cryptocurrencies represent important monetary innovations and have reinvigorated interest in and debate about notion and meaning of money. They aim to disrupt and challenge existing monetary and financial arrangements. Their market valuations though highly volatile may become substantial quickly. Their impact on the financial system therefore causes disquiet. It has already led to various regulatory measures and calls for more. However, few discussions on regulation have focused in earnest on the possibility of a sustained significant expansion of cryptocurrencies as money.

The total market capitalisation of digital coins and tokens at end-January 2018 was US$520 billion though down from US$830 billion in early-January 2018. There are 1474 cryptocurrencies at end-January compared with 682 at end-January 2017.[1] Initial coin offerings have sprung up as a new way to raise money for cryptocurrency-related ventures from 46 in 2016 totalling US$0.1 billion to 235 in 2017 totalling US$3.7 billion.[2] Retailers, though relatively few, are increasingly accepting bitcoins as payment.[3]

Cryptocurrencies promise to deliver critical economic benefits amid greater financial transaction efficiency, reduction of transaction costs and possibly an alternative to unsteady national currencies. At the same time, cryptocurrencies bear significant risks and have been derided as financial follies (James, 2018; Turner, 2018).[4] The rapid rise of cryptocurrencies raises fundamental concerns akin to the provision of private money-like assets and risk of financial instability (Potter, 2018).[5] It would be inconsistent with the notion that there ought to be some—though not necessarily easily quantifiable—ceiling of the amount of money in an economy to preserve macroeconomic stability (Friedman, 1960).

[1] Price and market capitalisation data from www.coinmarketcap.com. Data as of 31 January 2018. Data on number of cryptocurrencies as of 28 January 2018.
[2] Initial coin offering data from www.coinschedule.com. Data as of October 2017 (latest available).
[3] For a list or retailers, see e.g. Chokun (2018) and Moreau (2018). Also, e.g. Gerlis (2018) describes some incipient signs that works of art are sold for bitcoins hinting at aggregate demand and wealth effects from cryptonization.
[4] Turner states: "Like other cryptocurrencies, bitcoin serves no useful economic purpose […]."
[5] It is interesting to note that in his remarks delivered on 6 January 2018 about private money-like assets Potter (2018) makes no reference to bitcoins or other cryptocurrencies.

Recent developments of bitcoins and other cryptocurrencies have been well documented (White, 2015; Frisby, 2014; Vigna & Casey, 2015). However, comparatively little attention has been paid to the monetary impact of cryptocurrencies (Ali, 2014; Fernández-Villaverde, 2017). The monetary impact can be approximated by the role of dollarization or currency substitution and incidence of private monies and the risks to macroeconomic stability (Eken, 2005; IMF, 2017; King, 1983; Reinhart et al., 2003; Vacaflores, 2012).

Cryptocurrencies have recently been subject to severe criticisms by the official sector (Carstens, 2018; Mersch, 2018).[6] Announcements that the G20 will consider regulation for cryptocurrencies could produce a more comprehensive regulatory approach (Wilkes & Sano, 2018). The regulatory response to date has been concerned mostly with illicit transactions, consumer protection, market manipulation, capital flight and governance (Balboa, 2017; BIS, 2015; de Filippi, 2014; Morris, 2017; Wildau, 2017).[7] Concerns about money laundering and terrorist financing remain dominant amid the anonymity provided and limited identification of cryptocurrency participants (FATF, 2014). To date, regulatory actions include among others possible outright bans in China and South Korea, several initiatives in the European Union under anti-money laundering regulations and warnings about the risks of initial coin offerings to special regulatory regimes (sandboxes), regulatory approvals of cryptocurrency exchanges in Japan and adoption of bitcoin futures contracts in the U.S.[8] At the same time, there is recognition that cryptocurrencies have brought important innovations and should not unduly be stifled.[9]

Governments have commenced work on digital currencies themselves (Frost, 2016; Linnemann Bech & Garratt, 2017). The Chinese and Swedish governments are known to be in advanced stages of introducing digital currencies.[10] The decline of use of cash in some

[6] BIS General Manager Agustín Carstens described bitcoins as "a combination of bubble, a Ponzi scheme and an environmental disaster."
[7] While some regulators see no significant impact, others are more concerned. Governor of the central bank of Austria Ewald Nowotny was quoted saying "Simply because of the scale, it is certainly increasingly necessary to discuss whether and in what form regulations are needed here," Reuters (2017b). ECB Executive Board member Benoît Coeuré was quoted attesting that cryptocurrencies are limited to speculative funds and individuals "but it is not inherently a macroeconomic risk," Reuters (2017a).
[8] See e.g. Sulleyman (2018) on China, Kim and Kim (2018) on South Korea, Musaddique (2017) on the U.K., Bundesanstalt für Finanzdienstleistungsaufsicht (2017) on initial coin offerings. Japan in September 2017 approved 11 operators of cryptocurrency exchanges, See (Wada & Sano, 2017). Chicago-based derivatives exchanges Cboe and CME launched bitcoin futures contracts on 10 and 17 December 2017, respectively.
[9] Christopher Giancarlo, Chairman of the U.S. Commodity Futures Trading Commission (CFTC) was quoted saying "[i]t is important to remember that if there were no bitcoin, there would be no distributed ledger technology" (Shen, 2018).
[10] On Sweden's e-krona project, see Sveriges Riksbank (Central Bank of Sweden) (2017). On China, see Wang (2017).

countries has given rise to considerations about substituting physical notes and coins with digital currencies.

Private currencies are of course not entirely new. Bank notes were the great monetary innovation during the nineteenth century.[11] The emergence of cryptocurrencies can be compared with private banks of issue in e.g. Germany and other countries. Private banks of issue were a welcome development to facilitate rapidly increasing needs to conduct monetary transactions. The proliferation of bank notes though later raised concerns about the possible adverse impact on monetary stability. To regulate bank note issuance, Germany, like many other countries, established a central bank.

The present paper aims to review recent developments of cryptocurrencies and draw parallels with the monetary history of nineteenth century Germany to discuss possible regulatory approaches to support financial resilience. It sees cryptocurrencies as private currencies, that is, notes and coins that are of fixed nominal denominations as medium of exchange.[12] Other private monies like bank deposits or shares in money market funds are not considered herein as they do not exhibit immediate currency-like properties. The treatment of cryptocurrencies as money naturally implies national and international relations but only its national dimension will be considering herein. The data are reported mostly as of end-January 2018. The first section offers a brief overview of cryptocurrencies. The second section outlines principal monetary developments in nineteenth century Germany. The third section discusses the economic impact of cryptocurrencies and the fourth a possible regulatory approach. The last section provides some concluding remarks.

Cryptocurrencies

Cryptocurrencies represent important monetary innovations. They are, as is well known, private, digital, denationalised, unreserved, floating rate, convertible monies. The innovation

[11] In China, bank notes were introduced at least as early as the 10th century (jiaozi). In Europe, bank notes were introduced as early as the 18th century but became common as medium with legal tender or near legal tender status during the 19th century.
[12] IMF (2016) classifies domestic currency as "banknotes and coins issued by resident units that are used as a medium of exchange in an economy […]" (6.22) and as "[…] issued or authorised by central banks or governments" (4.25).

rests in large part with the notion of private and borderless currencies, strictly peer-to-peer not linked to the financial sector or a trusted third party and verified and authenticated solely by a computer network.[13] Cryptocurrencies may also bring important economic benefits, though not yet proven, by increasing financial intermediation efficiency and reducing transaction costs. Cryptocurrencies have also greatly contributed to drawing attention to the functions of money and role of governments in the production of money.[14]

Bitcoin, as is well known, was the first of a new generation of cryptocurrencies issued in 2009 (Nakamoto, 2008). The fundamental idea was to build a decentralised database or shared public ledger (blockchain) that validates and records immutably all monetary transactions by a computer network that acts as a timestamp server for the computational proof of the chronological order of transactions. The blockchain thus solves the double-spend problem of electronic monies. Maintenance and integrity of the blockchain are self-sustained amid the incentives offered (proof-of-work) by the network. The underlying blockchain, while generally seen as the key innovation, is here considered merely—though recognizing that it is a major achievement with many significant applications—a technological solution to facilitate cryptocurrency usage.

The aim of bitcoin and other cryptocurrencies is to profoundly change the organisation of the production of money, role of intermediaries and governments, national money monopolies and congruence between national borders and currency areas. The ideas are associated with some strong libertarian values and see in high inflation as repeated abuses of monetary monopolies by governments as validation of the need for change (Frisby, 2014; Hayek, 1990; Nakamoto, 2008; Vigna & Casey, 2015).

[13] The development of bitcoin was associated with the Cypherpunk movement of the 1990s that worked on privacy tools based on cryptography including anonymous digital currencies. The movement also aimed at reducing transaction costs and fostering privacy and financial inclusion.

[14] The role of government in the production of money has been repeatedly questioned in principle (Friedman, 1960; Hayek, 1990). Similarly, concerns about government abuses in the production of money are of course not new. Kisch and Elkin (1932) wrote: "It is the handling of the fiduciary issue that Governments have so frequently proved themselves unsatisfactory guardians of the public welfare. […] [A] State issue is likely to be unduly inelastic if the Government of the day keeps to the paths of financial virtue, but too elastic if the Government finding itself in pecuniary difficulties is unable to resist the attractions of the printing press."
Earlier apprehensions about the performance of money produced proposals for strict monetary rules, return to a commodity standard and currency competition (Salin, 1984). Other considerations refer to nineteenth century free-banking principles attesting that money should be no different than other goods and services where monopolies are seen as stifling high quality outcomes, see e.g. Glasner (1989).

The issuance algorithm of bitcoins and some other cryptocurrencies is comparable to a strict monetary rule to serve as anchor to offer a predictable level of issuance and avoid over-issuance. Friedman (1968) postulates: "*My own prescription is still that the monetary authority go all the way in avoiding such swings by adopting publicly the policy of achieving a steady rate of growth in a specified monetary total. The precise rate of growth, like the precise monetary total, is less important than the adoption of some stated and known rate*."[15] Earlier comparisons with bitcoins also referred to commodity-based monies (Krugman, 2011). However, e.g., gold supply can be unstable amid new discoveries or significant changes in extraction technologies and therefore does not offer a good benchmark. Böhme et al. (2015) therefore states that "*[…] [b]itcoin can be understood as the first widely adopted mechanism to provide absolute scarcity of a money supply.*"

The valuation of bitcoins and other cryptocurrencies has seen near unparalleled changes. The value of bitcoins increased from US$370 in January 2016, to US$970 in January 2017, US$19,500 in mid-December 2017 and dropped to US$10,200 at end-January 2018 (Figure 1). Other cryptocurrencies have seen even higher valuation increases. The prices of bitcoins and other cryptocurrencies have remained highly volatile.

The total market capitalisation of bitcoins and other cryptocurrencies increased to US$580 billion in January 2018 up from 17 billion in January 2017 (Figure 2). The total market capitalisation of bitcoins reached US$170 billion in January 2018 up from US$15 billion in January 2017 and its share in market capitalisation declined from 85 percent of total cryptocurrencies in January 2017 to 29 percent in January 2018. The ten largest cryptocurrency issuers by market capitalisation bitcoin, ethereum, ripple, bitcoin cash, cardano, stellar, neo, litecoin, eos and nem represent 80 percent of market capitalisation of cryptocurrencies at end-January.

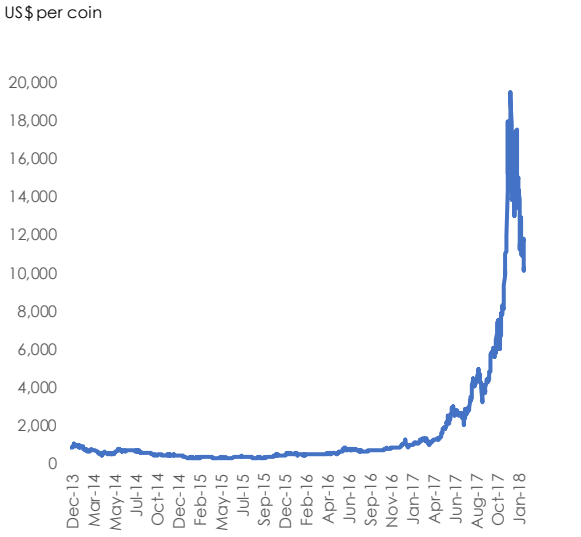
The market capitalisation of all cryptocurrencies at end-December 2017 represents more than 15 percent of currency held by the public issued by the Federal Reserve, European Central Bank and Bank of Japan combined compared with less than 1 percent in December 2016.[16]

[15] See e.g. Böhme et al. (2015) for a comparison with Friedman's fixed rule.
[16] The choice of numeraire is arbitrary and only serves as benchmark. Cryptocurrencies are highly popular in China, Japan and Korea.

The market capitalisation in terms of broad money has remained significantly more modest (Figure 2).

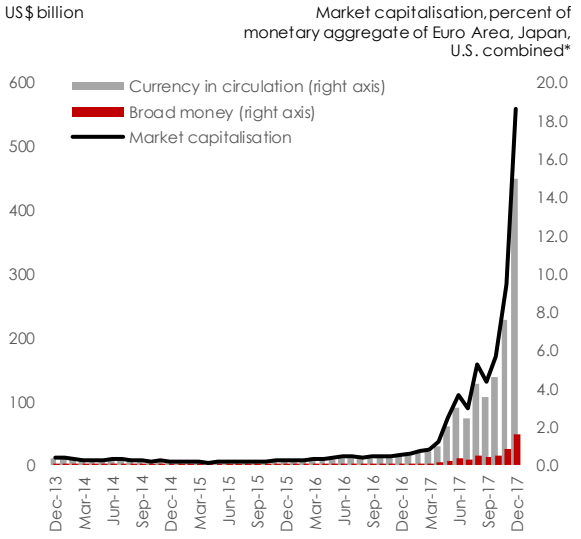
The supply of cryptocurrencies has increased noticeably. The number of cryptocurrencies increased from 682 in January 2017 to 1474 in January 2018. The number of cryptocurrency coins in circulation were up from 2.6 trillion in January 2017 to 9.1 trillion in January 2018.

Figure 1. Bitcoin price



Source: Coinmarketcap.com. Through 31 January 2018.

Figure 2. Market capitalization



Source: Bank of Japan, Coinmarketcap.com, ECB, Federal Reserve, IMF. Currency in circulation seasonally adjusted for Euro Area and Japan; weekly averages for U.S. Broad money (M2) seasonally adjusted.

The issuance of cryptocurrencies distinguishes decentralised and centrally issued coins and token. Coins, like bitcoin are created or "mined" at normally a fixed issuance algorithm and operate their own blockchain network. The number of for example bitcoins to be mined is halved every year until 21 million coins are issued (there are 16.4 million bitcoins in existence today) and the final halving will take place in 2140. Most cryptocurrencies are be pre-mined and issued in one instalment like e.g. ripple, cardano, stellar with only 486 currencies minable out of 1474.[17] Tokens, that are normally attached to a third blockchain network and can represent certain services are mostly non-minable. Coins and token are not fungible but may represent similar functionalities though highly specialised purposes exist. Cryptocurrencies are therefore not all congruent with the notion of currency.

Private monies in nineteenth century Germany

Bank notes were the cryptocurrencies of the nineteenth century.[18] Bank notes represented important innovations, reduced transaction costs, had some credit instrument attributes similar to checks and were predominantly private currencies issued by banks of issue. They were welcome and supported as necessary mediums to support the rapid rise of commercial transactions during the nineteenth century.[19] In Germany, bank notes increased from representing about one quarter of metal coins, official money, in circulation in 1860 to representing more than half in 1872. In 1875, Germany had 33 private banks of issue and corresponding number of different private bank notes in circulation. Period commentators were increasingly alarmed about the perceived excessive issuance of bank notes: "*The entire German market […] was inundated with paper currencies*".[20] Central banks were established mostly for the organisation of bank note issuance.[21] During the nineteenth century, the

[17] Data from www.coinmarketcap.com. Data as of 28 January 2018.
[18] Ali (2014) refers to the U.S. experience under free banking during the nineteenth century as a historical parallel for cryptocurrencies.
[19] The first paper currencies in Germany appeared in the early eighteenth century but the widespread introduction of paper currencies occurred after the Napoleonic wars. Rittmann (1975) cites the establishment of Banco di gyro d'affrancatione in Cologne in 1706 as the first bank of issue. Austria introduced paper currency in 1762.
[20] Simon (1884): "*Der Hauptzweck des Bankgesetzes sollte es sein, das Banknotenwesen zu regeln, insbesondere den übermässigen Banknotenumlauf einzuschränken. [...] Der ganze deutsche Markt, insbesondere der Kleinverkehr, wurde mit [...] papierenden Zahlungsmitteln überschwemmt.*"
[21] See e.g., Goodhart (1988) contends that early central banks e.g. in Germany have been founded to unify "*a somewhat chaotic system of note issue, to centralise, manage and protect the metallic reserve of the country and to facilitate and improve the payments system. In any case, prior to 1900, most economic analysis of the role of central banks concentrated on the issue of whether the note issue should be centralised, and, if and when centralised, now controlled by the central banks.*"
Similarly Smith (1936) argues that nineteenth century writers confronted the problem of note issuance with the following question: "*Is it preferable that the note issue should be in the hands of one single bank, or at any rate a definitely limited number of banks specially authorised to undertake it […] or is it preferable that there should be as many banks of issue as find it profitable to enter the note-issuing*

proliferation of bank notes defined institutional and regulatory change in the monetary sphere and triggered a debate of whether bank notes should be managed by a single or multiple central banks.[22]

Nineteenth century Germany established one of the most successful central banking systems amid stable bank note issuance and sustained economic growth. The 1871 and 1873 coinage acts (Münzgesetze) brought the adoption of the mark as a single currency and suspended the right of the federal states to issue their own paper currencies. In 1875, the bank act (Bankgesetz) established the first German central bank, the German Imperial Bank (Reichsbank). The act adopted a mixed central banking system with the Reichsbank at federal and the private banks of issue (Privatnotenbanken) at federal state level. It regulated the right of bank note issuance under federal law, prescribed central banking operations, minimum bank note reserve requirements and bank note convertibility and set prudential and disclosure requirements common for all institutions. The main motivations for a mixed system were concerns about the effectiveness of a single central bank to maintain monetary discipline and a desire for the preservation of local banking practices.[23]

The Reichsbank was endowed with certain advantages included by far the largest regulatory capital and non-reserved note issuance quota and the right to install branches throughout Germany. The Privatnotenbanken were obligated to adhere to the bank act or lose their note issuance right. The act de facto limited bank note circulation by the Privatnotenbanken to their home states. This significantly constrained the attractiveness of bank note issuance in particular for banks with a small home state. 15 Privatnotenbanken therefore abandoned their note issuance rights with the adoption of the act.

business?" James (1997) also highlights that in general in the debate about central banking, "the issue at stake […] was the extent to which monetary power should be federalised, decentralised or dissipated among private actors, such as commercial banks."

[22] Ugolini (2017) quotes The age of central banks by Curzio Giannini that "the 'dematerialisation' of money initiated by the 'invention' of banknotes called for new institutional solutions to a pressing social problem, that is, the provision of that 'public good' that is monetary stability. This solution was the modern central bank […]."

[23] The Privatnotenbanken had acquired the rights of note issuance and cancellation of such rights was seen as difficult also legally. President of the Chancellery, Rudolph von Delbrück (Deutscher Reichstag, 1874, p. 152): "*Es konnte in der That nicht wohl daran gedacht werden, über diese Privilegien einfach zur Tagesordnung überzugehen und eine Centralbank zu errichten, der man allein die Banknotenemission im Reiche gibt*."

Table 1. German banks of issue

		Non-reserved note issuance quota in 1875 (000 Mark)	Share of total quota (percent)	End of note issuance (year)
	Reichsbank	250,000	64.9	
1	Preußische Bank, Berlin 1846			
2	Bayerische Notenbank, München 1875	32,000	8.3	1934
3	Sächsische Bank, Dresden 1865	16,771	4.4	1934
4	Frankfurter Bank, Frankfurt a.M. 1854	10,000	2.6	1901
5	Bank für Süddeutschland, Darmstadt 1855	10,000	2.6	1902
6	Badische Bank, Karlsruhe 1870	10,000	2.6	1934
7	Württembergische Notenbank, Stuttgart 1871	10,000	2.6	1934
8	Hannoverische Bank, Hannover 1856	6,000	1.6	1889
9	Leipziger Bank, Leipzig 1838	5,348	1.4	1875
10	Bremer Bank, Bremen 1856	4,500	1.2	1889
11	Mitteldeutsche Creditbank, Meiningen 1855	3,187	0.8	1875
12	Braunschweigerische Bank, Braunschweig 1853	2,829	0.7	1905
13	Weimarische Bank. Weimar 1853	1,971	0.5	1875
14	Oldenburgerische Landesbank, Oldenburg	1,881	0.5	1875
15	Thürgingische Bank, Sondershausen 1855	1,658	0.4	1875
16	Gerarer Bank, Gera 1855	1,651	0.4	1875
17	Leipziger Kassenverein, Leipzig 1867	1,440	0.4	1890
18	Privatbank zu Gotha, Gotha 1856	1,344	0.3	1875
19	Communalständische Bank, Oberlausitz 1866	1,307	0.3	1875
20	Städtische Bank zu Breslau, Breslau 1848	1,283	0.3	1893
21	Danziger Privat-Aktienbank, Danzig 1857	1,272	0.3	1890
22	Kölnische Privatbank, Köln 1855	1,251	0.3	1886
23	Ritterliche Privatbank, Pommern 1825	1,222	0.3	1875
24	Provinzial-Aktienbank, Posen 1857	1,206	0.3	1890
25	Magdeburger Privatbank, Magdeburg 1856	1,173	0.3	1890
26	Rostocker Bank, Rostock 1850	1,155	0.3	1877
27	Bank des Berliner Kassenvereins, Berlin 1850	963	0.3	1875
28	Kommerzbank in Lübeck, Lübeck 1856	959	0.2	1887
29	Anhalt-Dessauische Landesbank, Dessau 1847	935	0.2	1875
30	Niedersächische Bank, Bückeburg 1856	594	0.2	1875
31	Lübecker Privatbank, Lübeck 1856	500	0.1	1875
32	Chemnitzer Stadtbank, Chemnitz 1848	441	0.1	1875
33	Homburger Bank, Bad Homburg 1853	159	0.0	1875
	Total	385,000	100.0	

Source: Kaiserliches Statistisches Amt (1880-95).

The principal bank lending operations were bills of exchange discounting with commercial banks, other banks of issue, non-bank corporate entities and individuals. The lending operations were funded primarily through bank note issuance constituting the banks' principal liabilities. Bank notes were to be reserved uniformly by one third ("Dritteldeckung") by eligible collateral including German currency (metal coins), Imperial Government securities (Reichskassenscheine), gold in bars and foreign coins. All bank notes were accepted at face value by the Reichsbank and the Privatnotenbanken and convertible on demand for gold. The banknotes of the Reichsbank and Privatnotenbanken were not legal tender.

The bank notes were subject to quotas (Kontingentierung) for unreserved bank note issuance by the Reichsbank and Privatnotenbanken (Table 1). Non-reserved bank note issuance beyond the quotas attracted a 5 percent note tax (Notensteuer).

The official discount rate was the main monetary policy instrument of the Reichsbank.[24] The discount rate signalled alterations in the monetary policy stance that materialised in net injections of monetary aggregates. The Privatnotenbanken were allowed to set their discount rate below, at so-called private or prime rates, the official discount rate set by the Reichsbank. From 1880, the Reichsbank also discounted at private rates. The differential discount rates were the main instrument to allow competition amongst the Reichsbank and Privatnotenbanken.

The competition between the Reichsbank and the Privatnotenbanken induced prudent note issuance behaviour and had a stabilising impact on the system. Banks limited bill discounting to preserve market share and maintained stable relations with clients if issuance of bank notes impaired note convertibility and caused the public to switch to bank notes of the Reichsbank or Privatnotenbanken that were prudentially stronger. Banks therefore, to preserve market shares, set discount rates so as to avoid coming close to their bank notes being perceived as not convertible.

Cryptonization, currency competition and monetary stability

The proliferation of cryptocurrencies as currencies evokes concerns normally associated with aggregate demand shocks and dollarization. The actual impact on macroeconomic stability naturally depends entirely on whether cryptocurrencies will grow significantly further in market capitalisation. If the 9.1 trillion in cryptocurrency coins and token in circulation were valued at US$4 each, that is, 0.04 percent of the value of 1 bitcoin at end-January, the combined value of cryptocurrencies would be US$36 trillion equivalent to that of broad

[24] The discount rate was typically by far the most important monetary policy instrument under the classical gold standard, see e.g. Bloomfield (1959). National Monetary Commission (1910a, p. 204): "*The Bank's investment are determined chiefly by the domestic demand for short-term credit. Owing to the preponderating importance of investment in bills, the discount rate is practically the only one to be taken into account. As in the case of merchandise, a high rate restricts and a low rate stimulates the demand.*"

money of the Euro Area, Japan and the U.S. combined.[25] This is highly improbable today. The widespread adoption of cryptocurrencies remains constrained by a number of factors including limited scope, fragmentation, lack of scalability, security concerns and in particular significant price volatility.[26] However, even more modest revaluations and partial substitution of national currencies—cryptonization—can have a profound impact on macroeconomic stability. Similarly, it can have positive effects from currency competition and greater payments efficiency.

The impact of cryptocurrencies on macroeconomic stability is at least two-fold through aggregate demand shocks and monetary policy efficiency. The first, similar to large-scale remittances or positive terms of trade shocks, due to significant increases in cryptocurrency valuations can be associated with Dutch disease-type effects, that is, inflation and an appreciation of the real effective exchange rate. The second can be impaired by dollarization-like effects, that is, the redenomination of assets and liabilities in the economy (Berg & Borensztein, 2000; Reinhart et al., 2003).[27] At the same time, cryptonization is more complex amid the sheer number of cryptocurrencies and also draws parallels with currency competition.

Dollarization can cause well known balance sheet vulnerabilities similar to foreign exchange borrowing. The nature of cryptocurrencies as peer-to-peer instruments can also lead to a disintermediation of conventional banking functions. The number of cryptocurrencies implies that there can be important inter-cryptocurrencies effects too. Dollarization is normally considered high when at least 10 percent of broad money, as a proxy for overall levels of domestic and external dollarization, is denominated in foreign currency.[28]

Monetary policy effectiveness can be impaired if bank disintermediation is pronounced, money velocity collapses and exchange rate volatility is enhanced. While there is considerable

[25] At a price of US$11,747 per bitcoin as of 28 January 2018 of circulating supply.
[26] BIS (2015) lists fragmentation, scalability and efficiency, pseudonymity, technical and security concerns, business model sustainability as supply side factors that may influence the future development of the technology underlying most cryptocurrencies, the distributed ledger or blockchain.
[27] Reinhart et al. (2003).
[28] Reinhart et al. (2003) define dollarization as a composite of the sum of bank deposits in foreign currency as a share of broad money, total external debt as a share of GNP and domestic government debt in foreign currency as a share of total domestic government debt. Countries are divided into different types depending on the importance of the levels of domestic and external dollarization. Dollarization distinguishes between currency and asset substitution. The first refers to domestic agents using foreign currency to conduct domestic transactions and the second to maintain assets and liabilities denominated in foreign currency

apprehension about the importance of monetary aggregates for the conduct of monetary policy, significant changes in the amount of money and money velocity are likely to affect monetary policy.[29] The exchange rate may be the dominant channel if the pass-through from exchange rate, that is cryptocurrency to national currency, to prices is high. Large-scale asset substitution may also lead to constraining the national currency to float freely against cryptocurrencies.[30] Where domestic agents continue to prefer the national currency for current domestic transactions, monetary stability must not be significantly impaired. Where cryptocurrencies are used as store of value predominantly, monetary stability can similarly remain intact. In contrast, if domestic agents increasingly use cryptocurrencies to conduct current domestic transactions, monetary stability could become compromised.[31]

The cryptocurrencies are subject to important currency competition amid reduced scope for differentiation, replicability and free entry. While different cryptocurrencies and in particular tokens target specific uses, many cryptocurrency coins aim to serve as medium of exchange and to perform other similar functions. This leads to immediate competition among cryptocurrencies to increase market share in monetary transactions amid positive network effects of widespread usage of a given cryptocurrency. While bitcoin maintains a lead and benefits of a first-mover advantage, its share in total cryptocurrency valuation has declined significantly indicating prompt adoption by users of new cryptocurrencies.

Currency competition, as is well known, can be considered an alternative rule to conventional monetary policy frameworks (Salin, 1984). Currency issuance is not subject to hitting a specific price or monetary target, but fear of market share losses among currency issuers could lead to issuance discipline. In a normative framework, profit-maximising issuers amid decreasing economies of scale induce adoption of prudent issuance behaviour if users switch currency upon perception of over-issuance. Currency competition does not prevent central banks from issuing official currencies but preservation of market share in monetary transactions would depend on relative stability and usage ease net of transaction costs.

[29] On the diminishing importance of monetary aggregates for the formulation of monetary policy, see e.g. Bernanke (2006).
[30] See e.g. Reinhart et al. (2003) on the "fear of floating" under dollarization.
[31] E.g. Gerlis (2018) describes some incipient signs that works of art are sold for bitcoins hinting at aggregate demand and wealth effects from cryptonization.

The organisation of money production as currency competition seems fundamentally controversial though is not uncommon in a historical context. Dollarization poses similar conditions though reduced in scope as it normally means adding one or two foreign currencies only in addition to the existing official domestic currency. Given the number of cryptocurrencies, the complexity of such a system could be overwhelming implying a multitude of exchange rates and as such be simply impractical. At the same time, high concentration in market capitalisation of cryptocurrencies mitigates undue dispersion.

Regulation

The regulation of cryptocurrencies and urgency thereof will naturally depend on the pace of adoption.[32] To date, regulation has been concerned mostly with illicit transactions, consumer protection, market manipulation, capital flight, governance. The case for regulating cryptocurrencies as currency, though not necessarily as legal tender, would be novel but controversial. The possible rapid rise of cryptocurrencies and function as medium of exchange, though highly limited, seems to warrant a currency-based approach. The multitude of cryptocurrencies may require a new regulatory framework to address inter-cryptocurrencies and national currency-cryptocurrencies relations. At the same time, the benefits of cryptocurrencies should not be unduly repressed.

The classification of cryptocurrencies as currencies is naturally contentious. Cryptocurrencies bear few if any of the properties normally associated with money, that is store of value, unit of account and medium of exchange functions. The classification would be in conflict with the general notion that most countries only accept as currency their own official currencies and that a monopoly for money issuance amid the generally assumed public good character of money should exist.[33] However, dollarization offers an important precedent and the fact that many currencies exhibit unsteady properties, e.g. amid high inflation or sharp exchange rate instability, lends support to applying a broader notion of currency. Some monies also may not

[32] No urgency is seen to date, e.g. Draghi (2018) states that "[...] we are not observing a systemically relevant holding of digital currencies by supervised institutions [...]."
[33] The presumption of a natural monopoly for money issuance seem ambiguous. For the arguments in favour of currency monopolies, see e.g. King (1983) and comment by Summers (1983) and Vaubel (1984)

represent legal tender but may still be widely and readily accepted for payments. Currency is generally seen as a social institution where acceptance is reached of what constitutes money by social consensus.[34]

Prevailing classifications of cryptocurrencies differ and remain uncertain complicating regulation.[35] The IMF considers bitcoins to be a non-financial asset:[36] "*Internet based currency, such as bitcoins, is not electronic money because it does not meet the definition of currency, as it is not issued or authorized by a central bank or government, and additionally is not widely accepted as a medium of exchange*." The U.S. Internal Revenue Service (IRS) classifies bitcoin as property for U.S. federal tax purposes and thereby transactions in bitcoins are guided by property transactions; the IRS acknowledges that (United States Internal Revenue Service, 2014): "*in some environments, virtual currency operates like a 'real' currency […] but it does not have legal tender status in any jurisdiction.*" The U.S. Commodity Futures Trading Commission classifies bitcoins as a commodity (United States Commodities Futures Trading Commission, 2017).

The nineteenth century Germany approach to private currencies was based on the fundamental objective of currency integration and issuance harmonisation. It introduced a second among equals regulatory framework based on quantitative ceilings and qualification criteria. The Privatnotenbanken followed similar rules as the Reichsbank but the Reichsbank maintained important privileges that relegated the Privatnotenbanken to secondary institutions. The common regulatory framework set the boundaries for bank note issuance but not the exact distribution among issuing entities.

A similar approach could be adopted for cryptocurrencies. Cryptocurrencies would have to satisfy certain qualification criteria to be considered under a common regulatory framework.

[34] See e.g. Tobin (2008) on money as a social institution and public good.
[35] Press conference with Taro Aso, deputy prime minister, minister of finance and minister of state for financial services, 5 December 2017 (Japan Financial Services Agency, 2017):
Question: I have a question about bitcoin. In the U.S. the listing of bitcoin futures have been approved, and it has been announced that its trading will begin in Chicago on the 10th. However, Japan Exchange Group CEO Mr. Kiyota is saying that careful consideration needs to be given to listing bitcoin futures on JPX or the Osaka Exchange. I'd like to hear your opinion.
Answer: This all comes back to whether bitcoin is money or a financial product?
Question: It's not money, but it's not a financial instrument, apparently.
Answer: That's the thing. Nothing's been decided about that yet, so if the Ministry of Finance has to deal with it, well, are we the Ministry of Economy, Trade and Industry? We're the Ministry of Finance. No one can say whether it's been decided that bitcoin is money, so the Tokyo Stock Exchange needs to think about that first.
[36] IMF (2016), p. 60.

The framework could allocate quotas to cryptocurrencies on the basis of some understanding of adequate limits to currency substitution. To preserve flexibility quota limits could be soft to allow temporary deviations against payment of a tax. A quota based system offers transparency while ensuring that desired limits to monetary expansion are preserved. The exchange rate among cryptocurrencies and against the national currency could be determined freely. Quota-based issuance limits would still allow important changes in valuations. The possibility to trade quotas may represent an important addition. The quota-based approach rests on some assumption that an outer boundary to avoid an extraordinary expansion of cryptocurrencies is warranted.

The importance of competition to attain monetary stability appears consistent with the principles underlying many cryptocurrencies.[37] Rapid entry and proliferation of cryptocurrencies and in many instances substitutability will likely provoke significant competition amongst cryptocurrencies to attain and preserve market share in monetary transactions. Competition will also emerge with regard to national currencies amid currency substitution. The role of competition to guard against undue cryptocurrency issuance would naturally be constrained by any quota-based allocation net of possible quota trading.

Conclusions

The adoption rate of cryptocurrencies will naturally determine the urgency of any regulation. The potential impact of cryptocurrencies on aggregate demand, balance sheet mismatches and conventional channels for the transmission of monetary policy justify some regulation to guide orderly entry, exit and expansion of cryptocurrencies. At the same time, cryptocurrencies represent important monetary innovations that may increase efficiency and choice in monetary transactions.[38] If cryptocurrencies are considered a new form of money, similar to the nineteen century, some institutional innovation and adoption should be

[37] Currency competition was also important in the U.S. under the free banking episode from 1839 through adoption of the National Currency Act of 1863, see e.g. King (1983). On currency competition, see e.g. Hayek (1990) and for a summary about international currency competition Mandeng (2010).
[38] See footnote 9.

forthcoming. While there is wariness that regulation may offer undue validation of cryptocurrencies' importance, a pro-active and constructive engagement should benefit all.

The adoption rate of cryptocurrencies will likely differ, as in dollarization, depending on countries' own monetary history. While some countries may have benefited from sustained currency stability, most countries have not; e.g. during the Tequila crisis of 1994-95, the Mexican peso depreciated 40 percent against the dollar between 19 and 27 December 1994. The idea expressed by some that there should be no alternative to government money may therefore seem to many as arbitrary.[39] The interests for regulating cryptocurrencies may consequently differ significantly between countries and between governments and citizens and the tone of regulation set by some may not be representative of attitudes towards money in other countries. Hence, the risk of home bias may be highly problematic for identifying a common regulatory approach.

Nineteenth century Germany embraced monetary innovation. It saw in the co-existence of private and official monies benefits for the operation of its monetary system. The regulation therefore reflected integration rather than exclusion while imposing common safeguards to preserve monetary stability.

The regulatory approach presented in this paper envisages a common framework for cryptocurrencies based on the fundamental assumption that some quantitative ceiling is needed to ensure financial resilience can be preserved and that any regulation needs to address inter-cryptocurrencies and national currency-cryptocurrency relations. The nineteenth century German bank note regulation was based on the principle of common regulation, quantitative ceilings, redistribution of bank note shares and flexibility. It relied on competition to exercise a stabilising influence on the system. The combination of rules-based and incentives-based elements and integration of institutions under a common though tiered framework seems highly adaptable to the proliferation of cryptocurrencies today.

[39] See e.g. Carstens (2018) and Mersch (2018).

The dollarization literature has usually seen the incidence of dollarization as important if the share of dollar-denominated liabilities in a country's total liabilities exceeds 10 percent. At the current number of cryptocurrencies, a 10 percent share of broad money of the Euro Area, Japan and the U.S. combined would be reached at an average price of US$0.4 per coin in circulation or US$0.004 percent of the price of 1 bitcoin. Such valuation level seems possible if not in the short term but over the medium term. A common regulatory framework for cryptocurrencies as currency would then be highly desirable.

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