CHAPTER 6

Facing the central bank digital currency trilemma

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How societies organise their monetary systems is a consequence of the interaction of ideas (e.g. should a central bank target price stability?) with technology (e.g. how good are we at issuing money that is hard to counterfeit?). This interaction is dynamic: improvements in technology drive how we think about money and, vice versa, changes in our ideas about money lead to developing new monetary technologies. Also, it is a punctuated interaction: periods of rapid change are intersected among long years of stability. Right now, we are living in one of those times of quick transformation. The internet, advanced cryptography, and fast computational power mean that it is well within the realm of feasibility to completely change our financial system. And these technologies have led the private sector to introduce new ideas in the form of digital currencies, from bitcoin to Facebook's diem.

In response to this technological and private sector pressure, central banks are considering a move from a structure where they operate only with large depository institutions to a system where they interact with the public at large ('central banking for all') through the issuance of central bank digital currencies (CBDCs). Even just 20 years ago, the logistical challenge of a central bank running hundreds of millions of checking accounts and tens of thousands of branches would have made the concept of a central bank open to all risible. Today, it is possible.

But something being possible does not make it desirable from society's perspective. As more central banks rush into considering CBDCs, we must step back and weigh the costs and benefits of this new dispensation. That is why, in our recent work (Schilling et al. 2020, Fernández-Villaverde et al. 2021), we have highlighted how central banks that issue a CBDC will need to confront classic banking issues: achieving maturity transformation while providing liquidity.

One first thread in our work is that central banks, contrary to the perception of many, are also subject to runs, which we call 'spending runs'. If the agents in the economy believe that the price level will increase soon (regardless of whether this belief is based on solid facts), they will run to get rid of their holdings of central bank liabilities – whether they be cash, deposits or CDBC – as soon as they can. Since the total amount of goods existing

in the economy is essentially fixed in the very short run, the consequence of a spending run will either be an immediate increase in prices, thus self-fulling the concerns about inflation that triggered the run, or shortages due to the stocking out of goods.

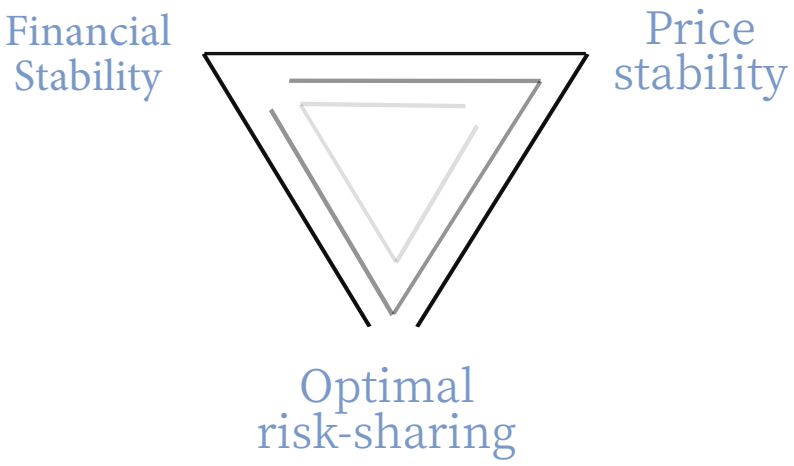
Such spending runs occurred often during the 20th century. For instance, in May 1990, the faltering Soviet government proposed an increase in retail prices. Although this proposal was never approved, it nonetheless led to a massive run on the ruble. Shops, either state-owned or in the growing private sector, soon stocked out (Ellman 2014: 78). Similar spending runs occurred in Latin America during the 1970s and early 1980s whenever rumours of a devaluation spread. Interestingly, when a spending run occurs, the central bank's ability to issue unlimited nominal liabilities (an alleged fool-proof barrier against financial crises) is counterproductive: additional nominal liabilities only aggravate the situation, as agents will have even more incentive to spend those nominal liabilities as soon as possible.

Note that a spending run is not about exchanging a CBDC for cash or deposits; these are just other nominal liabilities of the central bank, either directly (cash) or indirectly (deposits convertible into cash). A spending run is about getting rid of the CBDC and any other central bank nominal liability by transforming them into real goods or assets (rolls of toilet paper, a car, a house) before inflation erodes the rate of exchange between nominal liabilities and real goods.

Spending runs are not unique to CBDCs. We know since at least Obstfeld and Rogoff (1983) that self-fulling hyperinflation is inherent to government-issued monies. Fernández-Villaverde and Sanches (2019) show that the same problem plagues privately issued cryptocurrencies. But a CBDC puts the central bank on the spot because the speed of electronic transactions makes it possible to have a spending run nearly instantaneously.

A second main thread of our work is that, because of the existence of nearly instantaneous spending runs, central banks face what we call the *CBDC trilemma*. In general, one would like a central bank to deliver three goals. First, we want **financial stability** – that is, to avoid the spending runs we described above. Second, we want **efficiency** – that is, that the economy achieves the optimal risk-sharing between patient and impatient agents (or, equivalently, the optimal maturity transformation between short-run deposits and long-run investment projects). Third, we want **price stability** – that is, prices do not change too fast and disrupt allocations, for instance because most contracts are expressed in nominal terms.

FIGURE 1 THE CBDC TRILEMMA



Note: For the central bank, it is impossible to attain all three objectives at a time. When prioritising one objective, at least one other objective must be sacrificed.

In Schilling et al. (2020) we argued that, unfortunately, a central bank that operates a CBDC can only deliver two of these three goals. Figure 1 summarises the idea that, when prioritising one objective, at least one other objective must be sacrificed.

We formally prove our argument by building a nominal version of the classical model of Diamond and Dybvig (1983). We pick this model because it emphasises banks' role in maturity transformation: banks pool resources and finance long-term projects with demand deposits that can be withdrawn at a short time horizon to meet liquidity shocks by impatient agents. By offering risk-sharing, banks enable allocations that are not attainable under autarky. Yet, the optimal amount of risk-sharing requires banks to be prone to runs. While our results are cast in terms of our Diamond and Dybvig model, we conjecture that the CBDC trilemma appears in a large class of models of banking, as it captures essential trade-offs that reach beyond the details of a concrete model.

We depart from the original formulation of the Diamond and Dybvig model in a crucial aspect. While Diamond and Dybvig (1983) consider intermediation with private banks, a CBDC implies central bank intermediation. In fact, to make our model as stark as possible, we just assume that the central bank operates all real technology and provides all the economy's deposit functionality.1 This difference is consequential because a central bank can control the price level. For example, a central bank can issue additional units of a CBDC to cover losses in its loan portfolio, implicitly diffusing the costs of the credit losses among all holders of the currency. To further simplify the analysis, we also assume that a central bank can influence (within some constraints) how many goods are offered

1 In an extension, we analyse how our results extend to the case where the central bank shares the deposit market with private banks. Our main results hold with some minor qualifications.

in the economy in the short run. This assumption is not too different from, for example, the standard assumption in New Keynesian models where central banks determined output in the short run by setting a nominal interest rate.

As the first part of the trilemma, we prove that the central bank can always implement the socially optimal allocation in dominant strategies while deterring runs by credibly threatening high inflation whenever nominal spending is excessive. This threat is implemented by limiting the supply of goods in the case of a run, thereby rendering early spending by patient agents (i.e. those who do not receive utility from consuming right now) suboptimal ex post. Since holders of a CBDC are rational, the central bank's inflation threat deters runs ex ante, such that high inflation only occurs off the equilibrium path. This result contrasts with the Diamond and Dybvig model, where banks do not have the option of changing the aggregate price level in response to a run. Hence, there, runs can occur as equilibrium phenomena, in which case the social optimum does not obtain.

On the second part of the trilemma, the threat of inflation may not be credible for modern central banks given their commitment to price stability, which is often reinforced in their governing charters or imposed by the political process. If we take the central bank's commitment to price stability seriously and we enforce it as the primary objective within the model, either the allocation is suboptimal or a spending run on the central bank currency can no longer be ruled out.

Our CBDC trilemma does not appear because central bankers are pursuing their private interests; in our environment, central bankers try their very best to deliver the goals we impose (financial stability, optimal risk sharing and price stability) but face inescapable trade-offs. Nonetheless, CBDCs might also complicate the political economy of central banking in ways that are not fully appreciated. The CBDC trilemma becomes much more significant under these political-economy pressures.

In Fernández-Villaverde et al. (2021), we sketch some of these concerns. We prove that a central bank can offer the socially optimal deposit contract through CBDCs, just as commercial banks do (an 'equivalence result'). But we also show that a central bank can exploit two fundamental aspects of public law in nearly all legal systems: the seniority of the debt to the central bank and the protection it enjoys against forced liquidation. The central bank can take advantage of these two features to offer contracts with a higher expected rate of return than that which commercial banks can offer and displace them from the market. This displacement occurs even when the central bank does not have any fiscal backing from the government. But this monopoly power can endanger the supply of the first-best amount of maturity transformation in the economy by allowing the central bank to deviate from offering the socially optimal deposit contract. In other words, the 'equivalence result' is fragile.

Can central banks resist this temptation? Political-economic reasons make us doubt it. In July 2020, the ECB approved its new monetary policy strategy.2 A central aspect of the new strategy is an ambitious climate change action plan that answers growing political pressure across Europe. Indeed, if the central bank has market power, it can divert investment toward environmentally friendly technologies, for instance by diverting the profits generated by market power toward firms with lower CO_2 emissions through more advantageous financial contracts. Is this the best way to fight climate change?

The political-economic pressures are endless: diverting investment toward firms that lead in gender and racial equality, diverting investment toward firms to bridge the rural–urban divide, diverting investment toward poorer regions, diverting investment toward firms that offer a better balance of family and work life, diverting investment toward 'strategic' sectors of high added value, diverting investment toward 'national champions', and so forth. More worrisome, we are concerned with the ubiquity of less benign reasons, such as diverting investment to firms owned by the cronies of the political party in power.

We must realise, therefore, that CBDCs represent a risk to how central banks operate. By forcing central banks into policy issues beyond their core purview, CBDCs create mechanisms that might induce the political process to reconsider central bank independence. If a central bank is increasing financial inclusion (an explicitly stated goal of many defendants of CBDCs), many voters might ask why it should enjoy a higher level of independence while implementing this goal than, for example, a regular ministry of finance. Where are the time-inconsistency considerations that motivate granting independence to a central bank narrowly focused on conducting conventional monetary policy? While these might not be unsurmountable challenges to the introduction of CBDCs, they are, nonetheless, essential considerations to keep in mind.

Central banks will face, in a world with CBDCs, a whole new set of challenges. In our work, we have characterised what we think is the most important: the CBDC trilemma of financial stability, optimal risk sharing, and price stability. But the implications of this CBDC trilemma run deeper, to the core of central banking. We want to be sure of what we do before we open the door to CBDCs.

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