



On money, debt, trust and central banking¹

Keynote speech by Claudio Borio

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What institutions build, they can destroy.
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Few issues in economics have generated such heated debates as the nature of money and its role in the economy. What is money? How is it related to debt? How does it influence economic activity? The recent mainstream economic literature is an unfortunate exception. Bar a few who have sailed into these waters, money has been allowed to sink by the macroeconomics profession. And with little or no regrets.

Today, I would like to raise it from the seabed. To do so, I will look to an older intellectual tradition in which I grew up. I would thus like to revisit the basics of monetary economics and draw lessons that concern the relationship between money, debt, trust and central banking.

I approach the topic with some trepidation. So much has been written by scholars much better equipped than me, including a number in the audience. Still, I hope to shed some new light on some old questions. A number of the points I will be making are well known and generally accepted; others more speculative and controversial.

My focus will be the on the monetary system, defined technically as money plus the transfer mechanisms to execute payments.² Logically, it makes little sense to talk about one without the other. But payments have too often been taken for granted in the academic literature, old and new. In the process, we have lost some valuable insights.

Let me highlight three takeaways.

First, two properties underpin a well functioning monetary system. One, rather technical, is the coincidence of the means of payment with the unit of account. The other, more intangible and fundamental, is trust. In fact, a precondition for the system to work at all is trust that the object functioning as money will be generally accepted and that payments will be executed. But a well functioning system also requires trust that it will deliver price and financial stability. Ensuring trust is difficult and calls for strong institutions – an appropriate “institutional technology”. Central banks have evolved to become key pillars of the whole edifice alongside banking regulatory and supervisory authorities – often central banks themselves.

¹ I would like to thank, in particular, Piti Disyatat for extensive and invaluable discussions. My thanks also to Morten Bech, Ulrich Bindseil, Stijn Claessens, Egemen Eren, Marc Flandreau, Charles Goodhart, Mikael Juselius, David Laidler, Marco Lombardi, Robert McCauley, Benoît Mojon, Thomas Ryland, Hyun Song Shin, Nathan Sussman and Stefano Ugolini for very helpful comments and suggestions. I would like to dedicate this essay to Curzio Giannini, scholar, colleague and friend: we had started working on a project addressing these issues many years ago, but had to abandon it owing to tragic circumstances. The views expressed are my own and do not necessarily reflect those of the BIS.

² Giannini (2011) rightly takes this as the starting point of his inquiry into central banking.

Second, a key concept for understanding how the monetary system works is the “elasticity of credit”,³ ie the extent to which the system allows credit to expand. A high elasticity is essential for the system’s day-to-day operation, but too high an elasticity (“excess elasticity”) can cause serious economic damage in the longer run. In today’s economy, generally blessed with price stability, the most likely cause of damage is financial instability. This form of instability can generate serious macroeconomic costs even well short of banking crises. And when banking crises take place, it threatens to undermine the payments system itself.

Third, price and financial stability are inexorably linked. As concepts, they are joined at the hip: both embody the trust that sustains the monetary system. But the underlying processes differ, so that there can be material tensions in the short run. These tensions can disappear in the longer run provided the appropriate monetary and financial arrangements are in place. Resolving these tensions is far from trivial and is work in progress.

Along the way, I will touch on a number of sub-themes. Examples are: the risk of overestimating the difference between money and debt (or credit); the unviability of cryptocurrencies as money; and whether it is appropriate to think of the price level as the inverse of the price of money, to make a sharp distinction between relative and absolute price changes, and to regard money (or monetary policy) as neutral in the long run.

The structure of the speech is as follows. I will first discuss the elements of a well functioning monetary system. I will then turn to some of the key mechanisms to ensure trust in its day-to-day operation. Finally, I will explore ways to secure trust in price and financial stability in the longer run.

I – Elements of a well functioning monetary system

At its most essential, a monetary system technically consists of (i) a unit of account, (ii) a means of payment (“settlement medium”) and (iii) mechanisms to transfer the means of payment and settle transactions (execute payments). The unit of account measures the value of all goods, services and financial assets. It is a purely abstract, immutable unit of measurement – like, say, the unit of distance. The means of payment is a generally accepted instrument that settles (extinguishes) obligations.⁴

Two points about this definition.

For one, there is no explicit reference to the third well known function of money, ie being a store of value. This is not because it is unimportant. Far from it, the function is essential: stability in the value of money will play a key role in what follows. The point is simply that it is not a *distinguishing* feature of

³ This notion of “elasticity” belongs to the family of those used to characterise the potential of monetary arrangements to generate endogenous increases in the supply of money or credit, going as far back as authors such as Wicksell (1898) and Hayek (1933). It has affinities also with the earlier Bullionist debate in England and the birth of the Real Bills doctrine (Laidler (1991)). As used here, it is slightly narrower than the notion used in previous work, defined as the degree to which the financial system is prone to generating financial imbalances (Borio and Lowe (2002)). The main difference is that here, given the focus on the *monetary* system, rather than the broader *financial* system, I emphasise the elasticity of *bank* credit, which is directly related to the creation of means of payment (see below). Of course, *all* forms of credit, monetary or not, are relevant for a financial system’s elasticity.

⁴ Strictly speaking, there is a difference between the means of payment and the means of exchange, defined as what is widely accepted in transactions. Think, for instance, of bills of exchange. And not all means of payment are, or historically have been, widely accepted; Polanyi (1957) develops this point. In what follows, the term “means of payment” will be used interchangeably with “means of exchange”. Being a means of payment sets money apart from other instruments.



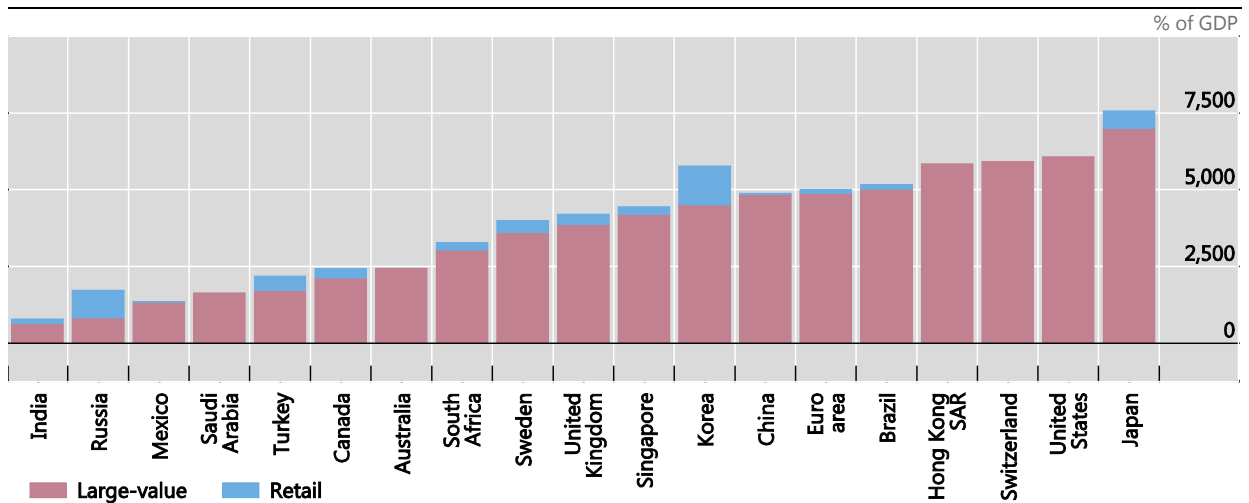
money.⁵ Any asset, financial and real, is a store of value. Moreover, and more importantly, a viable means of payment *must* also be a store of value. So, there is no need to refer to this function explicitly.

In addition, compared with the traditional focus on money as an object, the definition crucially extends the analysis to the payment mechanisms. In the literature, there has been a tendency to abstract from them and assume they operate smoothly in the background. I believe this is one reason why money is often said to be a convention (eg Lewis (1969)), much like choosing which hand to shake hands with: why do people coordinate on a particular “object” as money? But money is much more than a convention; it is a social institution (eg Giannini (2011)). It is far from self-sustaining. Society needs an institutional infrastructure to ensure that money is widely accepted, transactions take place, contracts are fulfilled and, above all, agents can count on that happening. Even the most primitive communities require generally agreed, if informal, norms and forms of enforcement. Putting in place the corresponding supporting institutions – or institutional technology – in a way that ensures trust is a major challenge. And the challenge naturally becomes more complex as societies develop.⁶ I will return to this point in due course.

The sheer volume of payments in our modern economies highlights their importance. The volume exceeds GDP many times over, *thousands* of times in fact (Graph 1). To a large extent, this is because most of the payments correspond to financial transactions and their volume dwarfs “real” economic activity. Hence also the common, largely efficiency-driven, distinction between wholesale payment systems, designed to deal with large-sized transactions, and retail ones, that deal with small-sized ones.

The value of payments dwarfs GDP¹

Graph 1



¹ The volume of payments in a country’s large value payment system reflects many factors, including the structure of the banking system, access policies or other requirements. The figures in the graph are indicative of the orders of magnitude of a country’s payments, but not lend themselves to straightforward cross-country comparisons.

Source: CPMI (2017).

⁵ This view harks back to the classics, such as Jevons (1875); see also Laidler (1991) for a review. By contrast, the more modern tradition has placed greater emphasis on the store-of-value function. An archetypal example is Samuelson’s (1958) famous model of money in an overlapping-generations framework.

⁶ On the importance of institutions and how they evolve with economic development, see North (1990).



At the very least, a well functioning monetary system has two properties

First, technically, it will exploit the benefits of unifying the means of payment with the unit of account. The main benefit of a means of payment is that it allows any economy to function at all. In a decentralised exchange system, it underpins the quid-pro-quo process of exchange. And more specifically, it is a highly efficient means of “erasing” any residual relationship between transacting parties: they can thus get on with their business without concerns about monitoring and managing what would be a long chain of counterparties (and counterparties of counterparties).⁷ The benefit of a unit of account is that it provides the simplest and most effective way of measuring relative prices, as it greatly reduces the number of relative prices that need to be known (eg Brunner and Meltzer (1971)).⁸ Unifying the two signifies that, by convention, the price of money relative to the unit of account is fixed at 1. The benefit is that this greatly reduces the uncertainty about the amount of resources the means of payment can “buy”. The residual uncertainty is that which surrounds changes in the prices of goods and services relative to the means of payment (ie the value of money).

Historically, we have seen cases where the unit of account and the means of payment have not coincided. But arguably this has generally reflected limitations of the monetary system. Think, for instance, of the coexistence of a multiplicity of settlement media in underdeveloped economic systems (eg in some ancient civilisations or in the early Middle Ages) or in fragmented monetary areas (eg in the Middle Ages and the Renaissance, notably in Italian city-states (eg Einaudi (1936), Cipolla (1956) and Eichengreen and Sussman (2000)). This strikes me as inefficient. Not surprisingly, it has been superseded over time. And in single currency systems, the two functions tend to become decoupled spontaneously only at very high inflation rates – a clear symptom of a dysfunctional monetary system (Heymann and Leijonhufvud (1985)).⁹ To me, all this indicates that the coincidence of the two functions is highly desirable. Thus, I don’t agree with proposals to split the two.¹⁰

Second, and more fundamentally, a well functioning monetary system will enjoy the solid trust of participants. To be sure, trust that people will accept the corresponding instrument as a means of payment and that the transfer will be effective are absolutely *necessary* for the system to function at all. But a well functioning system requires more. It requires trust that the value of the instrument will be stable in terms of goods and services, as fluctuations generate uncertainty, and trust that its value will not change strongly in one direction or the other. What I have in mind here is not just inflation, which erodes the value of the means of payment, or deflation, which increases the value of the debts generated in the monetary system, but also outright defaults, notably on bank deposits (inside money). The role of trust is especially evident

⁷ In other words, they do not need to rely on a ledger recording the whole history of transactions – the system’s “memory”. On money as memory, see Kocherlakota (1996). The concept is equivalent to the legal one of “finality”. On the idea of such a ledger keeping track of credits, see also Leijonhufvud (1981). The relationship between money and debt is discussed further below.

⁸ See also Doepke and Schneider (2017), who present a theory of why a unit of account becomes dominant in an economy in which non-contingent (debt-like) contracts exist and agents participate in credit chains. By adopting such a unit of account, agents can lower their exposure to relative price risk and limit default (effectively, a way of hedging).

⁹ Heymann and Leijonhufvud rightly stress the damage very high inflation inflicts on the economic and social fabric. This is consistent with what none other than Keynes (1919) famously said, attributing the statement approvingly to Lenin: “there is no subtler, no surer means of overturning the existing basis of society than to debauch the currency” (page 220).

¹⁰ See, in particular, Black (1970) and Fama (1980); see White (1984a) for a critique. Likewise, historically there have been several indexation proposals, effectively decoupling the means of payment from the unit of account (eg Jevons (1863), Marshall (1887) and Fisher (1911); see also Laidler (1991)). The fact that they did not come to be and that indexation of contracts has had such a hard time achieving traction is arguably indicative of the difficulties in implementing such a decoupling successfully.



when the means of payment is irredeemable (“fiat money”), so that the issuer simply commits to “settle” the IOUs by issuing an equivalent amount of them.¹¹

Naturally, ensuring trust is a multifaceted challenge. In addition to the legal and operational infrastructure, it calls for managing risks properly at all the stages of the monetary process. In what follows, to keep things manageable, I will focus only on those trust-building mechanisms closest to the monetary aspects of the challenge.

II – A well functioning monetary system: day-to-day operation

Two aspects of a well functioning monetary system in its day-to-day operation are worth highlighting. One is the need for an elastic supply of the means of payment; the other is the need for an elastic supply of bank money more generally. All this, in turn, points to the risk of overestimating the distinction between credit (debt) and money.

The central banks’ elastic supply of the means of payment is essential to ensure that (i) transactions are settled in the interbank market and (ii) the interest rate is controlled. The interbank market is a critical component of our two-tier monetary system, where bank customer transactions are settled on the banks’ books and then banks, in turn, finally settle on the central bank’s books. To smooth out interbank settlement, the provision of central bank credit is key. The need for an elastic supply to settle transactions is most visible in the huge amounts of intraday credit central banks supply to support real-time gross settlement systems – a key way of managing risks in those systems (Borio (1995)). But it also underpins the way central banks set interest rates – a process which is often misunderstood. It is worth considering this process in more detail, since it also sheds light on what is the ultimate anchor for credit creation.

Let me just sketch the mechanisms involved with the help of Graph 2; you can find a more articulated explanation in previous work (Borio (1997), Borio and Disyatat (2010)). The first point to recall is that our monetary system is a two-tier one: bank clients settle among themselves with bank money (deposits); in turn, banks settle among themselves in the interbank market with central bank money (bank reserves). Thus, Graph 2 illustrates what happens in that market, where the short-term (overnight) interest rate is determined.

There are two polar cases. In the first, the central bank satiates the market with bank excess reserves – the means of payment (scheme 2, right-hand panel). Then the demand for the means of payment becomes infinitely elastic at the rate paid on them, ie the rate on the central bank deposit facility: supply becomes irrelevant. In the second, the central bank meets exactly the demand for means of payment rather than satiating the market (scheme 1, left-hand panel). The key point here is that because the uncertainty regarding interbank settlement is minuscule and banks can count on the central bank to allow the system to settle by providing the necessary funds, the demand for bank reserves is, in effect, vertical at some frictional level, ie unresponsive to the interest rate. The central bank then simply sets the desired interest rate by signalling where it would like it to be. And it can do so because it is a monopoly supplier of the means of payment: it can credibly commit to provide funds as needed to clear the market. To simplify, scheme 2 is how the central banks that have engaged in quantitative easing are setting interest rates today, although some central banks were operating the scheme even before; scheme 1 is how most

¹¹ To be sure, if trust was perfect, there would be no need for settlement. This might conceivably be the case in the smallest and most tightly knit of communities: members might have the assurance that all obligations will be honoured. But in even slightly more complex societies, generating the necessary trust requires a more elaborate institutional technology.

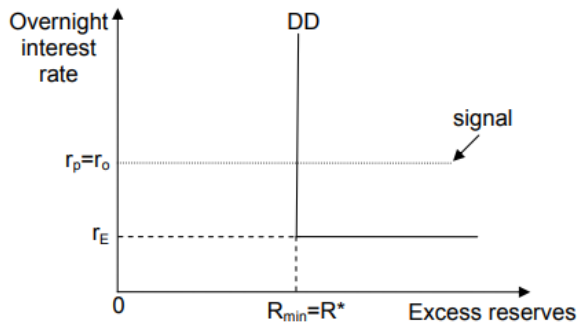


other central banks are doing it.¹² What the example makes clear is that there is no such thing as a well behaved demand for bank reserves, which falls gradually as the interest rate increases, ie which is downward-sloping.

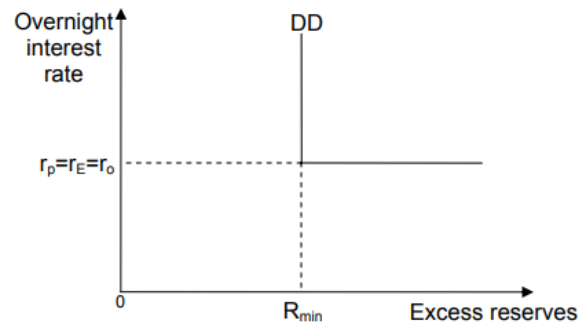
Implementing monetary policy: two schemes¹

Graph 2

Scheme 1

Equilibrium 1 $r_p = r_o > r_E$; $R^* = R_{min}$

Scheme 2

Equilibrium 2 $r_p = r_o = r_E$; $R^* > R_{min}$

¹ This figure describes the situation when reserve requirements, , have no averaging provisions. Consequently, the amount of reserves banks need to hold overnight, is determined entirely by banks' settlement needs, including any precautionary element. This demand depends on the wholesale settlement arrangements in place, and is in effect independent of the interest rate. Here, it is simply assumed to be zero, so that the equilibrium amount of reserves, R^* equals R_{min} . Under scheme 1, the existence of an opportunity cost of reserve holdings – the difference between the overnight rate, r_o , and the rate on the deposit facility, r_E or $(r_o - r_E)$ – implies that if excess reserves exceeded R_{min} , banks would attempt to lend out this surplus. In so doing, they would drive the overnight rate down to r_E . At this point, the opportunity cost would be eliminated. To avoid this, the central bank sets excess reserves at zero through its liquidity management operations and signals the policy rate it wishes to see. The overnight rate gravitates to that rate in line with the signal. This is because, should the central bank wish to do so, it could force banks to borrow at that rate so as to obtain the necessary funds to meet the reserve requirement needs by keeping banks short through its liquidity operations. Under scheme 2, there is no opportunity cost of holding excess reserves, as the central bank supplies reserves in excess of the minimum requirement, again through its liquidity management (recall that, for simplicity, minimum settlement balances are assumed to be zero). As a result, the overnight rate falls to the deposit facility rate, which in this case is the policy rate.

Source: Borio and Disyatat (2010).

But wait, one might argue: what about cash? Cash, too, is provided elastically, ie is purely demand-determined. In fact, the non-bank public would bring any excess to the banks; and the banks, in turn, would exchange any excess holdings for bank reserves. The central bank would have to oblige: this is what convertibility is all about.¹³

This analysis is something any central banker responsible for implementation would find familiar. But it has not filtered through sufficiently to academia. When I first discovered it the mid-1990s, much to

¹² The subtleties include reserve requirements with averaging provisions, which result in the demand for bank reserves becoming vertical only at the end of the averaging (maintenance) period, and the possible existence of a corridor around the target rate. See Borio (1997) for a detailed analysis; and Bindseil (2004) for a more mathematical treatment assuming optimal bank behaviour under some assumptions. The analysis also abstracts from a variety of possible market and regulatory frictions that would simply obscure the basic mechanisms at work (eg market segmentation). Woodford (2003) reaches similar conclusions, but neglects the essential role of the payment system and the means of payment. More generally, while there may of course be very small day-to-day variations in the overnight rate linked to the amount of excess balances, the key point is that any excess elasticity cannot be exploited to steer the overnight rate towards the policy rate precisely.

¹³ What would happen if, for whatever reason, cash was rationed? No doubt this would simply disrupt payments and force participants to shift to alternative settlement media with no benefit whatsoever.

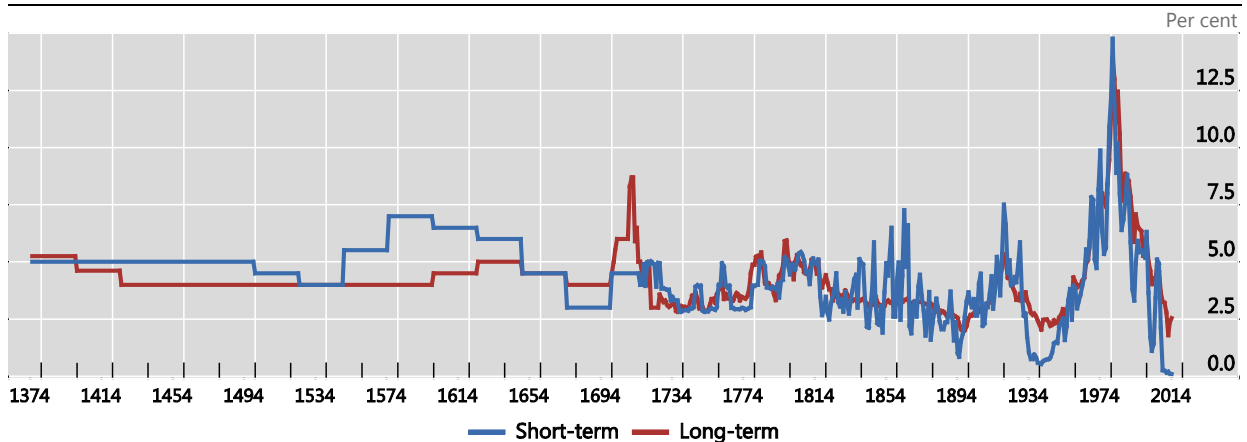


my disappointment I had to throw out of the window everything I had learnt in textbooks and at university on the topic.

Hence an implication that will play a bigger role later on. The monetary base – such a common concept in the literature – plays no significant causal role in the determination of the money supply (bank deposits with the non-bank public plus cash) or bank lending. It is not surprising that, as the experience in Japan has shown, large increases in bank reserves have no stable relationship with the stock of money (eg Borio and Disyatat (2010)). As has become increasingly recognised, the money multiplier – the ratio of money to the monetary base – is not a useful concept.¹⁴ In fact, in systems without reserve requirements the multiplier is, practically, infinite; and nothing calamitous has ever happened. Increasing bank reserves (the means of payment) beyond what markets want simply pushes interest rates to the deposit facility or, in its absence, to zero. Increasing the monetary base is like pushing on a string and could result in loss of control over interest rates (scheme 2). Bank lending reflects banks’ management of the risk-return trade-off they face, and bank transaction deposits the non-bank sector’s portfolio preferences. The ultimate anchor of the monetary system is not the monetary base but the interest rate the central bank sets. Moreover, there is clearly an element of convention in how interest rates are set nowadays, ie in how one chooses the point along a de facto vertical demand curve for reserves. This raises questions about how interest rates may have been set before the creation of central banks. As one might infer from the long-run stability of the short-term nominal interest, convention may well have played a bigger role than typically thought (Graph 3). Data limitations aside, this issue deserves further study.¹⁵

Rather stable level of “risk-free” interest rates historically except more recently¹

Graph 3



¹ The series is constructed by choosing the lowest interest rates available for each historical phase from various sources. See the original article for details

Source: Haldane (2015).

¹⁴ On this point and some of its broader implications not discussed here, see also eg Goodhart (2010), Disyatat (2008) and, for a reinterpretation of the meaning and effectiveness of “helicopter money”, Borio et al (2016). The notion that exogenous increases in the monetary base, under the control of the central bank, can generate any increase in the money stock the central bank desires, offsetting possible changes in the demand for money and bank reserves, is the central tenet of the famous Friedman and Schwartz (1963) interpretation of the Great Depression. See also Cagan (1965).

¹⁵ For instance, short-term rates in medieval times were “hidden” in exchange rates (eg 90-day bills of exchange); and there is evidence that those fluctuated quite a bit. Nor is it straightforward to produce a representative series for long-term rates.



All this points to the critical role central banks play in ensuring the smooth functioning of the payment system, including as overseer (Borio (1995)). Indeed, historically the precursors of central banks were arguably the city-state chartered public banks established mostly in 1400–1600.¹⁶ They were set up to improve the efficiency of payment systems by providing a high-quality means of payment and centralising a number of clearing and settlement operations. Thus, they came into being well before central banks started acting as lenders of last resort under stress – commonly regarded as the beginning of the central banking era.¹⁷

Now, a high elasticity in the supply of the means of payment does not just apply to bank reserves, it is also essential for bank money. This money is created as a counterpart to the loans banks extend or assets they buy. Without it, the economy could not run smoothly. More generally, credit creation is all around us: some we see, some we don't (Borio (1995)). For instance, explicit credit extension is often needed to ensure that two legs of a transaction are executed at the same time so as to reduce counterparty risks (delivery versus payment in the case of securities, and payment versus payment in that of foreign exchange transactions): the party in question may need to borrow to bridge the gap. And implicit credit creation takes place when the two legs are not synchronised. Today's economies are "credit-hungry".

In fact, the role of credit in monetary systems is commonly underestimated. Conceptually, exchanging money for a good or service is not the only way of solving the problem of the double coincidence of wants and overcoming barter. An equally, if not more convenient, option is to defer payment (extend credit) and then settle when a mutually agreeable good or service is available. In primitive systems or ancient civilisations as well as during the middle ages, this was quite common.¹⁸ For instance, in the feudal system a worker would receive a good from his landlord and pay later in kind, through his labour. It is easier to find such examples than cases of true barter.

On reflection, the distinction between money and debt is often overplayed.¹⁹ True, one difference is that money extinguishes obligations, as the ultimate settlement medium.²⁰ But netting debt contracts is indeed a widespread form of settling transactions. Needless to say, bank deposits constitute by far the bulk of all means of payment and are a form of debt. And even outside money, which is irredeemable, can be regarded as debt. This is so not just because the very instrument that counts as money is a liability (debt or "I Owe You" (IOU)) of the issuing agent. But also because, while not subject to legal default, like any form of money it is vulnerable to confidence crises – a flight to another currency –

¹⁶ Such banks were set up in places such as Barcelona, Genoa, Venice and Hamburg. See Van Dillen (1964), Roberds and Velde (2014) and Bindseil (2018). For the link with central banking, see Ugolini (2017) and Bindseil (2018).

¹⁷ That said, some public banks had already played this role before, notably the Bank of Hamburg in 1673; see Sieveking (1933), Bindseil (2018) and Schnabel and Shin (2018). Goodhart (1988) is a leading exponent of the view that central banks proper developed only later in the 19th century when the institutions started to act as lenders of last resort.

¹⁸ See Polanyi (1957), among many. Such systems preceded by millennia the invention of coinage. More generally, it has been common for various modes of payment to coexist, eg Braudel (1977) and Postan (1973). For example, Braudel (1977) notes that in France as late as the 19th century barter was common in the countryside, silver was more generally used at national level, and arrangements based on bills of exchange prevailed in international trade, with balances that could not be clearer settled in gold or silver.

¹⁹ See Mitchell-Innes (1914), who takes this argument to its logical extreme. Of course, it goes without saying that not all debt is money: a broad set of debt claims do not serve as a means of payment.

²⁰ A pivotal debt instrument in the evolution of monetary systems in general, and payments in particular, is the bill of exchange, from the days of the medieval trade fairs in the 12th century. Without necessarily reaching the status of settlement medium, the instrument has played a key role as a medium of exchange, not least in trade financing. See De Roover (1948, 1953) for a detailed analysis and history, Kindleberger (1984) for a general treatment, and Santarosa (2015) for the importance of the introduction of joint liability. Goodhart (1988) elaborates on the use of bills of exchange as payment instruments in the early part of the 19th century in England.



when the sovereign's creditworthiness is in doubt. For all intents and purposes, this is equivalent to a deposit run and a default. It undermines the role of money as a unit of account and even as a means of payment – think, for instance, of dollarisation.

Put differently, we can think of money as an especially trustworthy type of debt.²¹ In the case of bank deposits, trust is supported by central bank liquidity, including as lender of last resort, by the regulatory and supervisory framework and varieties of deposit insurance; in that of central bank reserves and cash, by the sovereign's power to tax; and in both cases, by legal arrangements, way beyond legal tender laws, and enshrined in market practice.

At an even deeper level, money is debt in the form of an implicit contract between the individual and society. The individual provides something of value in return for a token he/she trusts to be able to use in the future to obtain something else of value. He/she has a credit vis-à-vis everyone and no one in particular (society owes a debt to him/her).²²

All this also suggests that the role of the state is critical. The state issues laws and is ultimately responsible for formalising society's implicit contract. All well functioning currencies have ultimately been underpinned by a state, with the currency area often coinciding with a given political unit's perimeter.²³ Moreover, it is surely not by chance that dominant international currencies have represented an extension of powerful states – economically, financially and politically – from Byzantium's *solidus* to today's US dollar.²⁴ That said, it is no secret that the relationship between the sovereign and the currency has been a chequered one, to say the least. The sovereign has often yielded to the temptation to abuse its power, undermining the monetary system and endangering both price and financial stability.²⁵ This simply indicates that it is essential to put in place adequate safeguards. I will return to this point.

²¹ This point is related to Gorton's and Holmström's notion of debt as an information-insensitive asset, ie an asset whose (nominal) value is relatively insensitive to information about the condition of the issuer (see eg Holmström (2015) and references therein). One could think of good money as an asset whose nominal value is highly (ideally perfectly) insensitive.

²² This echoes very much Simmel's insight, when he describes money as "a claim on society" (Simmel (1978)). That said, the precise meaning of his expression is ambiguous, with some seeing it just as a statement of the Chartalist position. On the debate, see Dodd (2016). Regardless of the specific interpretation, not surprisingly Simmel, like Wicksell (1898) in his pure credit economy, foresaw the possibility of pure fiat money.

²³ There is a long-standing debate between those who see money as emerging spontaneously as a market institution and those who see it as deriving its strength from the state. Prominent members of the first group (referred to as "the catallactic school") include Jevons (1875), Menger (1892), von Mises (1912) and, much more recently, Alchian (1977) and Kiyotaki and Wright (1989). Members of the second (referred to as "the Chartalist school") include Knapp (1905), Grierson (1977), Einzig (1949), Polanyi (1957) and Melitz (1974). Ellis (1937) and Goodhart (1998) provide useful classifications and summaries of the debate.

²⁴ Examples abound, including the Muslim dinar, the Florentine florin, the Venetian ducat and, later on, the pound sterling. For a discussion of the older examples, see Cipolla (1956).

²⁵ Debasement to raise revenue has been quite common in history – see Eichengreen and Sussman (2000), Sussman (1993) and Bordo (1986); and, for the experience of the German city-states in the 1600s, with an emphasis on competition, Schnabel and Shin (2018). That said, transparent debasement could also be used as a sophisticated way of carrying out monetary policy; see Cipolla (2013) for the experience in Florence. The public banks also played a role in financing the sovereign – a role that was especially prominent in Genoa (eg Fratianni and Spinelli (2006)). Likewise, sovereign defaults have been at the origin of many banking crises throughout history, notably in 1343–46 the famous one involving the Bardi and Peruzzi, two leading Florentine merchant and fractional deposit banks, which had lent to the English crown as well as to the city-state government (eg Cipolla (2013)). Historically, sovereign defaults often caused banking crises: there were several between 1250 and 1600 (Lopez (1979), Blomquist (1979), English (1988), De Roover (1963), Doucet (1933)). Later, particularly in the 20th century, it became more common for banking crises to cause sovereign ones, presumably owing in part to the broadening of safety nets. On a chronology of sovereign defaults, see Reinhart et al (2003); on the link with banking crises, see Reinhart and Rogoff (2009) and Laeven and Valencia (2012). On the broader ambiguous relationship between the state and markets, both supportive and conflictual, see North (1990).

A new and controversial payment scheme – cryptocurrencies – illustrates some of the difficulties in generating trust through a fully decentralised system that does not piggy-back on existing institutional arrangements. This is so quite apart from the issues concerning scalability, finality and incentives to verify discussed in detail in this year’s BIS Annual Economic Report (BIS (2018)).²⁶ The above analysis points to another problem that can undermine trust, as also mentioned in the Report: the lack of elastic supply. Hence the cryptocurrencies’ extreme price volatility: changes in demand are fully reflected in the price. The volatility undermines the cryptocurrency’s role as a unit of account and as a means of payment. Not surprisingly, prices are still quoted and sticky in terms of national currencies.

The problem cannot easily be solved. A fully unbacked currency in elastic supply will not succeed in gaining the necessary trust. Alternatively, seeking to tie it to the domestic currency would require some agent to arbitrage in possibly unlimited quantities between the two, just as when central banks seek to keep exchange rates stable. And simply backing it with a sovereign asset or means of payment on a demand-determined basis would not do either. Not only would it defeat the purpose of having a cryptocurrency in the first place, as it would explicitly piggy-back on sovereign money. As in the case of any mutual fund unbacked by a supply of liquidity and a lender of last resort, it would also be vulnerable to runs (breaking the buck) – the equivalent of having to break the promise of convertibility. Moreover, in all probability it would not be profitable without taking on significant risk to pick up yield, which would increase the probability of such a run.

III – A well functioning monetary system: the longer run

Having discussed the issues that arise concerning the need to generate trust in the day-to-day operation of the monetary system, it is now time to turn to those that arise in the longer run in the context of delivering price and financial stability. Given the time available, as I have already covered these themes more extensively in the past, in particular those concerning financial stability, I will have to be brief and just sketch the main arguments.

The previous analysis suggests that the concepts of price and financial stability are joined at the hip. They are simply two ways of ensuring trust in the monetary system. Inflation, deflation and price volatility induce instability in the value of money – and its close cousin, debt – in terms of goods and services, undermining its means-of-payment (and store-of-value). Financial instability effectively undermines it through the threat and materialisation of default, which can bring the payments system to a halt when bank deposits are involved. Price and financial instability amount to broken promises.

It is no coincidence that securing both price and financial stability have been two core central bank functions. True, over time their interpretation has evolved. During the gold standard, for instance, the focus was not on price stability as such, but on maintaining convertibility and addressing banking stress through the lender of last resort function.²⁷ The objective of managing the economy, with a varying

²⁶ The reference here is to open (“permissionless”) schemes; permissioned ones do not raise the same issues. Distributed ledger technology (DLT), on which cryptocurrencies are based, has a broader set of potentially useful applications. On the viability of cryptocurrencies, see also Carstens (2018), Shin (2018) and BIS (2018).

²⁷ During this phase, price and financial instability were more transparently linked, through the single convertibility constraint. True, during this phase prices were generally stable over long horizons, even as episodes of financial instability (banking distress) were common. But it was the convertibility constraint – internal and external – that acted as a (loose yet) visible anchor for both price and financial stability. The constraint gave way when the price level increased too much or when financial stress emerged. And it set limits to the central bank’s ability to fulfil its lender of last resort tasks, owing to the need to defend the exchange rate peg. This is already clear in Bagehot’s (1873) famous narrative.



focus on price stability, made its first serious appearance in the 1920s, culminating in the arrangements with which we are so familiar today.²⁸ But, interpretations aside, performing both functions relies on the deployment of the central bank's balance sheet, to supply the means of payment, to set interest rates and, in an international context, to manage foreign assets (foreign currency reserves). In this sense, it is hard to separate neatly the two functions; any decoupling would be artificial. This is true even though, over time, more tools have been developed to perform them. A crucial one is the regulatory and supervisory apparatus, which is generally of more recent vintage²⁹ and in which central banks have typically played an important role.

While, *as concepts*, price and financial stability are joined at the hip, the *processes* behind the two differ. Let's look at this issue more closely.

The process underpinning financial instability hinges on how "elastic" the monetary system is over longer horizons, way beyond its day-to-day operation. Inside credit creation is critical. At the heart of the process is the nexus between credit creation, risk-taking and asset prices, which interact in a self-reinforcing fashion generating possibly disruptive financial cycles (eg Borio (2014)).³⁰ The challenge is to ensure that the system is not excessively elastic drawing on two monetary system anchors.³¹ One operates on prices – the interest rate and the central bank's reaction function.³² It is the interest rate that sets the universal price of leverage in a given monetary system. The other operates on quantities: bank regulatory requirements, such as those on capital or liquidity, and the supervisory apparatus that enforces them.³³

These aspects are downplayed in the current vintage of macroeconomic models. One reason is that the models conflate saving and financing (Borio and Disyatat (2011, 2015)). Saving is just a component

²⁸ This, of course, is a stylised description. Price stability was already the focus of the Bullionist controversy during the inconvertibility period in England (1897–1821). Absent price indices at the time – they would only be developed by Jevons (1863) later on – the sterling price of gold played a key role as proxy, alongside the prices of widely traded commodities and the exchange rate. See eg Fetter (1965), Laidler (2000) and Flandreau (2008) for analyses of the debate. Moreover, at the time, Attwood (1816), a member of the Birmingham School, had already advocated the active use of monetary policy under inconvertibility to reach full employment; see Laidler (2000).

²⁹ See Allen et al (1938) for a cross-country description of the origins and development of the frameworks since the 19th century. That said, going further back in history, sometimes tight constraints on and supervision of fractional reserve banks had already been in place. This was the case, for instance, in Venice, despite the existence of unlimited liability. Constraints there were implemented following the failure of several banks, seemingly related to the business cycle rather than lending to the state (eg Mueller (1997), Lane (1937)).

³⁰ See Claessens and Kose (2018) for an extensive review of the literature.

³¹ See Borio and Lowe (2002) for an early attempt to classify monetary regimes in history based on their elasticity. While, for simplicity, the discussion here assumes that the currency area and state borders coincide, see Borio (2016a) for a discussion of how the dominant role of the US dollar affects the (excess) elasticity of the international monetary system.

³² Balance sheet policies, such as large-scale asset purchases, are also primarily intended to influence yields (eg Borio and Disyatat (2010)).

³³ Sometimes portrayed as an alternative to the prudential framework is the idea of narrow banking. The idea is to make inside money perfectly safe (in nominal terms) by requiring issuing institutions to invest all the proceeds in central bank liabilities. (Some versions allow for government securities and others extend coverage to forms of deposits other than means of payment). This view was initially popularised in the early 20th century through the Chicago Plan (Simons (1934), Hart (1935)) and has had many illustrious adherents, sometimes from the opposite end of the intellectual and political spectrum, eg Friedman (1959) and Tobin (1985), just to mention two. There is no way to do justice to this topic here. My sense is that such a scheme, depending on its structure, would reduce the elasticity of credit to some extent. But it would not help much with the problem of financial instability. For instance, if deposits that act as a means of payment were so backed, a competitive financial system should be able to boost the velocity of credit, with maturity/liquidity mismatches and default risk migrating outside narrow banks. This would then call for an extension of the lender of last resort function and of the prudential framework to cover the corresponding institutions. Moreover, at times of stress, runs to narrow banks are likely to be stronger, forcing other credit institutions to liquidate their illiquid portfolios in the absence of central bank liquidity support or sovereign guarantees.



of national income – as it were, just a hole in overall expenditures, without a concrete physical representation. Financing is a cash flow and is needed to fund expenditures. In the mainstream models, *even when banks are present*, they imply endowments or “saving”; they do not create bank deposits and hence purchasing power through the extension of loans or purchase of assets.³⁴ There is no meaningful monetary system, so that any elasticity is seriously curtailed. Financial factors serve mainly to enhance the persistence of “shocks” rather than resulting in endogenous booms and busts.

The process underpinning price instability – as typically and, as I shall argue, somewhat misleadingly conceived – is best captured by the famous dictum: inflation is a monetary phenomenon. The process was described in very simple terms in the old days. An exogenous increase in the money supply would boost inflation. The view that “the price level is the inverse of the price of money” has probably given this purely monetary interpretation of inflation considerable intuitive appeal. Nowadays, the prevailing view is not fundamentally different, except that it is couched in terms of the impact of the interest rate the central bank sets.

This view of the inflation process has gone hand in hand with a stronger proposition: in the long run, money (monetary policy) is neutral, ie it affects only prices and no real variables. Again, in the classical tradition this was couched in terms of the money supply; today, it is in terms of interest rates. Of course, thus defined, neutrality is purely an analytical concept: it refers to the steady state, once prices have adjusted. Views about how long it takes for this process to play itself out in calendar time differ.³⁵ But proponents argue that the length is short enough to be of practical policy relevance.

Now, no one can deny that monetary accommodation is necessary to sustain inflation. In this sense, just as with financial stability, credit creation and hence the expansion of the means of payment are relevant. Nor can anyone deny that, over time, more of a given effect of a change in the stance of monetary policy will be reflected in prices. The empirical evidence is convincing.

But arguably, this literature, old and new, underestimates the role real factors play in the inflation process and overestimates the relevance of neutrality. Let me mention just three analytical reasons and three pieces of empirical evidence, in that order.

First, once we recognise that money is fundamentally endogenous,³⁶ analytical thought experiments that assume an exogenous change and trace its impact are not that helpful, if not meaningless.³⁷ They obscure, rather than illuminate, the mechanisms at work.

³⁴ This is also true of the so-called New Monetarists; see Williamson and Wright (2010). This perspective, proposed as an alternative to the dominant New Keynesian School, treats money as “essential” and as improving on barter. This is a step forward compared with the inclusion of money in utility functions or the imposition of a cash-in-advance constraint, which limits expenditures artificially and trivialises Clower’s (1967) seminal analysis (see also Laidler (2006)). But the approach does not develop the implications of the bank credit-induced generation of purchasing power and its implications for the economy. By contrast, Rungcharoenkitkul et al (2018) have recently developed such a model in an overlapping-generations context, and discussed how it can help generate a financial cycle driven by monetary policy. For an early attempt to introduce the difference between saving and financing in a DSGE model, see Benes et al (2014).

³⁵ One could think of, say, a decade, but sometimes of even much shorter periods; see eg Kocherlakota (2013), who argues that policymakers are simply tracking the natural rate in real time (the natural rate being that rate which equates actual output with potential output and is driven purely by real factors). Indeed, standard dynamic stochastic general equilibrium (DSGE) models prescribe optimal monetary policy as largely following the natural real rate much of the time.

³⁶ This point is one Post-Keynesians have long stressed, although arguably without paying sufficient attention to the factors that constrain the supply of credit noted above; see eg Moore (1988).

³⁷ Such thought experiments are the basis for the appeal of the quantity theory of money. For a classic modern restatement, see Friedman (1956); and for the long history of the hypothesis, see Laidler (1991).



Second, once we recognise that the price of money in terms of the unit of account is unity, it makes little sense to think of the price level as the inverse of the price of money. This conflates the *price* of money with the *value* of money, in real terms: it is simply a succinct way of stating “what money can buy”. But any financial asset fixed in nominal terms³⁸ has the same property.³⁹ As a result, thinking of inflation as a purely monetary phenomenon is less compelling.

Finally, once we recognise that the interest rate is the monetary anchor, it becomes harder to argue that monetary policy is neutral, at least over relevant policy horizons. After all, the interest rate is bound to affect different sectors differently, resulting in different rates of capital accumulation and various forms of hysteresis.⁴⁰ And for much the same reason, it is arguably not that helpful to make a sharp distinction between what affects *relative* prices and the *aggregate* price level. In practice, not least because prices move at different speeds and differ in their flexibility, changes in the overall price level and inflation result from a succession of relative price changes. It stands to reason that, at low inflation rates, the “pure” inflation component, pertaining to a generalised increase in prices, would be smaller, so that the distinction between relative and general price changes becomes rather porous.⁴¹ This, in turn, opens the door for real factors to play a bigger role than normally assumed.⁴² It may not be a coincidence that many central banks have been confounded by the behaviour of inflation for some time.

Turning to the empirical evidence, this comes from recent decades as well as from back in history.

First, a growing body of work has found that the globalisation of the real economy (trade integration) has played an underappreciated role in exerting persistent downward pressure on inflation over the last 20 years or so (eg Borio (2017) and references therein). Granted, the proposition has been challenged. But it is hard to imagine that the entry into the global economy of some 1.6 billion people as a result of the opening-up of former communist countries, China and emerging market economies should have had no material impact. Looking forward, one would expect technological advances to play an even bigger role.

Indeed, seen through this lens, the historical experience seems be consistent with this view. Under the classical gold standard, the central bank did not attempt to manage the economy or inflation explicitly. Moreover, the convertibility constraint acted as an anchor for inflation only over very long horizons. And yet, short-term volatility aside, linked to the composition of the price index, the price level tended to be pretty stable, gradually declining and then rising. One might speculate that inflation was held at bay by qualitatively similar forces to those at work over the past 20 years or so: a globalised real economy and

³⁸ By that I mean an asset that promises a fixed number of units of account to be provided in the settlement medium. This, of course, is quite different from the market value of the claims.

³⁹ I suspect that the tradition of simply putting money into agents’ utility function is partly responsible for this state of affairs. On this, see, in particular, the seminal work of Patinkin (1965). On the “non-essential” role of money in such a general equilibrium setting, see Hahn (1965).

⁴⁰ For a critique of the notion of money (monetary policy) neutrality, see also Borio (2016b) and references therein.

⁴¹ Indeed, studies that have attempted to decompose inflation into the relative price and “pure” inflation components (defined as the shared component of price changes associated with an equi-proportional change in all prices) have found that the pure component is comparatively low. For instance, Reis and Watson (2010) find that, since 1959, the share in the case of US inflation has been some 15%. A sizeable part of this is likely to reflect the high inflation of the 1970s, as more recent estimates find “pure” inflation to be considerably lower for both the United States and the euro area (Miles et al (2017)). Similarly, Apaitan et al (2018) found that pure inflation has accounted for only around 10% of variation in headline inflation in Thailand since 2002. Presumably, the share would be higher for countries with higher average inflation rates and in which the exchange rate played a key role in generating or sustaining inflation.

⁴² Even at low inflation rates, a key monetary influence on inflation is the exchange rate. How durable the impact on *inflation*, as opposed to the price level, is will depend on the presence and strength of second-round effects.

weak pricing power of workers and firms. After all, this was the globalisation wave that preceded the current one.

Second, turning to monetary neutrality, recent research going back to the 1870s has found a pretty robust link between monetary regimes and the *real* interest rate over long horizons. By contrast, the “usual suspects” seen as driving saving and investment – all real variables – do not appear to have played any consistent role (Borio et al (2017)). Given the trends in the data, they work reasonably well from the early 1980s onwards, at least qualitatively, but the relationships do not hold before then. Over the longer sample, no systematic pattern emerges – a sign that the relationships in the more recent period may be spurious.

Finally, studies indicate that financial booms tend to misallocate resources, not least because too many resources go into sectors such as construction, which depresses productivity growth persistently once the boom turns to bust (Borio et al (2016) and references therein). Furthermore, a large amount of empirical work indicates that the financial busts that follow booms may depress output for a long period, if not permanently.⁴³ It is hard to imagine that interest rates are simply innocent bystanders. At least for any policy relevant horizon, if not beyond, these observations suggest that monetary policy neutrality is questionable.

Given that the processes underlying price and financial stability differ, it is not surprising that there may be material tensions between the two objectives, at least in the near term. Indeed, since the early 1980s changes in the monetary system have arguably exacerbated such tensions by increasing the monetary system’s elasticity (eg Borio (2014)). This is so despite the undoubted benefits of these changes for the world economy. On the one hand, absent a sufficiently strong regulatory and supervisory apparatus – one of the two anchors – financial liberalisation, notably for banks, has provided more scope for outsize financial cycles. On the other hand, the establishment of successful monetary policy frameworks focused on near-term inflation control has meant that there was little reason to raise interest rates – the second anchor – since financial booms took hold as long as inflation remained subdued. And in the background, with the globalisation of the real side of the economy putting persistent downward pressure on inflation while at the same time raising growth expectations, there was fertile ground for financial imbalances to take root in.

While the near-term tensions are material, adjustments to the monetary system can help reconcile them over the longer term. Extending policy horizons is essential. Financial imbalances build up only gradually: they pertain to stocks (balance sheets) rather than flows. Typically, they grow over periods that are considerably longer than those associated with business cycles, as traditionally measured (eg Borio (2014)). And financial busts can not only cripple monetary policy but also result in unwelcome disinflationary pressures linked to deep demand weakness.

Strong monetary system anchors are crucial. As argued in more detail elsewhere, putting them in place requires action on two fronts. It calls for effective regulation and supervision. This must be so both in relation to banks (and other financial institutions) assessed on a standalone basis (the so-called “micro-prudential” perspective) and with respect to the system as a whole (the so-called “macroprudential” perspective). And it calls for monetary policy regimes that secure long-term price stability while taking advantage of any room for manoeuvre to respond to financial stability threats.

Still, all this would be to no avail unless the creditworthiness of the state was ensured. This is the ultimate linchpin of the monetary system. As history demonstrates, failing to ensure it would undermine both price and financial stability. Granted, central bank independence is precious and can provide a degree

⁴³ Borio (2014) and (2016a) contain many references to the literature.



of insulation. And a strong and independent regulatory and supervisory apparatus can help too. But, even combined, they cannot suffice in the longer run: the monetary system would not be able to survive. The dam would simply be too fragile to hold back the rising water.⁴⁴

It is sometimes argued that, assuming the sovereign remains creditworthy, the private sector could deploy sufficiently strong anchors; central banks and supervisory authorities could be dispensed with.⁴⁵ By implication, there would be no need for a monetary policy to actively manage the currency. Fully functioning central banks did not spread until the second half of the 19th century, but there were long periods of relative price stability while financial crises were not necessarily more frequent or severe than they are now. Free banking is sometimes recalled with nostalgia.⁴⁶

But I find this conclusion highly doubtful. In particular, the evaluation of free banking is overly rosy. For instance, some scholars have argued that even the Scottish experience is not well understood: according to them, the degree to which banks depended on London and the Bank of England has been underestimated (eg Goodhart (1988)).⁴⁷ More to the point, I cannot imagine that a completely *laissez-faire* solution could meet today's challenges. Our current financial system is several orders of magnitude larger and more complex. Competitive pressures are too fierce. Risk-taking incentives are too great.⁴⁸ The role of the safety net in abating them is overestimated: to my mind, the experience suggests that during financial booms it is not so much the reassuring comfort of safety nets that is at work, but the temptation to believe that "this time is different", to quote that felicitous expression (Reinhart and Rogoff (2009)). Banks, other financial institutions and businesses alike do not face sufficient discipline during financial expansions; rather, they enjoy indiscriminate and misplaced trust.⁴⁹ And should a financial crisis erupt – sooner or later, one will – I simply cannot imagine it could be handled effectively without the central bank as lender of last resort. The private sector is not well placed to perform this function. Whoever ends up performing it has to take too much risk and be implausibly immune to conflicts of interest.⁵⁰

⁴⁴ Combining adequate monetary and regulatory anchors with the sustained creditworthiness of the state is what in BIS (2018) is referred to as a "macro-financial stability framework".

⁴⁵ For variations on this theme, outlining different models, see Selgin and White (1994). Klein (1974) is a very good example.

⁴⁶ Recent proponents of free banking include Hayek (1978), White (1984b), Selgin (1988) and Dowd (1992). Dowd (1992) includes articles describing the experience with free banking around the world.

⁴⁷ Equally, on the other side of the debate, there are questions about how "free" banking was in the United States in 1837–61, given the state regulations in place, not least unit-banking restrictions. See eg Dwyer (1996).

⁴⁸ For similar reasons, I do not think clearing house arrangements like those in the United States would succeed today. On the US experience, see Timberlake (1984) and Gorton (1985).

⁴⁹ Not surprisingly, the evidence about the effectiveness of market discipline is about the *cross-sectional* – differentiation across institutions – rather than about the *time* dimension – the evolution of risk in the system as a whole. This is why financial cycles are so dangerous. For a survey of the cross-sectional evidence concerning US banks, see Flannery (1998). In fact, one could think of the financial cycle as partly reflecting a "trust" cycle. Booms signal too much (ie blind) trust in the monetary system; trust evaporates during a crisis; and trust is rebuilt during the subsequent expansion. This perspective is already articulated in Hicks (1967) with reference to the instability of the credit system.

⁵⁰ The importance of a lender of last resort in a monetary system to help manage stress is obvious. This is consistent with the view that the function emerged to overcome the inadequacy of previous arrangements (eg Goodhart (1988)), with one well known example being the creation of the Federal Reserve in 1913, following the 1907 crisis, and the establishment of a special commission that drew on the European experience. This general view, however, has not gone unchallenged. For instance, Calomiris et al (2016) stress the role of political expediency. Bagehot (1873) himself was of the same opinion concerning the Bank of England; not surprisingly, he was a supporter of free banking. Interestingly, this contrasts with Thornton (1802), the other famous scholar of the lender of last resort function.



None of this means that the current system is perfect – far from it.⁵¹ Nor that what we have today is the final destination. But the present system encapsulates many of the valuable lessons we have learnt during a long journey through history – a sometimes painful journey of trial and error, with setbacks and false starts. Those lessons should not be unlearnt.

Conclusion

Let me conclude. The monetary system is the cornerstone of an economy. Not an outer facade, but its very foundation. The system hinges on trust. It cannot survive without it, just as we cannot survive without the oxygen we breathe. Building trust to ensure the system functions well is a daunting challenge. It requires sound and robust institutions. Lasting price and financial stability are the ultimate prize. The two concepts are inextricably linked, but because the underlying processes differ, in practice price and financial stability have often been more like uncomfortable bedfellows than perfect partners. The history of our monetary system is the history of the quest for that elusive prize. It is a journey with an uncertain destination. It takes time to gain trust, but a mere instant to lose it. The present system has central banks and a regulatory/supervisory apparatus at its core. It is by no means perfect. It can and must be improved.⁵² But cryptocurrencies, with their promise of fully decentralised trust, are not the answer.

Paraphrasing Churchill's famous line about democracy, "the current monetary system is the worst, except for all those that have been tried from time to time".

⁵¹ What Hicks said in 1967 about the inherent instability of the credit system and the corresponding ebb and flow of trust is still fully applicable today: "To find a framework which can be relied on to give support when it is needed, and to impose restraint just when it is needed, is very difficult. I do not think it has ever been perfectly solved. Even in this day we do not really know the answer" (page 159).

⁵² Moreover, while its fundamental features are likely to remain the same, the system will no doubt evolve with technology. Just to mention one example: in the early 20th century, improvements in recording and communication technologies allowed bank deposits to take over from banknotes. Until then, notes had had a broader reach; in fact, for a long time deposit transfers required either the physical presence of the counterparties at the bank or, later, a notary document. Recently, the advent of DLT has not only led to the creation of fully decentralised cryptocurrencies (see above), but has also raised questions about central banks' adoption of the technology, either to improve wholesale interbank clearing and settlements or, indeed, to replace notes and coins. On these issues in general, see eg Bech and Garratt (2017) and BIS (2018); on the issuance of central bank digital currencies, see CPMI (2018).



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