



FINANCE AND DEVELOPMENT

SEPTEMBER 2022

A new era for  
money P.4

Regulating  
crypto P.18

DeFi's promise  
and pitfalls P.33

# The Money Revolution

Crypto, CBDCs, and the future of finance



# Contents



The era of physical currency is drawing to an end; the age of digital currencies has begun.

## THE MONEY REVOLUTION

### 4 A New Era for Money

As bytes replace dollars, euros, and renminbi, some changes will be welcome; others may not

*Eswar Prasad*

### 10 A Foundation of Trust

Central banks should harness crypto's technical wizardry to enable a rich monetary ecosystem

*Agustín Carstens, Jon Frost, and Hyun Song Shin*

### 14 Making Sense of Crypto

Central banks and regulators need to take a differentiated approach to various crypto innovations

*Ravi Menon*

### 18 Regulating Crypto

The right rules could provide a safe space for innovation

*Aditya Narain and Marina Moretti*

### 20 Bullet Train

New tokens and platforms may transform cross-border payments—and potentially much more

*Tobias Adrian and Tommaso Mancini-Griffoli*

### 24 'DeFi' and 'TradFi' Must Work Together

Decentralized and traditional finance can thrive in tandem to fund renewable energy

*Michael Casey*

### 27 The Superficial Allure of Crypto

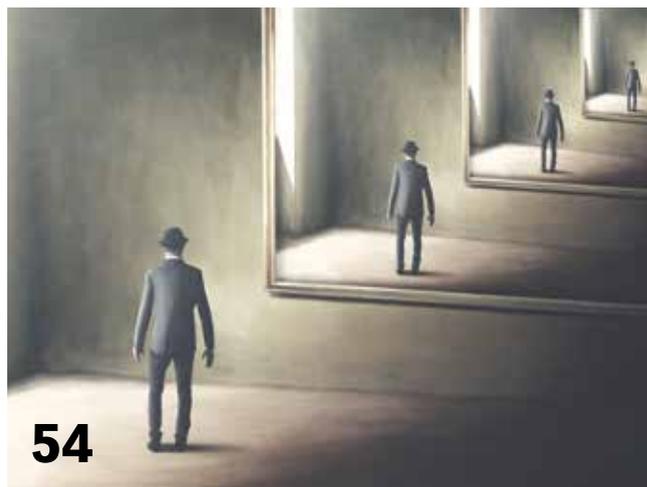
Cryptocurrencies can't deliver their claimed benefits, and instead pose grave risks

*Hilary J. Allen*

### 30 Central Bankers' New Cybersecurity Challenge

CBDCs may pose security risks, but responsible design can turn them into opportunities

*Giulia Fanti, Josh Lipsky, and Ole Moehr*


**54**

## ALSO IN THIS ISSUE

- 33 DeFi's Promise and Pitfalls**  
Decentralized finance could support a new financial infrastructure if challenges are overcome  
*Fabian Schär*
- 36 Digital Money 101**  
A brief guide to blockchain and crypto lingo
- 42 Digital Journeys: Bali, India, Africa**  
Digital innovation is disrupting the status quo  
*Harry Jacques, Jeff Kearns, Ashlin Mathew, and Chris Wellisz*
- 54 Hall of Mirrors**  
A deeper understanding of how consumers think about the economy would help policymakers control inflation  
*Carlo Pizzinelli*
- 58 The New Economics of Fertility**  
People and economies will prosper if policymakers help women combine career and family  
*Matthias Doepke, Anne Hannusch, Fabian Kindermann, and Michèle Tertilt*

## DEPARTMENTS

- 38 People in Economics**  
**Getting into People's Heads**  
*Marjorie Henríquez* profiles Harvard's **Stefanie Stantcheva**, who uses surveys to uncover the invisible
- 48 Picture This**  
**The Ascent of CBDCs**  
More than half of the world's central banks are exploring or developing digital currencies  
*Andrew Stanley*
- 50 Back to Basics**  
**Crypto's Conservative Coins**  
Stablecoins are far from the revolutionary ideals of crypto's creators and are not without risk  
*Parma Bains and Ranjit Singh*
- 52 Café Economics**  
**A Looming Food Crisis**  
FAO's *Maximo Torero Cullen* discusses how supply shortages could tip into a catastrophe
- 61 Book Reviews**  
*The Meddlers: Sovereignty, Empire, and the Birth of Global Economic Governance*, Jamie Martin  
*A Brief History of Equality*, Thomas Piketty  
*The United States vs. China: The Quest for Global Economic Leadership*, C. Fred Bergsten
- 64 Currency Notes**  
**Taking Digital Currencies Offline**  
In many regions, internet-free access may be a make-or-break feature for central bank digital currencies  
*John Kiff*


**38**



# Money, Reimagined

**THE FUTURE OF MONEY** is undoubtedly digital. The question is, What is it going to look like? In this issue, some of the world's leading experts try to answer this complex and politically charged question.

Of course, digital money has been developing for some time already. New technologies hope to democratize finance and broaden access to financial products and services. A key goal is to achieve much cheaper, instantaneous domestic and cross-border payments. Eswar Prasad takes us on a tour of existing and emerging forms of digital money and looks at the implications for finance, monetary policy, international capital flows—even the organization of societies.

Not every form of digital money will prove viable. Cryptocurrencies like Bitcoin fail as money, says Singapore's Ravi Menon, among others. Recently these tokens have lost two-thirds of their value. While they are actively traded and heavily speculated on, prices are divorced from any underlying economic value. Stablecoins are designed to rein in the volatility, but many have proved to be anything but stable, Menon adds, and depend on the quality of the reserve assets backing them.

Still, journalist Michael Casey argues, decentralized finance (DeFi) and crypto are not only here to stay but can address real-world problems such as the energy crisis. Regulation is key. The IMF's Aditya Narain and Marina Moretti call for global regulation to bring order to markets and provide a safe space for innovation.

Meanwhile, central banks are considering their own digital currencies. Bank for International Settlements Chief Agustín Carstens and his coauthors suggest that central banks should harness the technological innovations offered by crypto while also providing a crucial foundation of trust. Privacy and cybersecurity risks can be managed with responsibly designed central bank digital currencies, adds the Atlantic Council's Josh Lipsky.

It's too early to tell how the digital landscape will evolve. But with the right policy and regulatory choices, we can imagine a future with a mix of government and privately backed currencies held safely in the digital wallets of billions of people. **FD**

**GITA BHATT**, editor-in-chief



## ON THE COVER

Digital currencies and other financial technologies are reshaping everything from consumer banking to international payments. Illustrator Pete Reynolds uses a raised fist, symbol of social tumult, to show the power of this money revolution that is hidden in plain sight.



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# A NEW ERA FOR MONEY

As bytes replace dollars, euros, and renminbi, some changes will be welcome; others may not

**Eswar Prasad**







Money has transformed human society, enabling commerce and trade even between widely dispersed geographic locations. It allows the transfer of wealth and resources across space and over time. But for much of human history, it has also been the object of rapacity and depredation.

Money is now on the cusp of a transformation that could reshape banking, finance, and even the structure of society. Most notably, the era of physical currency, or cash, is drawing to an end, even in low- and middle-income countries; the age of digital currencies has begun. A new round of competition between official and private currencies is also looming in both the domestic and international arenas. The proliferation of digital technologies that is powering this transformation could foster useful innovations and broaden access to basic financial services. But there is a risk that the technologies could intensify the concentration of economic power and allow big corporations and governments to intrude even more into our financial and private lives.

Traditional financial institutions, especially commercial banks, face challenges to their business models as new technologies give rise to online banks that can reach more customers and to web-based platforms, such as Prosper, capable of directly connecting savers and borrowers. These new institutions and platforms are intensifying competition, promoting innovation, and reducing costs. Savers are gaining access to a broader array of saving, credit, and insurance products, while small-scale entrepreneurs are able to secure financing from sources other than banks, which tend to have stringent loan-underwriting and collateral requirements. Domestic and international payments are becoming cheaper and quicker, benefiting consumers and businesses.

### **Stability concerns**

The emergence of cryptocurrencies such as Bitcoin initially seemed likely to revolutionize payments. Cryptocurrencies do not rely on central bank money or trusted intermediaries such as commercial banks and credit card companies to conduct transactions, which cuts out the inefficiencies and added costs of these intermediaries. However, their volatile

prices, and constraints to transaction volumes and processing times, have rendered cryptocurrencies ineffective as mediums of exchange. New forms of cryptocurrencies called stablecoins, most of which ironically get their stable value by being backed by stores of central bank money and government securities, have gained more traction as means of payment. The blockchain technology underpinning them is catalyzing far-reaching changes to money and finance that will affect households, corporations, investors, central banks, and governments in profound ways. This technology, by allowing secure ownership of purely digital objects, is even fostering the rise of new digital assets, such as non-fungible tokens.

At the same time, central banks are concerned about the implications for both financial and economic stability if decentralized payment systems (offshoots of Bitcoin) or private stablecoins were to displace both cash and traditional payment systems managed by regulated financial institutions. A payment infrastructure that is entirely in the hands of the private sector might be efficient and cheap, but some parts of it could freeze up in the event of a loss of confidence during a period of financial turmoil. Without a functioning payment system, a modern economy would grind to a halt.

In response to such concerns, central banks are contemplating issuing digital forms of central bank money for retail payments—central bank digital currencies (CBDCs). The motives range from broadening financial inclusion (giving even those without a bank account easy access to a free digital payment system) to increasing the efficiency and stability of payment systems by creating a public payment option as a backstop (the role now played by cash).

A CBDC has other potential benefits. It would hinder illegal activities such as drug deals, money laundering, and terrorism financing that rely on anonymous cash transactions. It would bring more economic activity out of the shadows and into the formal economy, making it harder to evade taxes. Small businesses would benefit from lower transaction costs and avoid the hassles and risks of handling cash.

### **Risk of runs**

But a CBDC also has disadvantages. For one, it poses risks to the banking system. Commercial banks are crucial to creating and distributing credit that keeps economies functioning smoothly. What if



households moved their money out of regular bank accounts into central bank digital wallets, perceiving them as safer even if they pay no interest? If commercial banks were starved of deposits, a central bank could find itself in the undesirable position of having to take over the allocation of credit, deciding which sectors and firms deserve loans. In addition, a central bank retail payment system could even squelch private sector innovation aimed at making digital payments cheaper and quicker.

Of equal concern is the potential loss of privacy. Even with protections in place to ensure confidentiality, any central bank would want to keep a verifiable record of transactions to ensure that its digital currency is used only for legitimate purposes. A CBDC thus poses the risk of eventually destroying any vestige of anonymity and privacy in commercial transactions. A carefully designed CBDC, taking advantage of fast-developing technical innovations, can mitigate many of these risks. Still, for all its benefits, the prospect of eventually displacing cash with a CBDC ought not to be taken lightly.

The new technologies could make it harder for a central bank to carry out its key functions—namely, to keep unemployment and inflation low by manipulating interest rates. When a central bank such as the Federal Reserve changes its key interest rate, it affects interest rates on commercial bank deposits and loans in a way that is reasonably well understood. But if the proliferation of digital lending platforms diminishes the role of commercial banks in mediating between savers and borrowers, it's unclear how or whether this monetary policy transmission mechanism will continue to function.

### Currency competition

The basic functions of central-bank-issued money are on the threshold of change. As recently as a century ago, private currencies competed with each other and with government-issued currencies, also known as fiat money. The emergence of central banks decisively shifted the balance in favor of fiat currency, which serves as a unit of account, medium of exchange, and store of value. The advent of various forms of digital currencies, and the technology behind them, has now made it possible to separate these functions of money and has created direct competition for fiat currencies in some dimensions.

Central bank currencies are likely to retain their importance as stores of value and, for countries

## If market forces are left to themselves, some issuers of money and providers of payment technologies could become dominant.

that issue them in digital form, also as mediums of exchange. Still, privately intermediated payment systems are likely to gain in importance, intensifying competition between various forms of private money and central bank money in their roles as mediums of exchange. If market forces are left to themselves, some issuers of money and providers of payment technologies could become dominant. Some of these changes could affect the very nature of money—how it is created, what forms it takes, and what roles it plays in the economy.

### International money flows

Novel forms of money and new channels for moving funds within and between economies will reshape international capital flows, exchange rates, and the structure of the international monetary system. Some of these changes will have big benefits; others will pose new challenges.

International financial transactions will become faster, cheaper, and more transparent. These changes will be a boon for investors seeking to diversify their portfolios, firms looking to raise money in global capital markets, and economic migrants sending money back to their home countries. Faster and cheaper cross-border payments will also boost trade, which will be particularly beneficial for emerging market and developing economies that rely on export revenues for a significant portion of their GDP.

Yet the emergence of new conduits for cross-border flows will facilitate not just international commerce but also illicit financial flows, raising new challenges for regulators and governments. It will also make it harder for governments to control the flows of legitimate investment capital across borders. This poses particular challenges for emerging market economies, which have suffered periodic economic crises as a result of large, sudden outflows of foreign capital. These economies will be even more vulnerable to the monetary policy

## Digital central bank money is only as strong and credible as the institution that issues it.

actions of the world's major central banks, which can trigger those capital outflows.

Neither the advent of CBDCs nor the lowering of barriers to international financial flows will alone do much to reorder the international monetary system or the balance of power among major currencies. The cost of direct transactions between pairs of emerging market currencies is falling, reducing the need for “vehicle currencies” such as the dollar and the euro. But the major reserve currencies, especially the dollar, are likely to retain their dominance as stores of value because that dominance rests not just on the issuing country's economic size and financial market depth but also on a strong institutional foundation that is essential for maintaining investors' trust. Technology cannot substitute for an independent central bank and the rule of law.

Similarly, CBDCs will not solve underlying weaknesses in central bank credibility or other issues, such as a government's undisciplined fiscal policies, that affect the value of a national currency. When a government runs large budget deficits, the presumption that the central bank might be directed to create more money to finance those deficits tends to raise inflation and reduce the purchasing power of central bank money, whether physical or digital. In other words, digital central bank money is only as strong and credible as the institution that issues it.

### Government's role

Central banks and governments worldwide face important decisions in coming years about whether to resist new financial technologies, passively accept private-sector-led innovations, or embrace the potential efficiency gains the new technologies offer. The emergence of cryptocurrencies and the prospect of CBDCs raise important questions about the role the government ought to play in financial markets, whether it is impinging on areas that are preferably left to the private sector, and whether it can compensate for market failures, particularly

the large number of unbanked and underbanked households in developing economies and even in advanced economies such as the United States.

As the recent cryptocurrency boom and bust have shown, regulation of this sector will be essential to maintain the integrity of payment systems and financial markets, ensure adequate investor protection, and promote financial stability. Still, given the extensive demand for more efficient payment services at the retail, wholesale, and cross-border levels, private-sector-led financial innovations could generate significant benefits for households and corporations. In this respect, the key challenge for central banks and financial regulators lies in balancing financial innovation with the need to mitigate risks to uninformed investors and to overall financial stability.

New financial technologies hold the promise of making it easier even for indigent households to gain access to an array of financial products and services, and of thereby democratizing finance. However, technological innovations in finance, even those that might allow for more efficient financial intermediation, could have double-edged implications for income and wealth inequality.

The benefits of innovations in financial technologies could be captured largely by the wealthy, who could use them to increase financial returns and diversify risks, and existing financial institutions could co-opt these changes for their own benefit. Moreover, because those who are economically marginalized have limited digital access and lack financial literacy, some of the changes could draw them into investment opportunities whose risks they do not fully appreciate or have the ability to tolerate. Thus, the implications for income and wealth inequality—which has risen sharply in many countries and is fomenting political and social tensions—are far from obvious.

Another key change will be greater stratification at both the national and international levels. Smaller economies and those with weak institutions could see their central banks and currencies swept away, concentrating even more economic and financial power in the hands of the large economies. Meanwhile, major corporations such as Amazon and Meta could accrete more power by controlling both commerce and finance.



Even in a world with decentralized finance built around Bitcoin's innovative blockchain technology (which is likely to be its true legacy), governments have important roles to play in enforcing contractual and property rights, protecting investors, and ensuring financial stability. After all, it appears that cryptocurrencies and innovative financial products, too, work better when they are built on the foundation of trust that comes from government oversight and supervision. Governments have the responsibility to ensure that their laws and actions promote fair competition rather than favoring incumbents and allowing large players to stifle smaller rivals.

### Central or fragmented

Financial innovations will generate new and as yet unknown risks, especially if market participants and regulators put undue faith in technology. Decentralization and its corollary, fragmentation, cut both ways. They can increase financial stability by reducing centralized points of failure and increasing resilience through greater redundancy. On the other hand, while fragmented systems

can work well in good times, confidence in them could prove fragile in difficult circumstances. If the financial system is dominated by decentralized mechanisms that are not directly backed (as banks are) by a central bank or other government agency, confidence could easily evaporate. Thus, decentralization might yield efficiency in good times and rapid destabilization when economies struggle.

Potentially big changes to societal structures are also at hand. The displacement of cash by digital payment systems could eliminate any vestige of privacy in commercial transactions. Bitcoin and other cryptocurrencies were intended to secure anonymity and eliminate reliance on governments and major financial institutions in the conduct of commerce. Yet they are spurring changes that might end up compromising privacy. Societies will struggle to check the power of governments as individual liberties face even greater risk. **FD**

**ESWAR PRASAD** is a professor at Cornell University and a senior fellow at the Brookings Institution. This article draws on his latest book, *The Future of Money: How the Digital Revolution Is Transforming Currencies and Finance*.

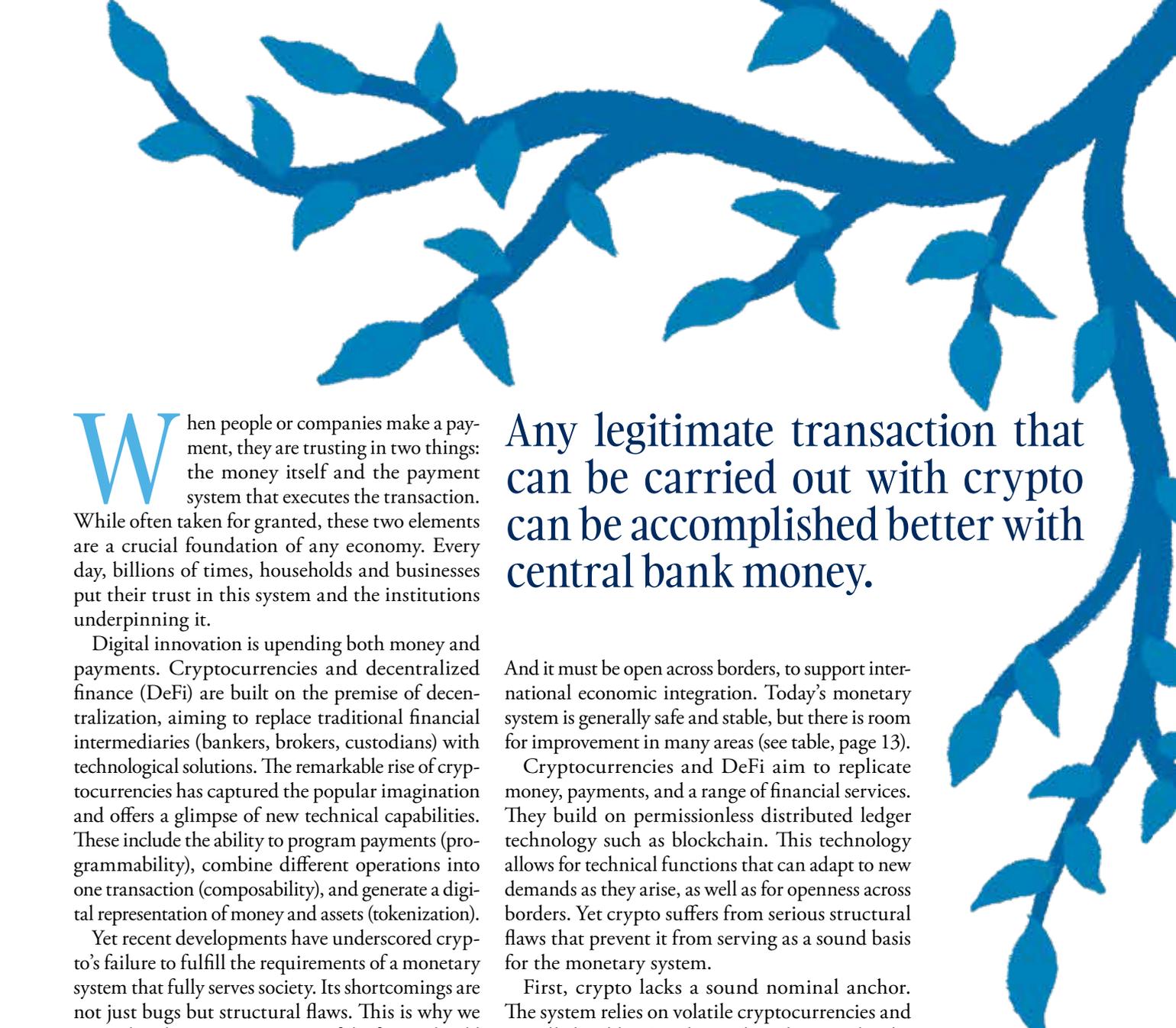




# A Foundation of Trust

Central banks should harness crypto's technical wizardry to enable a rich monetary ecosystem

Agustín Carstens, Jon Frost, and Hyun Song Shin



**W**hen people or companies make a payment, they are trusting in two things: the money itself and the payment system that executes the transaction.

While often taken for granted, these two elements are a crucial foundation of any economy. Every day, billions of times, households and businesses put their trust in this system and the institutions underpinning it.

Digital innovation is upending both money and payments. Cryptocurrencies and decentralized finance (DeFi) are built on the premise of decentralization, aiming to replace traditional financial intermediaries (bankers, brokers, custodians) with technological solutions. The remarkable rise of cryptocurrencies has captured the popular imagination and offers a glimpse of new technical capabilities. These include the ability to program payments (programmability), combine different operations into one transaction (composability), and generate a digital representation of money and assets (tokenization).

Yet recent developments have underscored crypto's failure to fulfill the requirements of a monetary system that fully serves society. Its shortcomings are not just bugs but structural flaws. This is why we argue that the monetary system of the future should harness the new technical capabilities demonstrated by crypto but be grounded in the trust central banks provide (BIS 2022).

In other words, any legitimate transaction that can be carried out with crypto can be accomplished better with central bank money. Central bank digital currencies (CBDCs) and other public infrastructure can underpin a rich and diverse monetary ecosystem that supports innovation in the public interest.

### **Crypto's structural flaws**

Let's start by looking at the requirements of a monetary system that can fully serve society. It must be safe and stable, with participants (public and private) who are accountable to the public. It must be efficient and inclusive. Users must have control over their data, and fraud and abuse must be prevented. The system must also adapt to changing demands.

**Any legitimate transaction that can be carried out with crypto can be accomplished better with central bank money.**

And it must be open across borders, to support international economic integration. Today's monetary system is generally safe and stable, but there is room for improvement in many areas (see table, page 13).

Cryptocurrencies and DeFi aim to replicate money, payments, and a range of financial services. They build on permissionless distributed ledger technology such as blockchain. This technology allows for technical functions that can adapt to new demands as they arise, as well as for openness across borders. Yet crypto suffers from serious structural flaws that prevent it from serving as a sound basis for the monetary system.

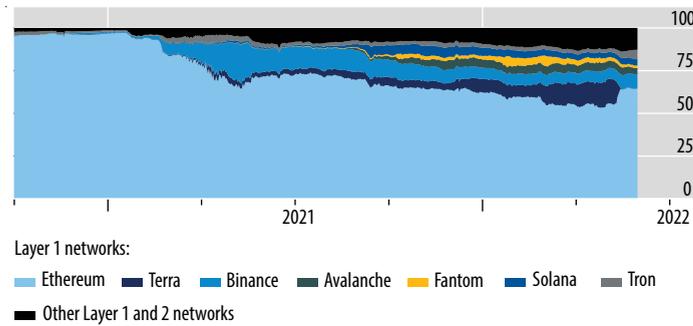
First, crypto lacks a sound nominal anchor. The system relies on volatile cryptocurrencies and so-called stablecoins that seek such an anchor by maintaining a fixed value to a sovereign currency, such as the US dollar. But cryptocurrencies are not currencies, and stablecoins are not stable. This was underscored by the implosion of TerraUSD in May 2022 and persistent doubts about the actual assets that back the largest stablecoin, Tether. In other words, stablecoins seek to "borrow" credibility from real money issued by central banks. This shows that if central bank money did not exist, it would be necessary to invent it.

Second, crypto induces fragmentation. Money is a social convention, characterized by network effects—the more people use a given type of money, the more attractive it becomes to others. These network effects are anchored in a trusted institution—the central bank—that guarantees the stability of the currency as well as the safety and finality (settlement and irreversibility) of transactions.

Chart 1

### A fraying landscape

Ethereum congestion has led DeFi users to other blockchains.  
(percent of total assets locked)

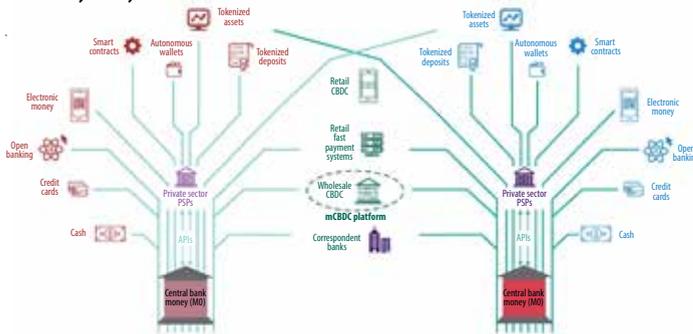


Sources: Boissay and others (2022); DeFi Llama; and Bank for International Settlements.

Chart 2

### Monetary flora

Central banks can be seen as the solid trunks of trees in the global monetary ecosystem.



Source: Bank for International Settlements.

Note: API = application programming interface; CBDC = central bank digital currency; mCBDC = multiple CBDC; MO = monetary base; PSP = payment service provider.

Crypto's decentralized nature means that it relies on incentives to anonymous validators to confirm transactions, in the form of fees and rents. This causes congestion and prevents scalability. For example, when the Ethereum network (a blockchain widely used for DeFi applications) nears its transaction limit, fees rise exponentially. As a result, over the past two years, users have moved to other blockchains, resulting in growing fragmentation of the DeFi landscape (see Chart 1). This inherent feature prevents widespread use (Boissay and others 2022).

Because of these flaws, crypto is neither stable nor efficient. It is a largely unregulated sector, and its participants are not accountable to society. Frequent fraud, theft, and scams have raised serious concerns about market integrity.

Crypto has introduced us to the possibilities of innovation. Yet its most useful elements must be put on a sounder footing. By adopting new technical capabilities but building on a core of trust, central bank money can provide the foundation for a rich and diverse monetary ecosystem that is scalable and designed with the public interest in mind.

### The trees and the forest

Central banks are uniquely placed to provide this core of trust, given the key roles they play in the monetary system. First is their role as the issuers of sovereign currency. Second is their duty to provide the means for the ultimate finality of payments. Central banks are also responsible for the smooth functioning of payment systems and for safeguarding their integrity through regulation and supervision of private services.

If the monetary system is a tree, the central bank is its solid trunk. The branches are banks and other private providers competing to offer services to households and businesses. Central bank public goods will support innovative services to back up the digital economy. The system is rooted in settlement on the central bank's balance sheet.

Zooming out, we can see the global monetary system as a healthy forest (see Chart 2). In the trees' canopies, the branches come together and allow economic integration across borders.

How can this vision be achieved? It will take new public infrastructure at the wholesale, retail, and cross-border levels.

First, wholesale CBDCs—a superior representation of central bank money for use exclusively by banks and other trusted institutions—can offer new technical capabilities. These include the programmability, composability, and tokenization previously mentioned. Wholesale CBDCs could unlock significant innovation that benefits end users. For instance, the buyer and seller of a house could agree up-front that the tokenized payment and the tokenized title transfer must be simultaneous. In the background, wholesale CBDCs would settle these transfers as a single transaction.

## Making the grade

The future monetary system can improve both on today's monetary system and crypto.

High-level goals for money and payments	Today's monetary system	Crypto universe (to date)	Future monetary system (vision)
1. Safety and stability			
2. Accountability			
3. Efficiency			
4. Inclusion			
5. User control over data			
6. Integrity			
7. Adaptability			
8. Openness			
<b>Status:</b>	Policy goal broadly fulfilled	Room for improvement	Not generally fulfilled

Source: Bank for International Settlements.

Hands-on work by central banks is showcasing this and many other applications (see “Making Sense of Crypto” in this issue of F&D).

Second, at the retail level, CBDCs have great potential, together with their first cousins, fast payment systems. Retail CBDCs would work as digital cash available to households and businesses, with services provided by private companies. Central-bank-operated retail fast payment systems are similar to retail CBDCs in that they provide this common platform while ensuring that services are fully connected. Both promise to lower payment costs and enable financial inclusion. Brazil's Pix system was adopted by two-thirds of Brazilian adults in only one year. Merchants pay a fee of just 0.2 percent of a transaction's value on average, one-tenth the cost of a credit card payment. Many central banks are currently working on inclusive designs for retail CBDCs to better serve the unbanked (Carstens and Queen Máxima 2022).

In conclusion, at the global level, central banks can link their wholesale CBDCs together to allow banks and payment providers to carry out transactions directly in central bank money of multiple currencies. This is made possible with so-called permissioned distributed ledger technology—restricted to trusted parties. Work by the Bank for International Settlements Innovation Hub with 10 central banks shows that such arrangements

can deliver faster, cheaper, and more transparent cross-border payments (Bech and others 2022). This can help migrants pay less for their remittances, allow greater cross-border e-commerce, and support complex global value chains.

Digital technologies promise a bright future for the monetary system. By embracing the core of trust provided by central bank money, the private sector can adopt the best new technologies to foster a rich and diverse monetary ecosystem. Above all, users' needs must be at the forefront of private innovation, just as the public interest must be the lodestar for central banks. [FD](#)

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# Making Sense of CRYPTO

## Central banks and regulators need to take a differentiated approach to various crypto innovations

Ravi Menon

Central banks and regulators cannot afford to wait for clarity on how crypto-related innovations will shape the future of money and finance. These innovations—including digital assets, cryptocurrencies, stablecoins, and central bank digital currencies (CBDCs)—are rapidly gathering momentum.

Some already pose risks that must be understood and addressed. But they also present potential benefits worth harnessing. Central banks and regulators around the world are developing frameworks that seek to balance risks and opportunities judiciously. The frameworks need to evolve continually, as technologies, business models, and market practices change.

The Monetary Authority of Singapore (MAS), Singapore's central bank and integrated financial regulator, aims to develop an innovative and responsible digital asset ecosystem. It has looked at the various crypto innovations individually, taking into account their specific risks and potential uses.

### Digital assets

MAS actively promotes the innovative and responsible use of **digital assets**.

A digital asset is anything of value whose ownership is represented in a digital or computerized form. It could be a financial asset, say a bond; a

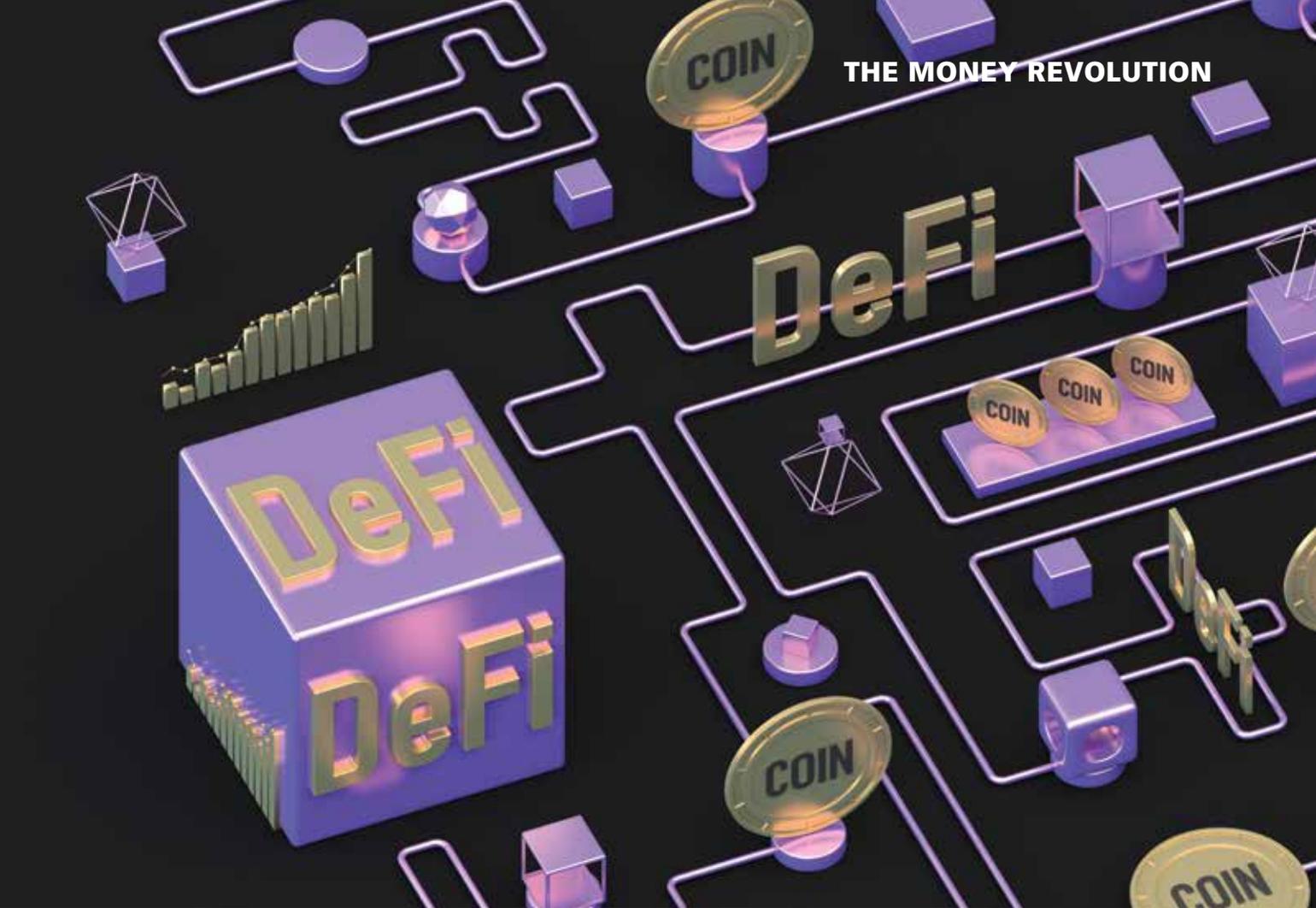
real asset, such as a work of art; or even something intangible, like computing resources. The digital asset ecosystem has three distinct features:

- *Tokenization*, which involves using software programs to convert ownership rights over an asset into a digital token that can be stored, sold, or used as collateral.
- *A distributed ledger, or blockchain*, which is an immutable computerized record of the ownership and transfer of ownership of a token.
- *Cryptography*, which uses advanced encryption techniques to ensure that transactions in these tokens are secure.

The digital asset ecosystem offers significant economic potential. It can facilitate more efficient transactions and unlock untapped economic value. The most promising use cases of digital assets in financial services are in cross-border trade and settlement, trade finance, and pre- and post-trade capital market activities.

In *cross-border payments and settlements*, common settlement networks using distributed ledger technologies are achieving reductions in settlement time from two-to-three days to less than 10 minutes and in transactions costs from 6 percent of transfer value to less than 1 percent. In *trade finance*, common ledgers that permit transactions to be traced have achieved reductions in processing time for letters of credit from five to 10 days to less than 24 hours. In *capital markets*, distributed ledgers are reducing the time to clear and settle securities transactions from two days to less than 30 minutes.

In Singapore, United Overseas Bank Ltd. has piloted the issuance of a S\$600 million digital bond



on Marketnode's servicing platform that facilitates a seamless workflow through smart contracts. Smart contracts are computer programs embedded in a distributed ledger that automatically execute actions—for example, a coupon payout—when pre-set conditions are met. Marketnode is a joint venture between the Singapore Exchange and the investment firm Temasek.

MAS itself has launched an initiative—called Project Guardian—to explore digital asset applications in wholesale funding markets. Led by DBS Bank, JP Morgan, and Marketnode, the first pilot involves creating a liquidity pool, comprising a collection of tokenized bonds and deposits locked in a series of smart contracts. The aim is to achieve seamless secured borrowing and lending of these tokenized bonds through the smart contracts.

The concept of tokenization to create digital assets has potential beyond finance. First, it can enable the monetization of any tangible or intangible asset. Second, tokenization makes it easier to fractionalize an asset (that is, split up the ownership of the asset, much as ownership of a company is split into shares of stock). Third, tokenization makes it easier to trade the assets securely and

## Central banks and regulators around the world are developing frameworks that seek to balance risks and opportunities judiciously.

seamlessly without the need for intermediaries. Assets that can be tokenized and traded include works of art, real estate, commodities, even live-stock. Not all tokenized assets make sense, but those that do could help unlock hitherto untapped economic value.

In Singapore, OCBC Bank has partnered with the digital exchange MetaVerse Green Exchange to develop green financing products using tokenized carbon credits. Tokenizing the carbon credits generated from green projects such as reforestation and placing them on a distributed ledger helps ensure their provenance and reduces the risk of double-counting of credits. Companies can buy these credits with confidence, to offset their carbon emissions.

A digital asset ecosystem will need a tokenized medium of exchange to facilitate transactions. Three popular candidates are cryptocurrencies, stablecoins, and central bank digital currencies (CBDCs).

## Cryptocurrencies

Private cryptocurrencies—of which Bitcoin is probably the best known—fail as money. They perform poorly as a *medium of exchange*, as a *store of value*, and as a *unit of account*. Many of the cryptocurrencies that are widely traded today are really utility tokens that represent a stake in blockchain projects. But they have taken a life of their own outside the blockchain. They are actively traded and heavily speculated on, with prices that are divorced from any underlying economic value on the blockchain. The extreme price volatility of cryptocurrencies rules them out as a viable form of tokenized currency or investment asset.

Because users of cryptocurrencies operate through e-wallet addresses or pseudonyms, cryptocurrencies have made it easier to conduct illicit transactions, including money laundering. Cryptocurrencies have also helped to fuel ransomware—one of the fastest growing crimes in cyberspace.

MAS has consistently warned the public of the hazards of trading in cryptocurrencies. It has also made it harder for individuals to have access to cryptocurrencies—employing such measures as banning the advertisement or promotion of cryptocurrencies to the general public. MAS plans to impose further restrictions on retail access to cryptocurrencies.

## Stablecoins

MAS sees good potential in stablecoins, provided they are well regulated and securely backed by high quality reserves.

Stablecoins are tokens whose value is tied to another asset—usually fiat currencies, such as the U.S. dollar. They seek to combine the benefits of stability and tokenization, thereby enabling them to be used as payment instruments on distributed ledgers.

Stablecoins are beginning to find acceptance outside the crypto ecosystem. Some technology firms have integrated popular stablecoins into their payment services. Visa and Mastercard allow transactions to be settled using USD Coin. This can be a positive development if stablecoins can make payments cheaper, faster, and safer. The competitive challenge that stablecoins pose to established players can also spur improvements in traditional payments.

But to reap the benefits of stablecoins, regulators must ensure that they are indeed stable. Being pegged to a fiat currency is not enough;

their stability depends on the quality of the reserve assets backing the coins. The recent meltdown of the stablecoin TerraUSD demonstrates the need for such quality backing. TerraUSD sought to achieve stability by relying on algorithms to control its supply through a complicated relationship with its unbacked sister cryptocurrency, Luna, rather than through secure asset backing.

National authorities recognize the potential of stablecoins and are developing proposals to regulate their issuance and circulation. The focus has been on governing the reserve assets that back the peg—the liquidity, credit, and market risks of the assets, the auditability of the reserves held, and the ability to redeem stablecoins at par.

But stablecoins are not without potential risks. Being collateralized by financial assets means they are more closely intertwined with the broader financial system than are unbacked cryptocurrencies. If faced with liquidity stresses, a stablecoin issuer that holds financial assets in reserve could be forced into a fire sale of those assets, which could have repercussions for the financial system.

While the risk of such contagion to the financial system is small at this point, appropriate regulatory levers are being considered in case the risk becomes significant. The Financial Stability Board (FSB) and other international standard setting bodies continue to update their guidance on this front. MAS will soon issue proposals to regulate stablecoins in Singapore.

## Wholesale CBDCs

A CBDC is a direct liability and payment instrument of a central bank. Wholesale CBDCs are restricted to use by financial intermediaries and are akin to the balances commercial banks now place with a central bank. MAS sees a strong case for wholesale CBDCs, especially in cross-border payments and settlements.

Cross-border payments today are slow, expensive, and opaque. Payments have to go through multiple banks before they reach their final destination. Directly linking instant payment systems across countries—such as between Singapore's PayNow and Thailand's PromptPay—achieves real-time payments and at considerably lower cost. But settlement is still not instant. The goal is to achieve cheaper, instantaneous cross-border payments that settle round-the-clock in real time.

## It is not unreasonable to imagine a future in which the digital asset ecosystem is a permanent feature of the financial landscape.

Wholesale CBDCs on a distributed ledger have the potential to achieve atomic settlement, or the exchange of two linked assets in real-time. The Bank for International Settlements Innovation Hub has embarked on Project Dunbar to explore a common multi-CBDC platform to enable atomic settlement across multiple countries. It is a partnership of the MAS, Reserve Bank of Australia, Bank Negara Malaysia, and South African Reserve Bank.

### Retail CBDCs

The case for retail CBDCs—essentially digital cash issued by a central bank to the general public—is less strong. The unique attribute of a retail CBDC relative to other regulated digital currencies (like stablecoins or tokenized bank deposits) is that it would be a liability of the central bank.

Interest in retail CBDCs has risen sharply in recent years, with many central banks experimenting with them. There are three commonly cited arguments for retail CBDCs.

First, a retail CBDC would preserve direct access to public money in a digital economy in which cash has disappeared. Members of the public may feel that they have a right to digital money that is always stable and free of credit and liquidity risks—as they do with cash today. But the differences between the liabilities of central banks and commercial banks are generally of little practical concern to most individuals. As long as people trust that their money is safe and that central banks stand ready to backstop the system during crises, direct access to public money may not be necessary.

Second, there may be a case for direct public provision of new digital money to act as a constraint on any monopoly power exercised in the retail payment space by banks or e-wallet providers. But there are other ways of enabling greater competition and ensuring that payments systems meet the required standards:

- opening up retail payment systems to more participants, including non-banks;
- capping interchange fees that merchants pay on credit and debit sales;

- setting minimum standards for speed, access, and interoperability (to enable payments across different payment networks).

The use of regulations should, of course, be weighed against the possibility that regulations could discourage new entrants to the payments system.

Third, a retail CBDC could offer greater privacy and control over personal information and transactions than provided by today's electronic payment system. But here too, enhancements to regulations or legislation to protect users' privacy and ensure sound data governance are possible alternatives to issuing retail CBDCs.

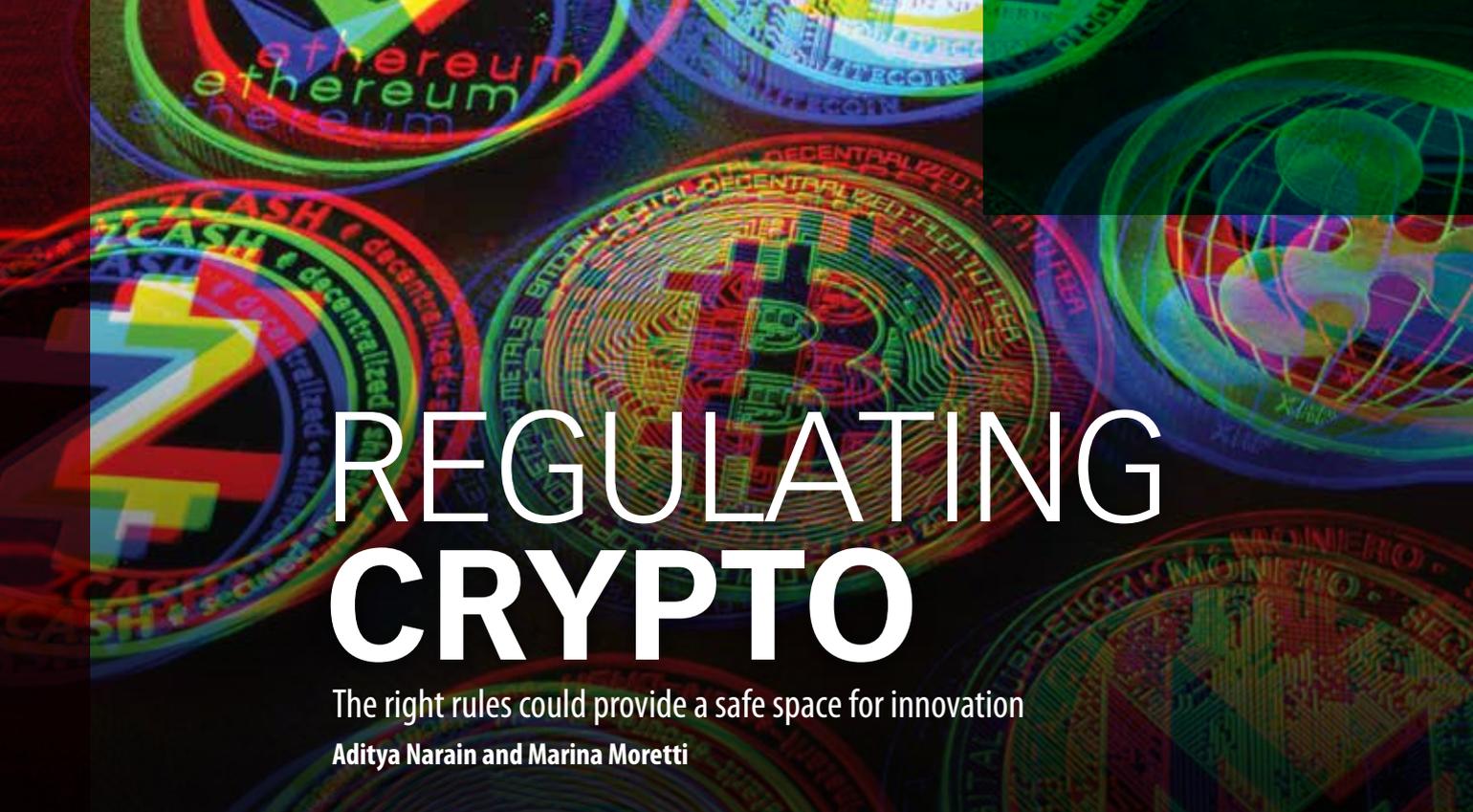
MAS believes that the case for a retail CBDC in Singapore is not compelling for now, given well-functioning payment systems and broad financial inclusion. Retail electronic payment systems are fast, efficient, and cost nothing, while a residual amount of cash remains in circulation and is unlikely to disappear. Nevertheless, MAS is building a technology infrastructure that would permit issuance of retail CBDCs should conditions change.

### Future state

It would be foolhardy to be too definitive about how these various innovations will pan out. Central banks and regulators must continually monitor trends and developments and adapt their policies and strategies accordingly.

But it is not unreasonable to imagine a future in which the digital asset ecosystem is a permanent feature of the financial landscape, co-existing with today's intermediary-based system. Traditional fiat currencies will continue to dominate, but securely backed private stablecoins and wholesale CBDCs could be expected to play an important role in cross-border payment and settlement. Retail CBDCs may well emerge as a small component of the monetary base—similar to the role played by cash today. [FD](#)

**RAVI MENON** is managing director of the Monetary Authority of Singapore.



# REGULATING CRYPTO

The right rules could provide a safe space for innovation

Aditya Narain and Marina Moretti

**C**rypto assets have been around for more than a decade, but it's only now that efforts to regulate them have moved to the top of the policy agenda. This is partly because it's only in the past few years that crypto assets have moved from being niche products in search of a purpose to having a more mainstream presence as speculative investments, hedges against weak currencies, and potential payment instruments.

The spectacular, if volatile, growth in the market capitalization of crypto assets and their creep into the regulated financial system have led to increased efforts to regulate them. So too has the expansion of crypto's many different products and offerings and the evolving innovations that have facilitated issuance and transactions. The failures of crypto issuers, exchanges, and hedge funds—as well as a recent slide in crypto valuations—have added impetus to the push to regulate.

Applying existing regulatory frameworks to crypto assets, or developing new ones, is challenging for several reasons. For a start, the crypto world is evolving rapidly. Regulators are struggling to acquire the talent and learn the skills to keep pace given stretched resources and many other priorities. Monitoring crypto markets is difficult because data are patchy, and regulators find it tricky to keep tabs on thousands of actors who may not be subject to typical disclosure or reporting requirements.

## Playing catch-up

To complicate matters, the terminology used to describe the many different activities, products,

and stakeholders is not globally harmonized. The term “crypto asset” itself refers to a wide spectrum of digital products that are privately issued using similar technology (cryptography and often distributed ledgers) and that can be stored and traded using primarily digital wallets and exchanges.

The actual or intended use of crypto assets can attract at once the attention of multiple domestic regulators—for banks, commodities, securities, payments, among others—with fundamentally different frameworks and objectives. Some regulators may prioritize consumer protection, others safety and soundness or financial integrity. And there is a range of crypto actors—miners, validators, protocol developers—that are not easily covered by traditional financial regulation.

Entities operating in financial markets are typically authorized to undertake specified activities under specified conditions and defined scope. But the associated governance, prudence, and fiduciary responsibilities do not easily carry over to participants, who may be hard to identify because of the underlying technology or who may sometimes play a casual or voluntary role in the system. Regulation may also have to reckon with the unwinding of conflicting roles that have become concentrated in some centralized entities, such as crypto exchanges.

Finally, in addition to developing a framework that can regulate both actors and activities in the crypto ecosystem, national authorities may also have to take a position on how the underlying technology used to create crypto assets stacks up against

other public policy objectives—as is the case with the enormous energy intensity of “mining” certain types of crypto assets.

In essence, crypto assets are merely codes that are stored and accessed electronically. They may or may not be backed by physical or financial collateral. Their value may or may not be stabilized by being pegged to the value of fiat currencies or other prices or items of value. In particular, the electronic life cycle of crypto assets amplifies the full range of technology-related risks that regulators are still working hard to incorporate into mainstream regulations. These include predominantly cyber and operational risks, which have already come to the fore through several high-profile losses from hacking or accidental loss of control, access, or records.

Some of these might have been lesser concerns if the crypto asset system had remained closed. But this is no longer the case. Many functions in the financial system, such as providing leverage and liquidity, lending, and storing value, are now emulated in the crypto world. Mainstream players are competing for funding and clamoring for a piece of the action. This is all leading to greater calls for the “same activity, same risk, same rule” principle to be applied, with the necessary changes, to the crypto world—piling pressure on regulators to act. It is posing another conundrum for public policy, too. How closely can the two systems be integrated before there is a call for the same central bank facilities and safety nets in the crypto world?

### Contrasting national approaches

It’s not that national authorities or international regulatory bodies have been inactive—in fact, a lot has been done. Some countries (such as Japan and Switzerland) have amended or introduced new legislation covering crypto assets and their service providers, while others (including the European Union, United Arab Emirates, United Kingdom, and United States) are at the drafting stage. But national authorities have, on the whole, taken very different approaches to regulatory policy for crypto assets.

At one extreme, authorities have prohibited the issuance or holding of crypto assets by residents or the ability to transact in them or use them for certain purposes, such as payments. At the other extreme, some countries have been much more welcoming and even sought to woo companies to develop markets in these assets. The resulting

fragmented global response neither assures a level playing field nor guards against a race to the bottom as crypto actors migrate to the friendliest jurisdictions with the least regulatory rigor—while remaining accessible to anyone with internet access.

The international regulatory community has not been sitting idle either. In the early years, the major concern was preserving financial integrity by minimizing the use of crypto assets to facilitate money laundering and other illegal transactions. The Financial Action Task Force moved quickly to provide a global framework for all virtual asset service providers. The International Organization of Securities Commissions (IOSCO) also issued regulatory guidance on crypto exchanges. But it was the announcement of Libra, touted as a “global stablecoin,” that grabbed the world’s attention and added a greater impetus to these efforts.

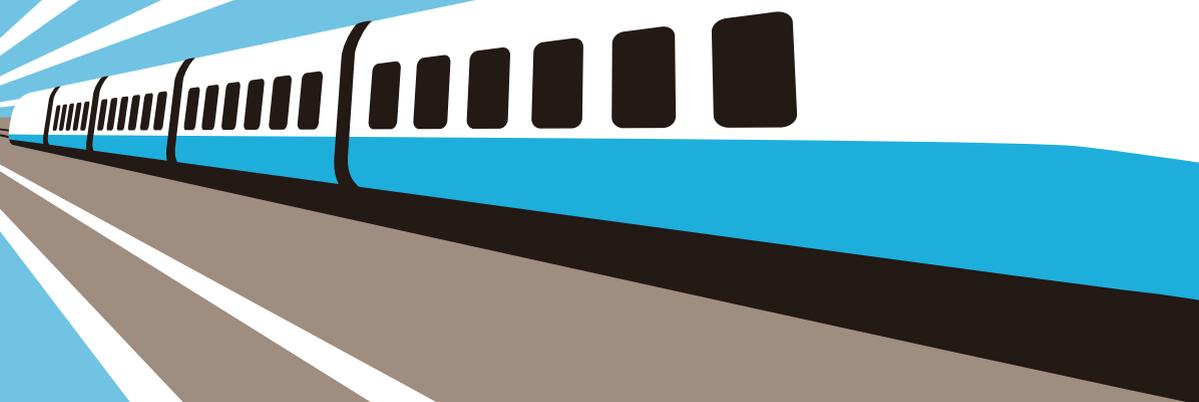
The Financial Stability Board began monitoring crypto asset markets; released a set of principles to guide the regulatory treatment of global stablecoins; and is now developing guidance for the broader range of crypto assets, including unbacked crypto assets. Other standard-setters are following suit, with work on the application of principles for financial market infrastructures to systemically important stablecoin arrangements (Committee on Payments and Market Infrastructures and IOSCO) and on the prudential treatment of banks’ exposures to crypto assets (Basel Committee on Banking Supervision).

The regulatory fabric is being woven, and a pattern is expected to emerge. But the worry is that the longer this takes, the more national authorities will get locked into differing regulatory frameworks. This is why the IMF is calling for a global response that is (1) coordinated, so it can fill the regulatory gaps that arise from inherently cross-sector and cross-border issuance and ensure a level playing field; (2) consistent, so it aligns with mainstream regulatory approaches across the activity and risk spectrum; and (3) comprehensive, so it covers all actors and all aspects of the crypto ecosystem.

A global regulatory framework will bring order to the markets, help instill consumer confidence, lay out the limits of what is permissible, and provide a safe space for useful innovation to continue. **FD**

**ADITYA NARAIN** is deputy director and **MARINA MORETTI** is assistant director of the IMF’s Monetary and Capital Markets Department.

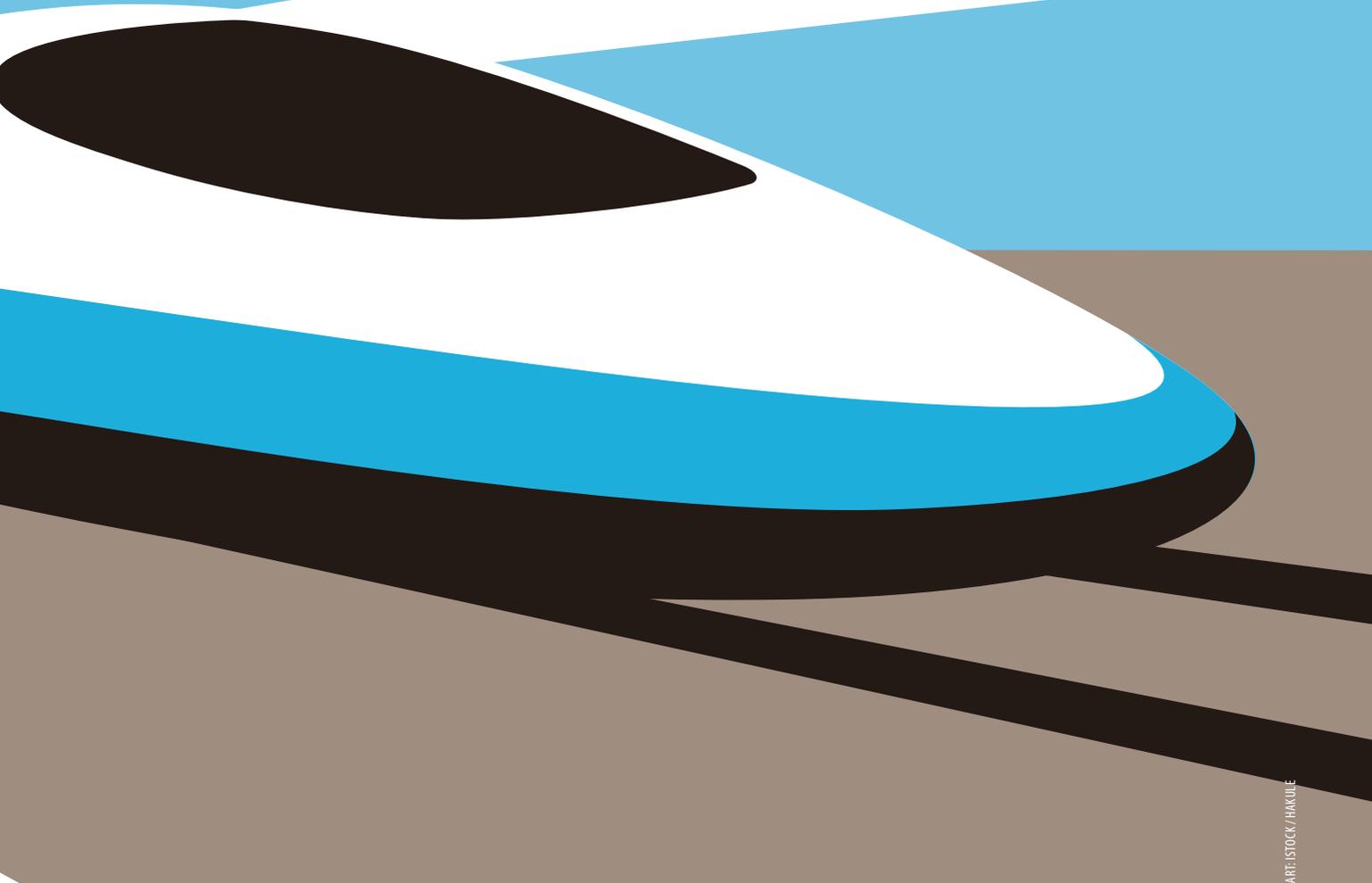
# BULLET



# TRAIN

New tokens and platforms may transform cross-border payments—and potentially much more

**Tobias Adrian and Tommaso Mancini-Griffoli**



ART: ISTOCK/HAKULE

e have all felt the frustration of sending money abroad. It takes time. It's expensive. It's cumbersome. And to some of us, it's embarrassing—because our friends who know we're economists always ask us what is going on behind the scenes, and the truth is we don't really know. It's messy.

But we redeem ourselves by talking about what the future may hold. That, people always find interesting, especially if the future promises to offer cheaper and more immediate and convenient ways to pay. Here is what we envisage: platforms offering a marketplace where digital money can be exchanged and sent internationally.

As with all good stories, it helps to start at the beginning. Once upon a time, there was money. What is money? It's essentially an IOU—a promise to pay—made by one party, like a bank, to another, like the holder of a savings or checking account. We lend funds to our bank, which in return offers us a means to buy goods and services. Modern money is credit.

As money is credit, its value lies in trust. We trust our bank to hold good-quality assets, and our bank trusts us not to engage in money laundering and terrorism financing. Trust is a two-way street. Without trust, money is no longer a good store of value or a means of payment. In exchange for a good that we sell, we accept only the money we trust. That is, money circulates only within an established network of trust.

### **Enter central banks**

So if Joe and Sally are customers of the same bank, Joe should readily accept Sally's money—both trust the same issuer and are trusted by it. But what if they bank with different institutions, albeit in the same country? Joe (or his bank) does not necessarily know or trust Sally's bank. And yet transactions from one bank to the other are common. We take these for granted, but in fact the invisible mechanisms that make them possible were developed and refined over centuries.

To cut the story short, the trick boils down to banks trusting not each other, but the central bank. Joe's bank does not receive or hold money from Sally's bank. It receives perfectly safe—and trusted—special central bank money called “reserves” from Sally's bank. Those reserves—accounts that banks hold at the central bank—and the network over which they are traded are two essential public goods provided by central banks behind the scenes. Central banks serve as the bridges between trust networks. And these

bridges allow money that Joe trusts on the one hand, and that Sally trusts on the other, to be exchanged.

Across borders, bridges between trust networks are much harder to establish. There is no commonly trusted asset or network to settle transactions. To make things worse, information is scarcer across borders and legal recourse more difficult. So the costs of establishing trust are higher.

And yet cross-border transactions do happen, albeit with the drawbacks we routinely face. Again, there's a trick, courtesy of specialized commercial banks called correspondent banks.

Imagine Sally and Joe live in different countries, and Sally wants to send money to Joe. Sally's bank contacts Joe's bank through a messaging network and asks it to credit Joe's account. Joe's bank initially protests, as it doesn't receive any funds in return. But Sally's bank offers an IOU, suggesting that next time Joe's bank needs to send a payment abroad, Sally's bank will reciprocate. It's give and take. So Joe's bank agrees to extend credit to Sally's bank (accept the IOU) and in turn to credit Joe's account. It's this handshake between banks that know each other well—that trust each other—that stands behind today's cross-border transactions.

But banks are not willing to shake many hands. Establishing and monitoring trust is costly, as is dealing with the risks inherent in extending bilateral credit to another bank. Few banks can cover these costs and still generate profits. So only a handful of very large institutions with strong bilateral relationships control the correspondent banking market. It's no surprise our payments are costly, slow, and opaque.

### **A radical transformation**

Things could change as money becomes tokenized; that is, accessible to anyone with the right private key and transferable to anyone with access to the same network. Examples of tokenized money include so-called stablecoins, such as USD Coin, and central bank digital currency (CBDC), which some countries, such as The Bahamas and Nigeria, have already launched and an increasing number are actively evaluating.

Tokenized money introduces a radical transformation that breaks down the need for two-way trusted relationships. Anyone can hold a token, even without having a direct relationship with the issuer. Joe can send Sally tokens he holds in his wallet, as long as Sally's wallet is compatible. The

issuer of Joe's tokens may not know anything about Sally—though her wallet will.

This transformation greatly enhances the efficiency of correspondent banking. How? First, risks are lower. Joe's bank does not have to extend unsecured credit—which isn't backed by any asset—to Sally's bank to process a payment. It will receive a tokenized deposit in Sally's bank—a concrete form of money—that can be sold onward or potentially even redeemed for hard assets such as government bonds. The need for trust dissipates.

Second, Joe's bank will hold a liquid asset that it can sell, trade, or hedge more easily than an unsecured IOU. And third, correspondent banking can be made more competitive, which should improve the quality of service—including speed—and reduce fees. Sally's bank does not have to deal exclusively with the correspondents it happens to trust. Any bank or financial institution with a compatible wallet can receive Sally's payment and issue a payment to Joe's bank. Handshakes are no longer limited to close friends.

## A digital platform

But handshakes do need to be coordinated. And that's where the platform comes in. The platform will broadcast Sally's payment order, collect participants' bids for correspondent banking services, and ensure payments are made in a timely fashion.

A key question is, Which assets will be traded on the platform? Tokenized bank deposits, as in the previous example, are one option. Another is CBDC. In that case, Sally's bank would first exchange its reserves for CBDC, then transfer it to a willing correspondent through the platform. The advantage is that more correspondents may be willing to engage, because holding CBDC is less risky, in most cases, than holding the liability of a foreign private company. And from a social perspective, settlement in a safe and liquid asset such as CBDC is preferable because it will give rise to fewer disputes down the line. But other digital assets, such as well-regulated stablecoins, could also be exchanged on the platform. The real requirement is that a wide body of counterparties trust the asset—not necessarily each other—to be stable.

The platform idea goes further. Instead of merely orchestrating payments (offering clearing services, in the jargon), the platform could provide settlement services—the handshakes that move money from one owner to another. In the earlier example, the

handshake was between two correspondent banks. But there is an alternative: the platform could take in money such as CBDC from Sally's bank, hold it in an escrow account, and issue a token against it for settlement on the platform to Joe's bank. In essence, the platform would bring each participating institution's money onto a single ledger. Think of that as taking in different monies, putting them in a basket everyone recognizes, and seamlessly exchanging those baskets between participants and across borders.

Doing so could be extremely powerful. The platform's ledger could be leveraged to write so-called smart contracts, which are essentially programmable transactions. For instance, a payment could be made only when another is received. Or firms could automatically hedge foreign exchange risks of transactions or pledge a future incoming payment in a financial contract. More is also possible. Auctions could be designed to encourage the exchange of currencies that typically are shunned, thus expensive, in cross-border payments.

The possibilities are infinite. And that is precisely the point—the private sector would be able to extend the uses of the platform by writing smart contracts. It would do so by leveraging two key public goods: a common settlement platform and a common programming language to write smart contracts that are compatible with one another. So the platform would emerge as a tight public-private partnership. The challenge will be to find the right governance arrangements and to mobilize a sufficient number of central banks to pull this off. The IMF, with its near universal membership, is a good place to start exploring these prospects.

We will soon publish two papers on these topics with coauthors Dong He and Federico Grinberg of the IMF; Rod Garratt of the University of California, Santa Barbara; and Robert Townsend and Nicolas Xuan-Yi Zhang of the Massachusetts Institute of Technology. The papers will lay out an initial blueprint for such platforms in the hope of stimulating further discussion on these important topics, which are likely to shape the future of cross-border payments. Much remains to be explored, debated, and eventually done. The effort is certainly worth it, if anything to avoid embarrassing questions about what happens today behind the cloak of bilateral handshakes. [FD](#)

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**TOBIAS ADRIAN** is director of the IMF's Monetary and Capital Markets Department, where **TOMMASO MANCINI-GRIFFOLI** is division chief.

## 'DeFi' and 'TradFi' Must Work Together

*Decentralized and traditional finance can thrive in tandem to fund renewable energy and other pressing needs, but only with clear standards and rules*

**Michael Casey**



PHOTO: COURTESY OF MICHAEL CASEY

**THE CRYPTOCURRENCY INDUSTRY** is in the throes of a crypto winter.

Tokens like bitcoin and Ethereum's ether have lost three-quarters of their value while major crypto lending and investing firms have collapsed into bankruptcy.

But to be fair, it's also pretty wintry in traditional finance—or TradFi, as the crypto and DeFi (decentralized finance) community refers to the financial and economic old guard. We have the highest inflation in 40 years, a war that's fractured the international monetary system, an energy and commodity crisis sowing famine and political unrest, and record temperatures exposing a massive shortfall in investment to fight climate change.

The reality is, both sides need each other.

If they are to attain mainstream adoption, DeFi and crypto must integrate some of the regulatory and self-regulatory practices that have brought functional stability to TradFi. But there's also an urgent need

for the stewards of the global economy to explore DeFi and crypto solutions to its many problems.

One area to focus on is the highly centralized energy industry.

Consider the negotiations with Saudi Crown Prince Mohammed bin Salman to boost oil production and combat soaring global prices in the aftermath of Russia's invasion of Ukraine. That world leaders must cater to the interests of a sole unelected human being to solve an economic crisis that affects all 8 billion of us is the epitome of a centralization problem.

Another stark example: Germany's dependence on Russian natural gas, which constrains its capacity to impose sanctions on the Kremlin. Or last year's shutdown of the Colonial pipeline, when ransom-demanding hackers exploited the fact that 60 million people depend on the pipeline's gasoline. And one more: 2017's Hurricane Maria, which after knocking down a few high-voltage transmission lines, left 90 percent of Puerto Ricans deprived of power for months.

Vulnerability to outside events—which electricity system designers describe as a lack of “redundancy”—is as good a reason as any to advocate for renewable energy in response to the climate crisis. We desperately need to decentralize our energy model. Renewables such as solar, geothermal, and wind—or the recycling of waste heat and energy—are the answer. They are locally sourced and can function at wide ranges of scale.

But what does decentralized energy have to do with decentralized finance?

It starts with recognizing that the world's insufficient response to our energy crisis is not a failure of technology—it's a failure of funding.

The Climate Policy Initiative, a San Francisco-based think tank, estimates that the world invested \$632 billion in addressing climate change in 2019–20, far short of the \$4.5–\$5 trillion it says is needed annually to achieve net zero carbon emissions by 2050.

It's not for lack of desire—governments and companies everywhere are committing to ambitious carbon reduction goals. It's that investors can't find enough projects in whose promised returns and impact they are sufficiently confident.

In most cases, two elements are lacking: first, reliable, rapidly actionable information with which to measure and project outcomes, and second, a source of persistent, flexible user demand that would make renewable energy production economically viable in places where it's available.

Both can be addressed by the financial innovation spurred by the open-source developer communities of DeFi and crypto.

### Green funding potential

The prospects for actionable information lie in the technology's ability to immediately convert data into tradable assets, a result of its automated, near-instant peer-to-peer settlement and its capacity to define unique digital units of any size or value. The efficiencies are potentially enormous when compared with, say, the analog world of green bonds, which require many layers of bureaucracy and are based on retroactive data that take months, even years, to generate and verify.

Crypto technology allows plants fitted with provably secure sensors and blockchain-based tracking systems to verify they're generating renewable power and then instantly represent that information as unique one-off tokens.

In a DeFi environment, those tokens can become collateral for lenders. Incorporating programmable cryptocurrencies, stablecoins, or central bank digital currencies, the model gives investors a form of remote security. With governments and ESG-compliant companies ratcheting up demand for proven carbon-reducing assets, a giant pool of liquidity could arise around these tokens, forging the deep capital markets that climate action needs.

This approach could drive down financing costs for all kinds of projects. Imagine a remote

community in Rwanda building a DeFi-funded solar microgrid to power a new irrigation system and you get an idea of the potential.

And then there's the demand problem.

Imagine that economies of scale require that, to be financially viable, the Rwandan microgrid must have at least 2 megawatts of capacity, but the new irrigation system needs only 500 kilowatts. How would a poor community with modest electricity needs make up the shortfall?

The answer lies in Bitcoin, which may seem counterintuitive to anyone who has joined recent crusades to ban "wasteful" proof-of-work mining in New York and elsewhere.

Unlike other users of energy, Bitcoin mining is geography-agnostic. Miners will operate anywhere. They will happily absorb any community's excess or otherwise wasted energy, so long as it is priced low enough to keep them profitable and competitive.

**If we can't regulate Bitcoin out of existence, then the objective should be to steer it toward renewable sources.**

What is the cheapest form of energy? By definition, it's renewables. Already, 53 percent of the Bitcoin network runs on renewable energy, according to the Cambridge Center for Alternative Finance, not because miners are altruistic but because they are profit-seeking.

Now that bitcoin prices have plunged, and with Intel's new Blockscales application-specific integrated circuits (ASICs) poised to create a glut of cheap chips for miners, the presence of low-cost energy will become the main factor in any miner's expansion plans.

As long as regulators don't prevent them from forging relationships, renewable energy developers will find miners to be willing, valuable partners.

They will agree to large energy contracts up-front that underwrite plant development and commit to consuming excess energy production during periods of low community consumption to smooth out the troughs and peaks in the grid. Mining can make the economics of electricity predictable and viable.

To be fair, the other 47 percent of the Bitcoin network is emitting a lot of carbon. The Cambridge Center for Alternative Finance’s midrange estimate is that the total network currently consumes around 84 terawatt hours of electricity annually, about 0.38 percent of total world consumption. That’s because Bitcoin’s proof-of-work algorithm is highly energy-intensive. It’s why proponents of far less energy-intensive proof-of-stake systems advocate their usage for digital assets such as non-fungible tokens.

Like it or not, however, Bitcoin is not going away. When mining is banned in one place, it simply moves, as in 2021, when a ban in China prompted much of the industry to migrate to the United States, Kazakhstan, and other places.

If we can’t regulate Bitcoin out of existence, then the objective should be to steer it toward renewable sources—or away from fossil fuel sources. It’s time for sensible energy policies that remove subsidies for dirty power plants and entice Bitcoin miners to provide long-term funding commitments to renewable providers with minimum capacity thresholds for their communities.

The goal here is not just renewables expansion, but decentralization. Let’s not follow the lead of El Salvador, whose government is mining Bitcoin at a government-owned geothermal plant and keeping the proceeds for itself. Rather, developing economies should encourage partnerships between miners and community-based solar microgrids, spreading wealth and generation capacity to achieve both social goals and grid redundancy.

### Rethinking regulation

None of this is to say the crypto industry is without problems. The sector’s recent financial contagion highlighted the dangers of a speculation culture that spawned unfettered leverage and scams. The use of anonymity to front-run markets through wash trades and other pump-and-dump scams is especially acute. Clearer, more effective regulation is needed.

We should avoid, however, applying the outdated regulatory models of the existing centralized financial system to decentralized crypto projects that function very differently. By applying a centralized solution—for example, by trying to make far-flung, leaderless groups of open-source developers accountable for users of the DeFi protocols they work on—we may introduce rather than mitigate risks.

The three biggest sources of the recent financial contagion were centralized “CeFi” services—Celsius, Voyager Digital, and Three Arrows Capital—while the other big failure, the de facto Ponzi scheme known as Terra Luna, was DeFi in name only. Real DeFi projects such as Aave and Compound have so far survived this intense stress test remarkably well.

Yet there are other big risks in DeFi. Crypto security firm Immunefi estimates that \$670 million was lost in the second quarter of 2022 from smart contract breaches and hacks. If DeFi is to win over new followers, users will need much stronger assurances that their funds are safe.

### The trick is to find a balance

Regulators should impose stricter fiduciary requirements on the managers of CeFi services—treat them like brokerages or other regulated financial institutions. But for DeFi operations, they should work with the industry to develop self-regulatory solutions that tap its technological strengths and lean into its decentralized structure. Ideas include expanding the “bug bounties” that reward developers who identify and fix incidents, mandating periodic software audits, and conducting frequent stress tests of leverage and collateral models.

Above all, we need consensus around what constitutes a decentralized system and on whether projects that intend to evolve in that direction are appropriately doing so.

In short, all interested parties from both the DeFi and TradFi worlds must first agree on frameworks and a common lexicon, then establish standards and rules. This is not easy—but it must be done. There is too much at stake. **FD**

**MICHAEL CASEY** is chief content officer of the news site CoinDesk.

# The Superficial Allure of Crypto

*Cryptocurrencies cannot deliver their claimed benefits, and instead pose grave risks that policymakers must curb*

Hilary J. Allen



PHOTO: BEVY GEBBO

**IN THE 14 YEARS** since Bitcoin emerged, proponents have made promises that crypto will revolutionize money, or payments, or finance—or all of the above. These promises remain unfulfilled and look increasingly unfulfillable—yet many policymakers have accepted them at face value, supporting crypto experimentation as a necessary step toward some vague innovative future. If this experimentation were harmless, policymakers could let it be, but the ills of crypto are significant. Given these negative impacts, policymakers must train a more critical eye both on crypto assets themselves and on their underlying databases (known as blockchains) to determine whether crypto can ever deliver on its promises. If it cannot, or is even unlikely to, deliver, there must be strong regulation to rein in the negative consequences of crypto experimentation.

Among its negative impacts, the rise of crypto has spurred ransomware attacks and consumed excessive energy. Bitcoin's blockchain relies on a proof-of-work validation mechanism that uses about as much energy as Belgium or the Philippines; the Ethereum

blockchain keeps promising to shift from proof of work to the more energy-efficient proof of stake, but this never seems to happen.

A crypto-based financial system would perpetuate, and even magnify, many of the problems of traditional finance. For example, the amount of leverage in the financial system could be multiplied through a potentially unlimited supply of tokens and coins serving as collateral for loans; rigid self-executing smart contracts could deprive the system of the flexibility and discretion so necessary in unexpected and potentially dire situations. More generally, the crypto ecosystem is extremely complex, and that complexity is likely to be a destabilizing force (both because complexity makes it hard to assess risks even when there's plenty of data and because the more complex a system is, the more susceptible it is to “normal accidents,” when a seemingly minor trigger cascades into significant problems). So any crypto-based financial system would likely be subject to regular destabilizing booms and busts.

Crypto's complexity arises from attempts at decentralization—by distributing power and governance in the system, there is theoretically no need for trusted intermediaries like financial institutions. That was the premise of the initial Bitcoin white paper, which offered a cryptographic solution intended to allow

**Policymakers should not be swayed by the dubious promises of decentralization and democratization.**

payments to be sent without involving any financial institution or other trusted intermediary. However, Bitcoin became centralized very quickly and now depends on a small group of software developers and mining pools to function. As internet pioneer and publisher Tim O'Reilly observed, “Blockchain turned out to be the most rapid recentralization of a decentralized technology that I've seen in my

lifetime.” Although the Bitcoin white paper’s promise of decentralization did not deliver, the underlying complexity of the technology that tried to do so remains—which is also true of crypto writ large.

Over the spring and summer of 2022, we saw a number of other purportedly decentralized crypto players stumble and fail—and as they did so, it became abundantly clear that there were intermediaries calling the shots. A stablecoin is a type of crypto asset designed to maintain a stable value, and as the Terra stablecoin lost its peg to the dollar in May 2022, holders looked to founder Do Kwon’s Twitter feed for guidance. Before Terra failed, it received an attempted rescue package of crypto loans from a nonprofit established by Kwon. The loaned crypto was allegedly deployed to allow some of Terra’s largest holders—commonly referred to as “whales”—to redeem their Terra stablecoins at close to par value, while smaller investors lost nearly everything. In the crypto market turmoil that followed the failure of Terra, multiple episodes showed the power of founders and whales in platforms ostensibly administered by decentralized autonomous organizations. Many crypto proponents were quick to criticize the affected platforms, saying that they were never really decentralized in the first place and that only the “truly decentralized” deserved to survive. *All* of crypto, however, is centralized to varying degrees.

### ‘Decentralization illusion’

Voting rights in decentralized autonomous organizations and wealth tend toward concentration in crypto even more than in the traditional financial system. In addition, decentralized blockchain technology cannot handle large volumes of transactions very well and does not accommodate transaction reversal, so it seems inevitable that intermediaries will emerge to streamline unwieldy decentralized services for users (especially because there are profits to be made by doing so). Without mincing words, economists at the Bank for International Settlements concluded that there is a “decentralization illusion” that is “due to the inescapable need for centralized governance and the tendency of blockchain consensus mechanisms to concentrate power.” And of course, many of the crypto businesses that have emerged over the past decade make no pretense of decentralization: centralized

exchanges, wallet providers, and stablecoin issuers, for example, are all critical players in the crypto ecosystem. Many of these intermediaries are simply new (and often unregulated) equivalents of what already exists in traditional finance.

And so crypto users will always have to trust in *people*. These people are no less greedy or biased than anyone else—but they are largely unregulated (sometimes even unidentified), and in the absence of consumer protection regulation, the crypto industry’s claims of furthering financial inclusion take on a more troubling cast. The crypto ecosystem is certainly rife with hacks and scams that prey on users, but at a more fundamental level, the value of crypto assets is driven entirely by demand because there is no productive capacity behind them, and so founders and early investors can profit only if they can find new investors to sell to. If they rely on traditionally underserved populations to make up that market, then the most vulnerable members of society—in both developed and developing economies—could be left holding the bag.

Even if the market for crypto assets were somehow sustainable, there are many reasons to doubt that crypto could democratize finance. For example, crypto lending platforms demand significant amounts of crypto collateral before they grant loans, so they won’t help those who lack financial assets to begin with. And although stablecoins are often touted as a better payment mechanism for underserved populations, the World Economic Forum concluded that “stablecoins as currently deployed would not provide compelling new benefits for financial inclusion beyond those offered by preexisting options.”

### Fixing finance’s flaws

To be clear, financial inclusion is a real and pressing problem, and there are also many other problems with traditional finance that need to be solved. Part of the reason crypto firms, venture capitalists, and lobbyists have been so successful in selling crypto is their very lucid and compelling indictment of our current financial system. The largest banks *did* perform terribly in the lead-up to 2008 (and some still do); lots of people *are* underserved by the current financial system; in the United States, in particular, payment processing *is* too slow.

## Applying laws and rules to centralized crypto intermediaries would be relatively straightforward.

However, these are by and large political rather than technological problems—and if the underlying political issues aren't resolved, the new crypto intermediaries that emerge will simply perpetuate existing problems. Where technological upgrades to our current systems are indeed necessary, there are often simpler, centralized technological solutions already (as is the case with real-time payments). What is often lacking is the political will to implement those solutions.

In an era of growing political dysfunction, it is understandable that policymakers might want to believe that technology can fix things without their involvement. Unfortunately, crypto does not live up to its claims of decentralization, and crypto's booms and busts could have broad economic consequences if it is integrated with the traditional financial system and able to interrupt the flow of capital to the real economy.

To limit the fallout from crypto implosions and protect the broader economy, regulators should take steps to erect a firewall between crypto and traditional finance.

As a first priority, banks should be prohibited from issuing or trading any crypto asset, including stablecoins (which are rarely used for real-world payments; they mostly facilitate crypto investments). Such steps could be carried out within existing banking law frameworks, often without any new laws or rules. Policymakers should consider enacting new laws or rules, though, that target the crypto industry more directly. Given crypto's lack of benefits and negative impacts, an outright ban may be appropriate; if policymakers don't wish to implement a ban, crypto's negative impacts should be managed with more targeted laws or rules. Applying laws and rules to centralized crypto intermediaries would be relatively straightforward (although jurisdictional issues may arise); their application to nominally decentralized players may face a few extra hurdles. These hurdles are not insurmountable, though, because no part of crypto is entirely decentralized. People could be barred from holding governance tokens in noncompliant decentralized

autonomous organizations, for example—which would be relatively easy to enforce against the founders, venture capital firms, and whales who own the lion's share.

Ultimately, policymakers should not be swayed by dubious promises of decentralization and democratization; they should be proactive in stopping crypto's negative impacts. The architects of the future of finance have many problems to solve and should come up with the simplest and most direct solutions. Trying to retrofit crypto assets and blockchains to solve those problems will in all likelihood only make things worse. **FD**

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# CENTRAL BANKERS' NEW CYBERSECURITY CHALLENGE

Central bank digital currencies may pose security risks, but responsible design can turn them into opportunities

**Giulia Fanti, Josh Lipsky, and Ole Moehr**

In the typically cautious world of central banking, the idea of a central bank digital currency (CBDC) is moving at lightning speed. Atlantic Council GeoEconomics Center research shows that 105 countries and currency unions are currently exploring the possibility of launching a CBDC, either retail—issued to the general public—or wholesale, used primarily for interbank transactions. That’s up from an estimated 35 as recently as 2020. It is not just smaller economies that are interested, either; 19 Group of Twenty (G20) countries are considering issuing CBDCs, and the majority have already progressed beyond the research stage.

But as more countries launch CBDC pilot projects, concerns about cybersecurity and privacy loom large. Federal Reserve Chair Jerome Powell recently listed “cyber risk” as his number one worry relating to financial stability, and a recent UK House of Lords report specifically described cybersecurity and privacy risks as potential reasons not to develop a CBDC.

These concerns are not unfounded. CBDC vulnerabilities could be exploited to compromise a nation’s financial system. CBDCs would be able to accumulate sensitive payment and user data at an unprecedented scale. In the wrong hands, this data could be used to spy on citizens’ private transactions,

## Technology enables central banks to ensure that both cybersecurity and privacy protection are embedded in any CBDC design.

obtain security-sensitive details about individuals and organizations, and even steal money. If implemented without proper security protocols, a CBDC could substantially amplify the scope and scale of many of the security and privacy threats that already exist in today's financial system.

Until recently, little work had been done publicly in the cybersecurity and central banking world to actually understand the specific cybersecurity and privacy risks associated with CBDCs. Few have considered whether CBDC designs could mitigate risks or perhaps even improve the cybersecurity of a financial system.

Our new research, published in the Atlantic Council's recent report, titled "Missing Key—The Challenge of Cybersecurity and CBDCs," analyzes the novel cybersecurity risks CBDCs may present for financial systems and makes the case that policymakers have ample options to safely introduce CBDCs. There are many design variants for CBDCs, ranging from centralized databases to distributed ledgers to token-based systems. Each design needs to be considered before reaching conclusions about cybersecurity and privacy risks. These designs also need to be compared with the current financial system—the one that keeps Powell up at night—to determine if new technology could deliver safer options.

So what are some of the main new cybersecurity risks that could arise in a CBDC? And more important, what can be done to mitigate these risks?

### Centralized data collection

Many of the proposed design variants for CBDCs (particularly retail CBDCs) involve the centralized collection of transaction data, posing major privacy and security risks. From a privacy standpoint, such data could be used to surveil citizens' payment activity. Accumulating so much sensitive data in

one place also increases security risk by making the payoff for would-be intruders much greater.

However, the risks associated with centralized data collection can be mitigated either by not collecting it at all or by choosing a validation architecture in which each component sees only the amount of information needed for functionality. The latter approach can be aided by cryptographic tools, such as zero-knowledge proofs, which authenticate private information without revealing it and allowing it to be compromised, or cryptographic hashing techniques. For example, Project Hamilton (a joint effort by the Boston Federal Reserve and the Massachusetts Institute of Technology to explore a US CBDC) has designed a system that separates transaction validation into phases, and each phase requires access to different parts of the transaction data.

These cryptographic techniques can be extended even further to build systems that verify transaction validity with only encrypted access to transaction details like sender, receiver, or amount. While these tools sound too good to be true, they have been tested extensively in privacy-preserving cryptocurrencies such as Zcash and are based on significant advances in the cryptography community. The bottom line is that technology enables central banks to ensure that both cybersecurity and privacy protection are embedded in any CBDC design.

### Transparency vs privacy

A common concern with privacy-preserving designs (including those that use specialized cryptographic techniques) is reduced transparency for regulators. Regulators generally require enough insight to identify suspicious transactions, enabling them to detect money laundering, terrorism financing, and other illicit activities.

But even this is not an either/or decision. Cryptographic techniques can be used to design

## International standard-setting and more knowledge sharing between banks is critical at this moment of rapid development and adoption.

CBDCs that provide cash-like privacy up to a specific threshold (for example, \$10,000) while allowing government authorities to exercise sufficient regulatory oversight. This kind of threshold is not so different from the current system in the United States, which allows reduced reporting for transactions under \$10,000. The reality is that in many ways, a new CBDC system would not need to reinvent security protocols but could instead improve on them.

Several countries have committed to or even deployed retail CBDCs whose underlying infrastructure is based on distributed ledger technology. Nigeria's eNaira, launched in October 2021, is a good example. Such designs require the involvement of third parties as validators of transactions. This introduces a new role for third parties (for example, financial and nonfinancial institutions) in central bank money operations. Critically, the security guarantees of the ledger would depend on the integrity and availability of third-party validators, over which the central bank may not have direct control. (Although it is possible to implement distributed ledger technology with all validators controlled by the central bank, doing so largely defeats the purpose of using the technology.) The associated risks can potentially be mitigated through regulatory mechanisms such as auditing requirements and stringent breach disclosure requirements. However, there is not a clear blueprint for devising these regulations in a system as time-sensitive and closely interconnected as a distributed-ledger-based CBDC. This is why the need for international standard-setting and more knowledge sharing between banks is critical at this moment of rapid development and adoption.

### Threat or opportunity?

Over the past 18 months some central banks have prematurely decided that a CBDC poses too many cybersecurity and privacy risks. We wanted to determine what is truly a threat and what is actually an opportunity. We concluded that

governments have many CBDC design options to choose from, including new variants that have not yet been fully tested in current central bank pilots. These variants present different trade-offs in terms of performance, security, and privacy. Governments should choose a design option based on a country's needs and policy priorities. Based on our evaluation of these trade-offs, CBDCs are not inherently more or less secure than existing systems. While responsible designs must take cybersecurity into account, that should not prevent consideration of whether to design and test a CBDC in the first place.

One thing is abundantly clear in our research. Fragmented international efforts to build CBDCs are likely to result in interoperability challenges and cross-border cybersecurity risks. Countries are understandably focused on domestic use, with too little thought for cross-border regulation, interoperability, and standard-setting. Regardless of whether the United States decides to deploy a CBDC, as issuers of a major world reserve currency, the Federal Reserve should help lead the charge toward development of global CBDC regulations in standard-setting bodies. International financial forums, including the Bank for International Settlements, IMF, and G20 have a similarly critical role to play.

CBDCs' cybersecurity and privacy risks are real. But solutions to these challenges are within the grasp of technologists and policymakers. It would be unfortunate to preemptively decide the risks are too high before developing solutions that could actually help deliver a more modern and stable global financial system. [FD](#)

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# DEFI'S PROMISE AND PITFALLS

Decentralized finance could support a new financial infrastructure if challenges are overcome

Fabian Schär

**D**igital innovation has brought major improvements to the financial system. But the system's architecture remains essentially the same. It's still centralized.

Decentralized finance (DeFi) offers an alternative. It uses public blockchain networks to conduct transactions without having to rely on centralized service providers such as custodians, central clearinghouses, or escrow agents. Instead, these roles are assumed by so-called smart contracts.

Smart contracts are instructions in the form of computer code. The code is stored on public blockchains and executed as part of the system's consensus rules. DeFi protocols can be designed in a way that prohibits intervention and manipulation. All participants can observe the rules before they engage and verify that everything is executed accordingly. State changes (for example, updates to account balances) are reflected on the blockchain and can be verified by anyone.

In the context of DeFi, smart contracts are used mainly to ensure the atomic (simultaneous and inseparable) transfer of two assets or to hold collateral in an



escrow account. In both cases, the assets are subject to the smart contract's rules and can be released only if the predefined conditions are met.

Making use of these properties, DeFi can mitigate counterparty risk and replicate numerous financial services without the need for intermediaries and centralized platform operators. This can reduce costs and the potential for errors. Lending markets, exchange protocols, financial derivatives, and asset management protocols are just a few examples.

Smart contracts can reference other smart contracts and make use of the services they provide. If, for example, an asset management protocol uses a decentralized exchange, incoming assets can be swapped as part of the same transaction. This concept, of actions across multiple smart contracts that can take place within a single transaction, is referred to as “intra-transaction composability” and can effectively mitigate counterparty risk (the likelihood that other parties will not fulfill their end of the deal).

### **Benefits of decentralization**

Many advantages usually attributed to DeFi—or blockchains in general—can also be achieved via centralized infrastructure. Smart contracts are not limited to decentralized systems. In fact, the same standards and execution environments can be used on centralized ledgers. There are countless examples of the Ethereum virtual machine (a virtual machine that runs on all computers in the blockchain network and executes smart contracts) being employed alongside heavily centralized consensus protocols. Similarly, the same token standards and financial protocols can be used on centralized platforms. Even composability can work on such systems.

Moreover, well-managed centralized systems are much more efficient than public blockchains. That could lead to the conclusion that public blockchains and DeFi are inferior to centralized systems.

However, centralized systems rest on a very strong assumption: trust in intermediaries and institutions that are largely opaque. But such trust should not be taken for granted. History provides countless examples of corruption and errors within institutions. Yet, when economists discuss financial infrastructure and compare the properties

of public blockchains with those of centralized ledgers, they usually assume centralized entities are benevolent, making it hard to see the benefits of decentralization.

Public blockchains are transparent. Because they are not controlled by a single entity, they can provide a neutral, independent, and immutable infrastructure for financial transactions. The code is stored and executed on an open system. All data is available and verifiable. This allows researchers and policymakers to analyze transactions, run empirical studies, and compute risk metrics in real time.

Most important, access is not restricted. This has two implications.

First, the absence of access restrictions provides a neutral foundation that cannot discriminate between use cases nor stakeholders. This is in sharp contrast to permissioned ledgers, whose rules are set by a centralized entity. Because it's so centralized, universally accepted standards may be hard to achieve, and the rights to access and use the infrastructure could easily be politicized. In anticipation of such problems, participants who feel that this may be to their disadvantage will not use the centralized infrastructure in the first place. Decentralized systems can mitigate these holdups, potentially preventing the problem of no, or minimal, cooperation.

Second, DeFi is built on a layered infrastructure (see Schär 2021). A decentralized ledger does not mean that everything deployed on top of it must be equally decentralized. There may be good reasons for access to certain tokens or financial protocols to be restricted or subject to intervention. These restrictions can be implemented at the smart contract level without compromising the general neutrality of the base infrastructure. However, if the ledger itself (settlement layer) were already centralized, it would be impossible to credibly decentralize anything built on top of it.

It is very likely that we will see a move toward ledgers that combine payments, tokenized assets, and financial protocols, such as exchanges and lending markets. DeFi is the first example of this development, but there will be similar developments in centralized infrastructure. The rationale is that intra-transaction composability works only if the assets and financial protocols are on the

## Centralized systems rest on a very strong assumption: trust in intermediaries and institutions.

same ledger. There are strong network effects, and neither crypto assets nor central bank digital currencies would be particularly compelling if deployed on a ledger with no other assets or financial protocols. It is possible to create composable centralized infrastructure with additional assets and financial protocols, but it would be risky and difficult to govern given the challenges associated with permissioned ledgers. This makes a strong case for decentralization.

### Challenges and risks

There are many advantages to be gained from DeFi, but there are challenges and trade-offs to be considered.

First, there is the risk of deception, or “decentralization theater.” What is generally referred to as DeFi is, in fact, often heavily centralized. In many cases, DeFi protocols are subject to centralized data feeds and can be shaped or influenced by people with “admin keys,” or a highly concentrated governance token allocation (voting rights). While partial centralization is not necessarily a bad thing, it is important to strictly differentiate between true decentralization and companies that claim to be DeFi when in fact they provide centralized infrastructure.

Second, immutability can introduce new risks. It might be harder to enforce investor protection, and smart contract programming errors can have devastating consequences. Composability and complex token wrapping schemes (Nadler and Schär, forthcoming) that resemble the rehypothecation of collateral contribute to shock propagation in the system and may affect the real economy.

Third, the transparent nature of the blockchain and decentralized block creation can be problematic from a privacy perspective. Moreover, it allows for the extraction of rents through generalized front-running—a phenomenon known as miner/maximal extractable value (MEV). Those who observe a transaction that contains an order to swap assets on a decentralized exchange can try to front-run (or sandwich) this action by issuing a transaction of their own. The front-runner thereby

profits at the expense of the issuer of the original transaction. There are potential solutions that may at least partially mitigate this problem, but they involve trade-offs.

Finally, the scaling of public blockchains cannot be done easily without compromising some of their unique properties. Decentralized block creation inflicts severe costs. Hardware requirements to run a node can't be arbitrarily high, as this would price out many stakeholders and compromise decentralization. This limits on-chain scalability, pushing up transaction fees. This trade-off between security, decentralization, and scalability is usually portrayed as a trilemma. A potential solution is so-called Layer 2s. These are designed to move some of the burden away from the blockchain while allowing participants to enforce their rights on the blockchain in case anything goes wrong. This is a promising approach but, in many cases, still requires trust and various forms of centralized infrastructure.

DeFi still faces many challenges. However, it can also create an independent infrastructure, mitigate some risks of traditional finance, and provide an alternative to excessive centralization. The open-source nature of DeFi encourages innovation, and there are many talented people—academics and practitioners alike—working on these challenges. If they can find solutions without undermining the unique properties at the core of DeFi, it could become an important building block for the future of finance. **FD**

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## CENTRAL BANK DIGITAL CURRENCY

Potentially a new form of digital central bank money that can be distinguished from reserves or settlement balances held by commercial banks at central banks. It is a central bank liability, denominated in an existing unit of account, which serves both as a medium of exchange and a store of value. CBDCs are not cryptoassets.



## FINANCIAL INCLUSION

Individuals and businesses have access to useful and affordable financial products and services that meet their needs—such as transactions, payments, savings, credit, and insurance—and are delivered in a responsible and sustainable way.

## SECURITY TOKENS

Crypto assets that meet the definition of security in the jurisdiction where they're issued, marketed, transferred, exchanged or stored.

## STABLECOIN

A crypto asset that aims to maintain a fixed value relative to a specified asset, or a basket of assets.



## DECENTRALIZED FINANCE (DEFI)

A set of alternative financial markets, products and systems that use crypto assets and software known as smart contracts that are built using distributed ledger or similar technology.

## UNBACKED CRYPTO ASSET

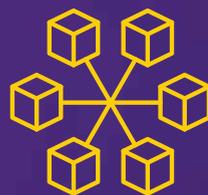
Crypto assets that are neither tokenized traditional assets nor stablecoins.



## BLOCKCHAIN

A distributed ledger in which transaction details are held in blocks of information.

A new block is attached to the chain of existing blocks via a computerized process that validates transactions.



# DIGITAL MONEY

**DIGITAL ASSETS**

A digital instrument issued or represented using distributed ledger or similar technology. This excludes digital representations of fiat currencies.



**DISTRIBUTED LEDGER TECHNOLOGY (DLT)**

A means of saving information through a distributed ledger, such as a repeated digital copy of data available at multiple locations. A database that's stored, shared and synchronized on a computer network. Data is updated by consensus among the network participants. Blockchain is one example, but it doesn't necessarily maintain its record using the same chain of blocks architecture.

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**CRYPTO ASSET**

Also known as cryptocurrency, a private sector digital asset that depends primarily on cryptography and distributed ledger or similar technology.

**E-MONEY**

A stored monetary value or prepaid product in which a record of the funds or value available to the consumer for multipurpose use is stored on a prepaid card or electronic device like a computer or phone, and which is accepted as a payment instrument by other than the issuer (multipurpose use). The stored value represents a claim enforceable against the e-money provider to repay the balance on demand and in full.

**UTILITY TOKENS**

Crypto assets that give holders a right to access a current or prospective product or service from the issuer or issuing network.

A close-up portrait of Stefanie Stantcheva, a woman with long, wavy brown hair, smiling slightly. She is wearing a dark blazer and a colorful patterned scarf. The background is a blurred outdoor setting with green foliage.

# Getting into PEOPLE'S HEADS

*Marjorie Henriquez profiles Harvard's **Stefanie Stantcheva**, who uses surveys and experiments to uncover the invisible in traditional economic data*

PHOTO: TYLER SMITH

**A**fter studying taxation for several years, Stefanie Stantcheva came to a daunting conclusion: people have complex and deep-rooted views that are hard for economists to understand. When crafting policy advice with a social objective in mind, like reducing inequality, economists don't have enough data to guide them on what people know, believe, and consider to be fair, she found.

Stantcheva, an economics professor at Harvard University, wants to change that. "The goal is really to get into people's minds and try to understand how they reason, what their perceptions are, their attitudes, their knowledge on various economic policy issues," she says.

Using large-scale social economic surveys and experiments, often in several countries, she has been able to get a glimpse into why people support some policies and not others, on issues ranging from redistribution to trade to environmental taxes.

"These surveys uncover what is invisible in traditional economic data and bring economics closer to other social sciences such as psychology, sociology, and political science," says Emmanuel Saez, director of the Center for Equitable Growth at the University of California, Berkeley, and coauthor of the Paris School of Economics' *World Inequality Report*. "This line of work could be a game changer for the economic profession as it will force a reevaluation of the most standard assumptions about rational economic behavior."

Since earning her PhD from the Massachusetts Institute of Technology (MIT) in 2014, Stantcheva, 36, has become one of the world's leading young economists. Among a boatload of awards and honors, she won the 2020 American Economic Association's Elaine Bennett Research Prize, which recognizes outstanding research by a woman within the first seven years of receiving her PhD. She was the first woman to join the editorial board of the influential *Quarterly Journal of Economics*.

Early in her doctoral program, Stantcheva stood out for being drawn to questions at the center of economic research and public policy discussion. "Stefanie is fearless in the questions she asks," says James Poterba, her doctoral advisor at MIT. "From her first year in graduate school, it was clear that she was thinking about the unanswered questions, the topics for future research, as much as the well-resolved ones."

Stantcheva has also made important contributions to research on optimal taxation theory, a subject

economists have studied for close to 100 years with much yet to learn. The field examines how to design taxes that maximize social welfare by reflecting society's choices between equality and efficiency.

### Taxation as a powerful tool

Stantcheva was 11 years old in 1997 when inflation in her birth country of Bulgaria surpassed 2,000 percent on an annual basis. Although she and her family had already left the country, the episode helped shape her eventual decision to study economics.

By the time she started undergraduate studies at the University of Cambridge, Stantcheva had already lived in East Germany, witnessing pay disparities with the West, and in France, where she was troubled by the level of inequality.

"Having lived in such different countries as a child made me witness a lot of very different economic and social systems," she says. "When I understood that there was a field called economics that deals with these things I was interested in, it was clear that I wanted to study that."

After Cambridge, she returned to France, where she studied master's level economics and finance at the École Polytechnique, ENSAE, and the Paris School of Economics. When she began thinking about a doctorate, she focused on taxation to help address the inequalities she had seen growing up.

"I realized that taxation is a super powerful tool that governments have and that can be applied to many different areas," Stantcheva says. "There is so much that actually relies on taxation. It is extremely potent in that it can have a lot of cascading effects, which could be very good or could be terrible if you get it wrong."

One focus is the effects of taxes on various activities, with an emphasis on those that take place over long periods. Her 2017 study, "Optimal Taxation and Human Capital Policies over the Life Cycle," broke new ground by analyzing in unprecedented detail how tax and human capital policies, such as investment in higher education, interact over a person's life span.

She was interested in addressing the widespread problem of high student debt. Is there a system where people can pay for higher education—not just once but over a lifetime—without going into debt and exacerbating inequality? Stantcheva found that income-contingent loans can provide such a solution.

"It's thinking jointly about the whole system—financing education and then taxing the income

generated throughout life in a way that balances the decision to acquire human capital against the disincentives that taxes create,” she says.

Under this system, a person would take out a government loan for education. As individuals earn more as a result, they pay a higher share of their incomes through taxes, which flow into the government’s common pool for education. Conversely, when people are down on their luck and their income takes a hit, they pay less.

Although nine or so countries, including Australia, New Zealand, and the UK, have adopted some form of income-contingent loans, they protect the borrower during bad times but fail to collect more during good times. For the common pool to remain funded and be truly optimal, Stantcheva found, it must work both ways.

### The Social Economics Lab

“As I was studying these issues of taxation, it became very clear that something that is often missing—but that is really critical—is how people think about tax and other policies,” Stantcheva says. “Ultimately, what they consider to be the right social objective, what they consider to be fair.”

This led Stantcheva to create the Social Economics Lab at Harvard in 2018, where she and a team of about 20 research fellows, including graduate and undergraduate students, are uncovering these invisible data through rigorous large-scale surveys and experiments, the results of which in some cases debunk standard theory.

The median-voter theory, for example, predicts that wider inequality should lead to increased demand for redistribution from high-income to low-income earners as policymakers cater to the median voter. Data collected by the lab, however, suggest that the existence of inequality alone doesn’t really lead people to support redistribution. Instead, perceptions are what shape their backing for most policies.

Stantcheva, along with Harvard colleagues Alberto Alesina and Armando Miano, set out in 2018 to find out whether and how perceptions about immigration affect support for redistribution policies. They focused on two key considerations: who people think benefits from redistribution—in this case, is it immigrants?—and to what extent people think that is fair.

They surveyed 22,000 people in six countries—France, Germany, Italy, Sweden, the UK, and the

US—and found large gaps between reality and perceptions. In all countries, respondents greatly overestimated the number of immigrants. They also perceived immigrants to be economically weaker, more unemployed, and less educated than they really were. This, in turn, led survey participants to say they thought immigrants paid less in taxes and received a much larger share of government transfers than was actually the case.

“These misperceptions are largest among people with lower education, in lower-paid jobs, working in sectors that employ many immigrants,” she says. “And, across all countries, among people on the right of the political spectrum.”

Just making people think about immigration before asking them about redistribution policies, they found, makes them less likely to support redistribution. “The two biggest predictors of reduced support for redistribution are the perception that immigrants ‘free-ride’ and do not put in hard work, and the perception that immigrants are economically weak,” Stantcheva says.

Through her research in other areas, she has discovered that facts and explanations of how a policy works are often effective in helping people understand it and sometimes come to support it more. However, giving people facts about immigrants, such as their numbers or origins, doesn’t shift views on redistribution, Stantcheva found. Narratives, on the other hand, do.

“One of the most effective ways to counter people’s misperceptions of immigrants is to actually tell them a story about a very hard-working immigrant that counters the free-rider narrative,” she says.

### Notion of fairness

While economists have traditionally relied on arguments about economic efficiency to garner support for redistribution policies, Stantcheva has found that what appears to really matter to people is who the winners and losers are.

“Everybody cares about fairness, but it means different things to different people,” she says. Someone on the left who is less tolerant of income inequality, for instance, might think it only fair that a high earner share his or her income through higher taxes, she says, and someone on the right is more likely to consider that unfair.

Such notions of fairness are more likely to shape people’s views than arguments about efficiency, her studies show. In the case of immigration and

redistribution, people who think that immigrants are not hard workers and are free-riding are also likely to expect that immigrants will unfairly benefit from redistribution.

Stantcheva reports seeing similar results in a current project, a study of attitudes concerning climate change across 20 countries. Survey data from the project already show that people's views are shaped by who they think will bear the burden of paying for climate change.

"People think it's unfair that the lower- or middle-income class bears a disproportionate burden through environmental taxes or other sacrifices, when they have the perception that higher-income people don't bear as much of the burden," Stantcheva says.

At the onset of the COVID-19 pandemic, French President Emmanuel Macron tapped Stantcheva, who is a member of the French Council of Economic Analysis, to join an international commission to assess long-term challenges beyond the pandemic and come up with proposals. She and the Harvard Kennedy School's Dani Rodrik, a professor of political economy, were assigned to look into the challenge of inequality.

A number of their proposals reflected what Stantcheva's surveys in France showed about people's perceptions. For instance, knowing that many in France blame globalization and outsourcing for the lack of jobs, they urged policymakers to pay attention to how trade policies affect local labor markets.

"Under our proposal, it would be possible—after an appropriately deliberative and broadly participatory domestic process—to restrict imports that are produced under conditions that violate labor rights abroad and threaten jobs or working conditions at home," they said in an opinion piece published by the international media organization Project Syndicate.

### Carrying on a legacy

While she devotes considerable energy to the rigors of her research and often speaks at more than one conference in a day, Stantcheva adamantly makes a top priority of teaching and of coaching graduate and undergraduate students.

"I love teaching students, seeing them grasp new concepts, have lightbulb moments, experience the world through a new lens," she says. Her colleagues say they admire the way she interacts with and cares for students.

In the past couple of years, Stantcheva has taken on an unexpected role. In May 2020, her Harvard colleague, mentor, and Social Economics Lab collaborator Alesina died suddenly at the age of 63. The Italian-born professor was one of the world's most influential economists and was widely considered a pioneer of modern political economy, the study of how economics and political systems are linked.

"Stefanie in a very natural way has stepped up to the role that Alberto used to have for many of us," says Pierfrancesco Mei, a Harvard student and research fellow at the lab. "One of the most special things she has done is to keep Alberto's legacy alive."

### Helping people make better decisions

Stantcheva is currently studying how the general property tax in the US shaped economic development in the 19th century and the impact of France's wealth tax on tax evasion and wealth. In addition to her project on perceptions of climate policy, she will continue extending her research on how people form views on key economic policies, she says.

Stantcheva is often asked to present her findings to policymakers. They are curious and are slowly becoming aware of the power of survey methods for understanding how people think, she says. She just published a note for the French Council of Economic Analysis on French people's attitudes about climate policies.

"The *gilets jaunes* crisis [the "yellow vest" protests that started in 2018 over economic unrest] has traumatized policymakers in France and elsewhere in Europe, so her research, based on very rich surveys on the acceptability of these policies, is discussed with great interest," says Philippe Martin, professor of economics at the Paris Institute of Political Studies and chair of the French Council of Economic Analysis.

Stantcheva says she ultimately hopes her research will give economists and policymakers a greater chance to build consensus around social policies that improve people's lives. More important, she says, she hopes that by understanding how people process information, economists will be able to provide the tools people need to make better decisions.

"Our goal is to find what explanations are useful to improve people's understanding of core policies that really shape their daily lives," she says. **FD**

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*Tokocrypto, an Indonesian affiliate of Binance, has a large presence in Bali.*

## DIGITAL JOURNEYS

# BALI'S CRYPTO SUMMER ENDS

The Indonesian island became a base for crypto entrepreneurs, but few priced in the crypto winter

Harry Jacques

**A** short stroll from a clutch of Balinese beach clubs a group of blockchain professionals mingles poolside in a villa owned by a swimwear entrepreneur. Millennial enthusiasts and more seasoned finance professionals take turns staking chips on village-fete-style games set up in the garden around frangipani trees and an open bar.

The event in May was thrown by a Singapore-based finance firm in Bali to mark the launch of its ESG—environmental, social, and governance—“legacy token.” The company, which holds concession rights to an estimated 150,000 troy ounces of gold beneath a forest in Ontario, Canada, has proposed the token as an innovative mechanism to leave the gold unmined.

Energetic ideas founded on blockchain technology sprang up quickly around Canggu, Seminyak, and

other districts in Bali—flush with remote workers as pandemic restrictions eased halfway through 2022.

Many cryptocurrency speculators with an instinct for arbitrage were drawn to the possibilities of Bali's crypto summer, with high-end amenities at far lower cost than in San Francisco or Singapore.

“You can have the quality of life in Bali while earning the salary of a Western country,” said Paul, 19, a self-taught developer, who arrived in Bali to spend one month remotely coding a blockchain platform for a retailer in Paris.

Few appeared to have priced in the emergence of a crypto winter—Bitcoin fell from an all-time-high above \$68,000 in November 2021 to below \$20,000 in June as some exchanges paused withdrawals and alternative assets collapsed.

Like Paul, many new arrivals find a network a stone's throw from the beach at T-Hub, a coworking space operated by Tokocrypto, an Indonesian affiliate of Binance, the world's largest crypto exchange.

"There are people who are not in the mood to talk about crypto," said Antria Pansy, who runs community engagement for Tokocrypto in Bali. "But there have been winters in the past."

Tokocrypto claims to have tens of thousands of registered users in Bali, an order of magnitude increase over just one year. Pansy said this breakneck growth could be the result of tens of thousands of newly unemployed tourism workers searching for income during the pandemic and of media coverage of cryptocurrencies in Indonesia that began a couple of years ago.

## Silicon Bali

At discussion groups in July attendees pondered the emergence of "Silicon Bali" for crypto and blockchain and brainstormed how best to link foreign visitors with Indonesian talent.

An event that month packed about 30 people into T-Hub. Aaron Penalba arrived in a T-shirt embossed with a Nike Swoosh and the words "Just HODL It"—Hold on for Dear Life—a mantra among those who believe that Bitcoin's utility and finite stock herald wealth.

A young crowd listened to Penalba explain the basics of minting and staking and the nuances of royalty fees for those who want to begin trading in non-fungible tokens (NFTs), forms of digital data stored on a blockchain ledger.

Penalba, who describes himself as a full-time NFT trader, was an early adopter in what became frenzied trading in digital art collections such as Bored Ape Kennel Club. ("Basically, it's dogs," he explains.)

Digital artist Mike Winkelmann famously sold his NFT artwork through auction house Christie's for \$69 million in May 2021 as NFT transactions soared to about \$17 billion that year.

"At first it was just being there—getting in early," said Penalba.

But sales of digital art, music, and other NFTs crashed by about 92 percent from January to May 2022 as sentiment changed, according to NonFungible, a blockchain data company established in 2018.

Statistics agency data show that Indonesia's main tourism destination is still finding its feet after a

devastating two-year blackout caused by the pandemic. Tens of thousands of tourism workers had their working hours cut or lost their jobs entirely as the travel industry collapsed around them.

In April 2019 almost half a million people arrived at Bali's Ngurah Rai International airport—this year in April, with restrictions beginning to ease, the total was barely one-tenth that (although there were signs of a stronger recovery in May and June).

Young professionals newly released from lockdowns in Europe and elsewhere appear eager to choose Bali as a base, although some say challenges with paperwork have curbed enthusiasm for longer stays.

"I think it's very nomadic here," said Gabrielle, who organizes crypto networking events in Dubai and Singapore.

In 2021, Thailand announced it would issue 10-year work permits to foreign nationals earning more than \$80,000 a year. This year Indonesia's tourism minister, Sandiaga Uno, unveiled similar plans for a five-year visa for Bali targeting the rise in remote workers.

## Cautionary tales

Tales of scams are common among Bali's crypto traders and are a fresh priority for regulators keen on restricting the influence of advertising and irresponsible social media influencers.

The Commodity Futures Trading Regulatory Agency, part of Indonesia's trade ministry, assumed oversight of cryptocurrencies in 2018. It currently permits trading in 229 assets.

Cryptocurrency transaction volume in Indonesia grew from Rp 64.9 trillion in 2020 to Rp 859.4 trillion in 2021, the agency head said at a parliamentary hearing in March. By February this year, the number of participants transacting in cryptocurrencies in Indonesia had more than doubled, to 12.4 million, compared with just 10 months earlier.

Blockchain developer Paul guesses that most people in Bali's cryptocurrency community are simply speculating on rising prices, with only a fraction working on technology that proponents hope will cut costs for everything from agriculture to migrant worker remittances.

"You can make a lot of money," said Penalba during his presentation. "If you are lucky." **FD**

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## DIGITAL JOURNEYS

# INDIA EMBRACES MOBILE MONEY

The central bank has played a key role in the country's digital payment boom

Jeff Kearns and Ashlin Mathew

**T**he Reserve Bank of India's headquarters, opened in 1981, is a high-rise building clad in white towering over Mumbai's Fort district, a few blocks from the waterfront.

The RBI is also a pillar of the country's rapidly growing digital payment network and a lesson in cooperation between a central bank and private firms.

India's digital payment volume has climbed at an average annual rate of about 50 percent over the past five years. That itself is one of the world's fastest growth rates, but its expansion has been even more rapid—about 160 percent annually—in India's unique, real-time, mobile-enabled system, the Unified Payments Interface (UPI). Transactions more than doubled, to 5.86 billion, in June from a year earlier as the number of participating banks jumped 44 percent, to 330. Values nearly doubled in the same period. In addition, the RBI in March introduced a

UPI for feature phones (older devices with buttons instead of touchscreens) that can potentially connect 400 million users in distant rural areas.

The UPI system was introduced in 2016, just before the end of RBI Governor Raghuram Rajan's term. The shock of the demonetization initiative followed near the end of that same year, when high-denomination banknotes were withdrawn from circulation.

UPI was a response to the nation's patchwork of rules and paperwork for payments. The goal was to make transfers easier and safer by allowing multiple bank accounts on the same mobile platform for individual and business use alike. It rapidly came of age.

The UPI network's genesis traces back even further, to 2006, when the RBI and Indian Banks' Association jointly formed the National Payments Corporation of India (NPCI).



The goal was to be an umbrella institution for digitalization of retail payments, and it was incorporated as a nonprofit company intended to provide India's people a public good. This public good approach to providing digital financial infrastructure is relevant for all economies, whatever their stage of development, researchers at the Bank for International Settlements wrote in a 2019 paper.

### Going cashless

Growth for individual digital payment users is set to triple in five years to 750 million, according to NPCI Chief Executive Officer Dilip Asbe; merchant users could double to 100 million. The central bank fosters a varied ecosystem of payment systems, he said, including RuPay, a debit and credit card issuer with a large market share, the National Financial Switch cash machine network, and a payment system using the national identity program to bring banking to underserved areas.

"RBI was determined that a country our size needs multiple payment systems so citizens can choose from multiple payment options," he said. "A system like UPI cannot come into any country unless the central bank and the government of that country are keen to bring in such an innovation, which democratizes the payment system to the smallest value and the most reasonable cost. UPI is nearly free today for consumers in India, and the government is providing incentives for promotion of UPI merchant payments."

With a burgeoning cashless society, the old ways are increasingly forgotten by the country's hundreds of millions of young people. It is they who have helped swell the ranks of users of Paytm, one of the world's largest mobile money services providers, to more than 400 million.

Anjchita Nair, an entrepreneur and cofounder of the New Delhi-based arts and culture organization Culture, uses Paytm for sales and Razorpay's platform for online transfers. For personal use she prefers Google Pay, another of India's most popular platforms.

"Monetary transactions can be done quickly and conveniently," she said. "The younger generation are more and more using cashless methods such as UPI and wallets, and we wanted to make transactions easier for them. We also have small-value transactions happening for some of our products, and it reduces the hassle of handling cash."

With the memory of cash reliance already rapidly fading since the beginning of the smartphone era, the pandemic helped further accelerate the embrace of contactless digital transactions, especially for small amounts, as people tried to protect themselves from the virus.

### Unique digital infrastructure

This transition piggybacked on another unique domestic innovation, the India Stack, a digital identity and payment system built on an open application programming interface, or API. It has been a force for greater financial inclusion by making services easier for consumers to access, including by incorporating the national identity program, Aadhaar, with 1.3 billion users.

Open-stack technology is the foundation of UPI, which transformed India's digital payments, said Dinesh Tyagi, CEO of CSC e-Governance Services India, the government's operator of centers for electronic public services in villages and other remote areas.

"The government promoted open-stack technology so that people can try to integrate very quickly," he said. "We also promoted private fintech companies, in addition to traditional public sector banks, which is what [allowed] quicker adoption of these technologies. These services are also available at no cost to the citizen, and that is the uniqueness of India's digital transformation."

Meanwhile, policymakers are planning another big bet on the future of digital money, with even more far-ranging effects on the economy. The RBI is exploring a central bank digital currency (CBDC) designed to meet monetary policy objectives of financial stability and efficient currency and payment operations.

RBI Deputy Governor Rabi Sankar, who oversees payment systems and financial technology, said achieving such an advance would have advantages for currency management, settlement risk, and cross-border payments.

He said in a June address at an IMF event on digital money that a digital rupee would have big implications for crypto assets: "CBDCs could actually be able to kill whatever little case there could be for private cryptocurrencies." **FD**

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## DIGITAL JOURNEYS

# FREEING FOREIGN EXCHANGE IN AFRICA

The continent seeks to ease cross-border payments in a bid to boost trade

Chris Wellisz

**M**aking payments from one African country to another isn't easy. Just ask Nana Yaw Owusu Banahene, who lives in Ghana and recently paid a lawyer in nearby Nigeria for his services.

"It took two weeks for the guy to receive the money," Owusu Banahene says. The cost of the \$100 transaction? Almost \$40. "Using the banking system is a very difficult process," he says.

His experience is a small example of a much bigger problem for Africa's economic development—the expense and difficulty of making payments across borders. It is one reason trade among Africa's 55 countries amounts to only about 15 percent of their total imports and exports. By contrast, an estimated 60 percent of Asian trade takes place within the continent. In the European Union, the proportion is roughly 70 percent.

"When the payments are unlocked, invariably you are unlocking trade between African countries," says Owusu Banahene, the Ghana country manager for AZA Finance, which handles foreign

currency transactions for companies doing business in Africa.

Cross-border payments are just one of the many barriers to trade in Africa. Others range from high tariffs and cumbersome border procedures to divergent commercial regulations and congested roads.

A trade agreement that went into effect in 2021 aims to lower some of those hurdles and create a vast trading area from Casablanca to Cape Town, encompassing 1.3 billion people. In its first phase, the African Continental Free Trade Area (AfCFTA) agreement would gradually eliminate tariffs on 90 percent of goods and reduce barriers to trade in services. In later stages, it would harmonize policies on investment, competition, e-commerce, and intellectual property rights.

The AfCFTA's backers say lowering trade barriers will supercharge commerce, attract foreign direct investment, and boost economic growth. A recent World Bank study estimates that the deal, if carried out in full, would raise real income by 9 percent and lift 50 million people out of extreme poverty by 2035.

Working in tandem with the agreement will be the Pan African Payment and Settlement System (PAPSS), a project of the AfCFTA secretariat and Cairo-based Afreximbank, which specializes in trade finance. The system aims to link African central banks, commercial banks, and fintechs into a network that would enable quick and inexpensive transactions among any of the continent's 42 currencies.

As of 2017, only about 12 percent of intra-African payments were cleared within the continent, according to the Society for Worldwide Interbank Financial Telecommunication (SWIFT). The rest are routed through overseas banks, mostly in Europe and North America. As a result, an African currency must first be exchanged for dollars, pounds, or euros and then swapped a second time for a different African currency. That adds an estimated \$5 billion a year to the cost of intra-African currency transactions.

Owusu Banahene says his \$100 payment to his lawyer was relatively straightforward, because banks in both Ghana and Nigeria have correspondent banking relationships with overseas counterparts that use dollars in foreign currency transactions. But in the case of Ghana and Côte d'Ivoire, transactions involve two overseas banks—because Ivorian institutions have ties to banks that use the euro.

Most of the cost of Owusu Banahene's transaction consisted of the standard \$35 fee charged by SWIFT. As a proportion of the amount of the transaction, costs are typically much lower, though still considerable, amounting to as much as 4 to 5 percent.

Still, the cost of small-value transactions can be a barrier to the small cross-border traders who account for a significant portion of intra-African commerce. Many of them don't have bank accounts to begin with, and even those who do often exchange money on the black market, which can involve the risk of being robbed or receiving counterfeit currency, says Richard Adu-Gyamfi, senior advisor at the AfroChampions Initiative, which seeks to nurture African multinational enterprises.

There are other obstacles. One is the volatility of African exchange rates. In the case of Ghana, it took about ₵6 to buy a dollar in mid-July 2021; a year later, the cost was ₵8, a depreciation of 25 percent. Volatility increases the risk, and therefore the cost, of foreign currency transactions.

Another hurdle: some African central banks, seeking to support the value of their currencies, ration dollars and other hard currencies by holding regular auctions. This has been a source of frustration for Sasha

Naryshkine, the operations manager for Kuza Africa, which exports avocado seedlings from Tanzania.

"We have sold seedlings in Angola and have had to wait for payment simply because the central bank in Angola didn't have enough dollars for people to settle their trade," he says. Delays and uncertainty make it difficult to decide when to plant avocados, he says, and put a damper on business.

One of his customers is Lourenço Rebelo, commercial director of FertiAngola, a dealer in agricultural products ranging from seedlings to tools. Rebelo says delays in getting access to foreign currencies mean some shelves stay empty, resulting in lost sales.

"We're a one-stop shop," he says. "So if I'm out of fertilizers, for instance, [customers] will not come in, and the other stuff will not be selling."

PAPSS aims to solve such problems by settling transactions in local African currencies, obviating the need to convert them into dollars or euros before swapping them for another African currency. In essence, PAPSS would eliminate costly overseas intermediaries. The system aims to complete transactions in less than two minutes at a low though unspecified cost.

"This will be a game changer for trade on the African continent," says Wamkele Mene, secretary general of the AfCFTA.

Still, PAPSS faces hurdles of its own. The central banks at the heart of the system will have to reconcile differences in national regulations, infrastructure, and oversight systems. Deciding how to settle transactions among a number of volatile currencies could also prove difficult.

Formally launched in January 2022, the system had yet to complete a single commercial transaction as of midsummer. It has integrated six central banks, with more on the way, and 16 commercial banks, says John Bosco Sebabi, deputy chief executive officer of PAPSS.

Sebabi concedes that awareness of the system is low in the business community. He says Afrexim and PAPSS have a joint marketing campaign under way, although he says he cannot provide details.

"While implementing a project of this magnitude, there are always glitches along the way," he says. "However, we are set to have commercial bank transactions very soon. We cannot say today or tomorrow, but very soon." **FD**

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# THE ASCENT OF CBDCs

More than half of the world's central banks are exploring or developing digital currencies

**CENTRAL BANK DIGITAL CURRENCIES** (CBDCs) are digital versions of cash that are issued and regulated by central banks. As such, they are more secure and inherently not volatile, unlike crypto assets.

While some may assume that CBDCs are a new concept, they have in fact been around for three decades. In 1993, the Bank of Finland launched the Avant smart card, an electronic form of cash. Although the system was eventually dropped in the early 2000s, it can be considered the world's first CBDC.

But not until recently has research into CBDCs proliferated globally. Central banks all over the world are now exploring their potential benefits, including how they improve the efficiency and safety of payment systems.

As of July 2022, there were nearly 100 CBDCs in research or development stages and two fully launched: the eNaira in Nigeria, unveiled in October 2021, and the Bahamian sand dollar, which debuted October 2020.

Countries have different motives for exploring and issuing CBDCs, but in the case of The Bahamas, the need to serve unbanked and under-banked

populations across more than 30 of its inhabited islands was a primary driving force.

Beyond promoting financial inclusion, leading experts argue that CBDCs can make domestic payment systems more resilient and foster competition, which may lead to better access to money, increase payment efficiency, and lower transaction costs. CBDCs can improve transparency in money flows and could help reduce currency substitution.

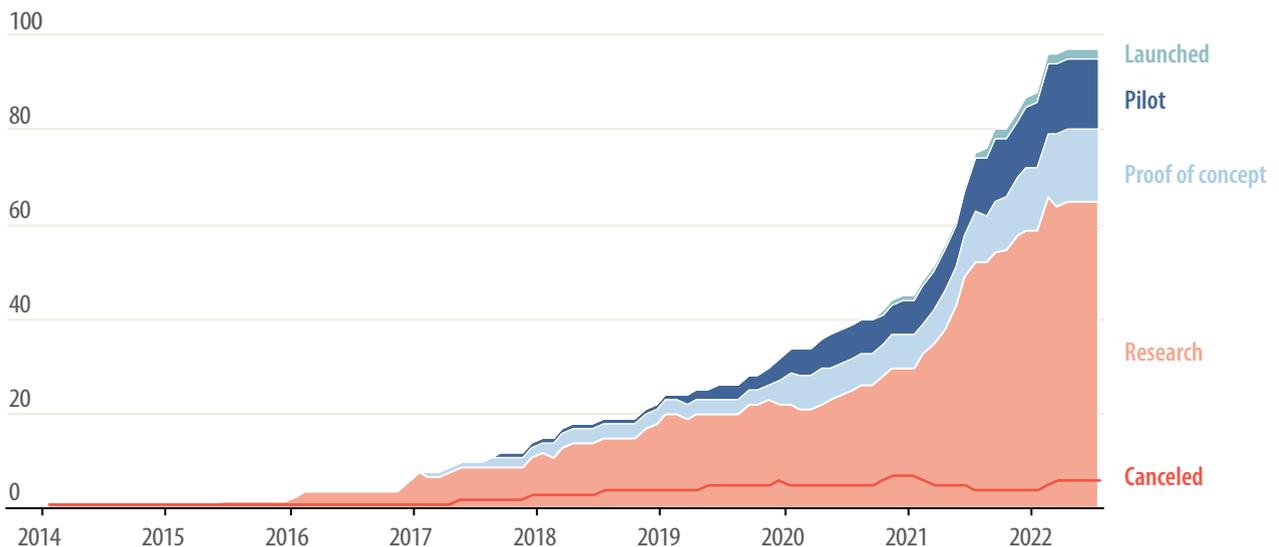
While a CBDC may have many potential benefits on paper, central banks must first determine if there is a compelling case to adopt them, including if there will be sufficient demand. Some have decided there is not, at least for now.

And, issuing CBDCs comes with risks that central banks need to consider. Users might withdraw too much money from banks all at once to purchase CBDCs, which could trigger a crisis. Central banks will also need to weigh their capacity to manage risks posed by cyberattacks, while also ensuring data privacy and financial integrity. **FD**

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## Gaining currency

CBDC research and development have exploded in the past few years, with 15 pilots ongoing across the world and 15 more in an advanced research stage.



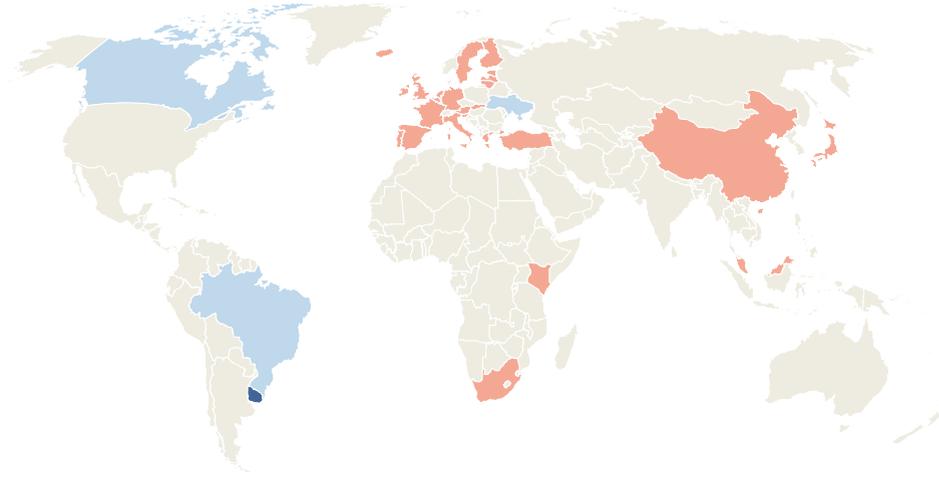
Source: CBDC Tracker (cbdctracker.org). The chart shows the status of CBDCs worldwide by month. Proof of concept = advanced research stage.

### CBDC cultivation

Central banks are going through various stages of development to assess the benefits and risks of CBDCs and to consider how best to deploy them. (CBDC development status by country for stated period)

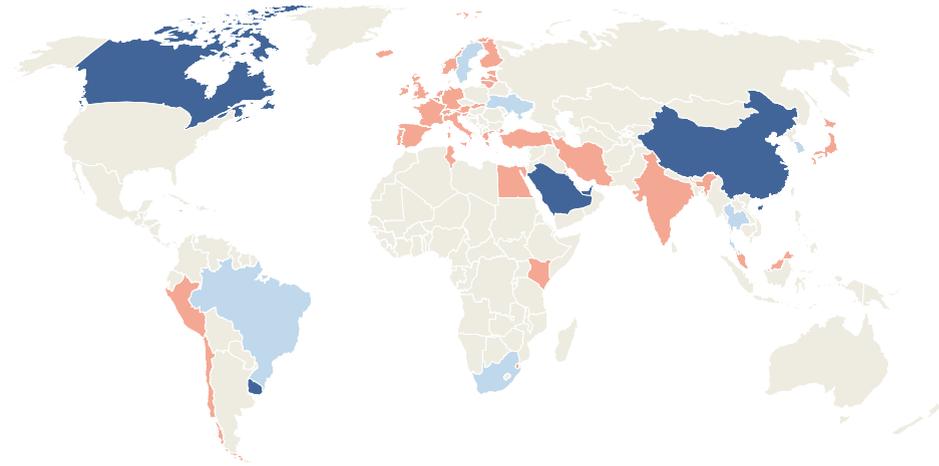
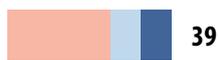
#### July 2018

- Launched (0)
- Pilot (1)
- Proof of concept (3)
- Research (15)



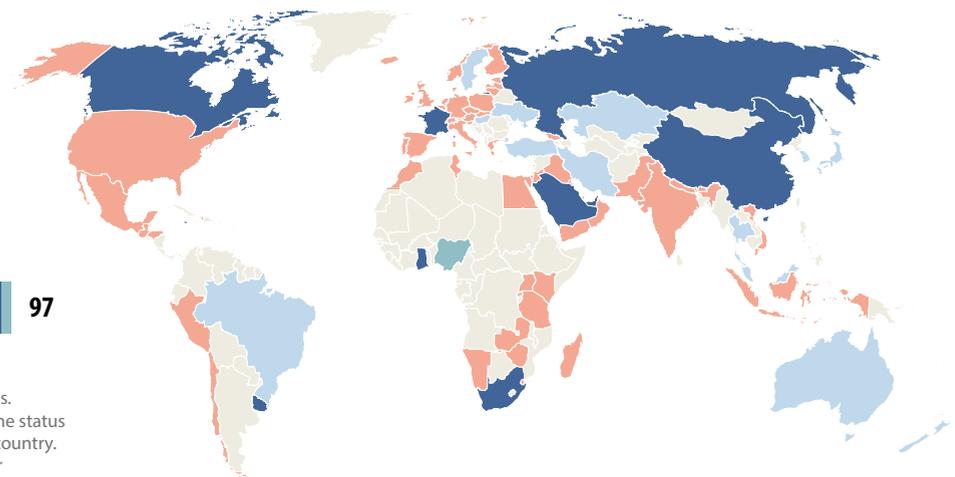
#### July 2020

- Launched (0)
- Pilot (7)
- Proof of concept (7)
- Research (25)



#### July 2022

- Launched (2)
- Pilot (15)
- Proof of concept (15)
- Research (65)



Source: CBDC Tracker ([cbdctracker.org](http://cbdctracker.org)).  
 Note: The map shows both retail and wholesale CBDCs. A country can have multiple CBDCs; the map shows the status of the most advanced stage of development in each country. The boundaries, colors, denominations, and any other information shown on maps do not imply, on the part of the IMF, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

# Crypto's Conservative Coins

Stablecoins are far from the revolutionary ideals of crypto's creators and are not without risk

Parma Bains and Ranjit Singh



**WHEN IT WAS LAUNCHED IN 2009**, the crypto revolution was about much more than just finance. The financial crisis shook people's trust in banks and the governments that bailed them out. For those wanting to shun traditional institutions and find alternative means to make payments, Bitcoin and the innovative blockchain technology that underpins it promised to decentralize and democratize financial services. Power would be placed in the hands of the people—this remains a compelling vision.

The problem was that speculators soon piled into the market. Instead of spending bitcoins and other crypto assets, speculators simply hoarded them in the hope that prices would rise ever higher. Crypto assets struggled to prove their potential as a payment instrument and instead became a speculative punt. The creation of thousands of other volatile “altcoins”—many of them nothing more than schemes to get rich quick—made it even more problematic to use crypto assets for transactions. After all, how do you pay for something with an asset that is not a stable store of value or a trusted unit of account?

A stablecoin is a crypto asset that aims to maintain a stable value relative to a specified asset, or a pool

of assets. These assets could be a monetary unit of account such as the dollar or euro, a currency basket, a commodity such as gold, or unbacked crypto assets. This stability can be achieved only if a centralized institution is in charge of issuing (minting) and redeeming (burning) these crypto assets. Another centralized institution (a custodian) must hold corresponding reserves (typically fiat currency issued by governments) that back each unit of stablecoin that is issued.

## Centralizing finance

This evolution is at odds with the original vision. Rather than decentralizing finance, many stablecoins have centralizing features. Instead of moving away from fiat currencies, most types of stablecoins are fundamentally reliant on those currencies to stabilize their value. Rather than disintermediating markets, they lead to new centralized intermediaries, such as stablecoin issuers (who hold data on their users), reserve managers (usually commercial banks), network administrators (who can change the rules of the network), and exchanges and wallets (that can block transactions). In fact, given the transparency of blockchains and the need to comply with anti-money-laundering rules, stablecoins may offer less privacy than existing payment rails.

If stablecoins oppose elements of the initial vision of Bitcoin, why do they exist and what purpose do they serve? Stablecoins are used primarily to permit users to remain in the crypto universe without having to cash out into fiat currency. They're used to purchase unbacked crypto assets as well as access and operate in decentralized finance (DeFi). They were a key element in the growth of the crypto asset and DeFi markets.

In some emerging market and developing economies, dollar-denominated stablecoins could become popular as a store of value and a hedge against inflation and currency depreciation. From the users' perspective, this so-called cryptoization provides an avenue to protect financial interests in the face of macroeconomic pressures and weak financial institutions. Where they are not regulated, stablecoins can circumvent controls on free capital movement while complicating macroeconomic management by the central bank.

For some, stablecoins represent the future of payments. After all, in many economies most money in circulation is not central bank money but privately issued commercial bank money. Furthermore, blockchains have the potential to increase the speed and reduce costs for services traditionally offered by banks, in particular cross-border remittances. An argument can be made that stablecoins will be the privately issued money of the future.

### Unstable coins

This vision comes with some challenges. First, stablecoins are not all stable. In fact, most stablecoins fluctuate around their desired value rather than sticking rigidly to it. Some stablecoins can deviate significantly from their desired value. This is particularly true of algorithmic stablecoins. These tokens aim to stabilize their value through an algorithm that adjusts issuance in response to demand and supply, sometimes combined with backing through unbacked crypto assets. However, these tokens are extremely risky. They are susceptible to de-pegging in the event of a large shock that becomes self-perpetuating once it starts, as the TerraUSD experience shows.

This stablecoin suffered a peg failure in mid-2022 after bank-like runs by users. The collapse of TerraUSD, then the third-largest stablecoin, triggered significant ripple effects across the entire crypto market. Similar contagion in the future could go well beyond crypto markets: many stablecoins hold reserves in traditional financial instruments, and exposure to crypto assets among traditional financial market participants has increased.

Second, the distributed ledger technology that underpins stablecoins has not been tested at scale from a payment perspective. These technologies could make cross-border remittances and wholesale payments somewhat more efficient, but they may not offer sizable advantages over domestic payment systems, especially in advanced economies.

While financial inclusion is often touted as a benefit of stablecoins, most users are educated, relatively young, and already have bank accounts. Unless transactions are conducted outside the blockchain—taking stablecoins further away from the traditional crypto ideals of transparency and decentralization—they can at times be more expensive than alternatives such as mobile or electronic money. These non-crypto alternatives raised financial inclusion in Kenya from 14 percent to 83 percent between 2006 and 2019.

### Regulation challenges

Finally, regulatory barriers may arise. Regulators of domestic payment systems may not allow stablecoins to serve as a payment instrument for purchases of goods and services and integrate with domestic payment systems. In addition, stablecoins (and the wider crypto universe) are not yet regulated for conduct and prudential purposes in many jurisdictions. Although some anti-money-laundering rules might apply, users aren't protected if something goes wrong. Users could face large losses without recourse to compensation if, for example, fraudulent stablecoins were issued, issuers claimed their stablecoins were backed but were not, stablecoins were stolen, or users couldn't access their stablecoins or redeem them at par.

## Stablecoins permit users to remain in the crypto universe without having to cash out into fiat currency.

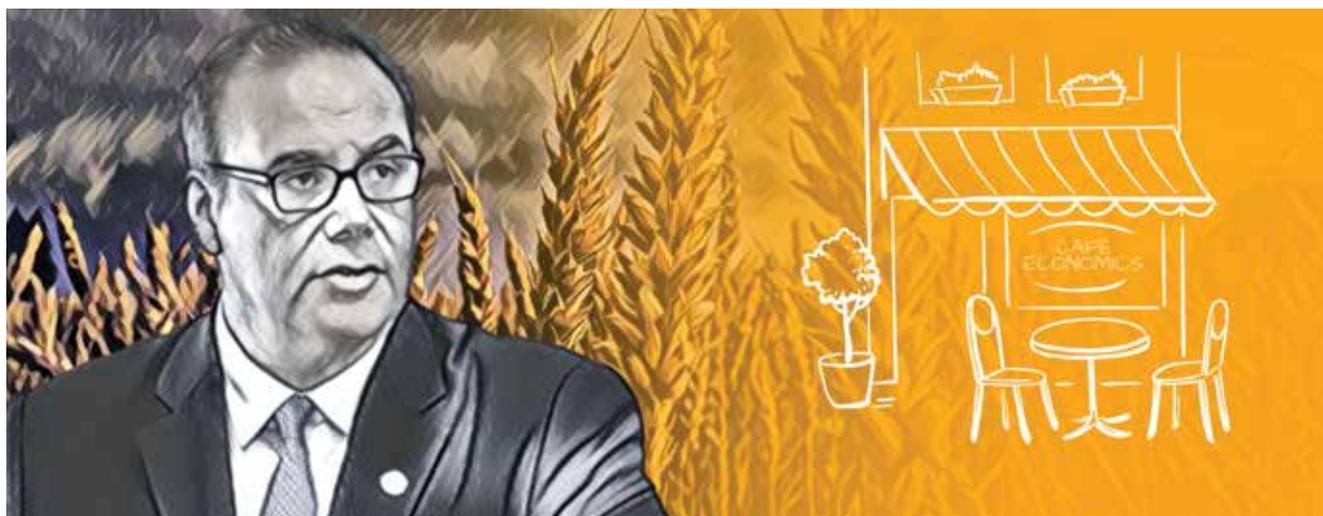
Given the risks they pose, some authorities have looked to regulate stablecoins in a manner similar to traditional financial institutions, with different rules according to their business models, economic risks, and economic functions. For example, where stablecoins are not issued by banks and are used for payments on a small scale, issuers might be subject to adjusted payment regulations. Where stablecoins have less liquid reserve assets and are used for investment purposes, issuers might be subject to requirements similar to those applied to securities.

One of the proposals floated by many authorities is to apply bank-like regulations to stablecoins, particularly if they become more widely used for payments. Should this happen, stablecoins will themselves become the banks that crypto assets were meant to replace.

Any innovation that provides people with more choice, reduces the power of institutions that are too big to fail, and increases access to financial services should be explored. With the right regulation in place, stablecoins could grow to play a valuable role in delivering these benefits, but they won't be able to do so alone. And they are far from the revolutionary vision of crypto's creators. **FD**

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## A Looming Food Crisis

*FAO's Maximo Torero Cullen discusses how global food supply difficulties could tip into a full-blown catastrophe*

**BECAUSE OF HIGH NATURAL GAS PRICES** rising food prices could make the difference between life or death for millions of people around the world. Organizations such as the United Nations Food and Agriculture Organization (FAO) are closely tracking the effects of price hikes on global food security.

In an interview with F&D's Bruce Edwards, Maximo Torero Cullen, FAO's chief economist, says wheat and fertilizer supply shortages have driven up prices and increased food import bills for the most vulnerable countries by more than \$25 billion, putting 1.7 billion people at risk of going hungry.

**F&D: We know the war in Ukraine is affecting food supply in some parts of the world. What other factors are at play?**

**MTC:** The main driver behind the food price problems we are facing is conflict; most of the countries in food crisis have internal conflict. The second is economic downturns; COVID-19 is one of the major reasons most poor countries are facing significant challenges. And the third, of course, is climate change.

The war in Ukraine has exacerbated the problem, as it stopped exports from two key exporters of cereals: Ukraine and Russia. Around 50 countries depend on these two exporters for at least 30 percent of their cereal imports. For about 20 of these countries, it's more than 50 percent.

Another factor is that Russia is the world's leading exporter of nitrogen, the second of potassium, and the third of phosphorus fertilizer. When it

halted the exports of fertilizers, that drove up the prices—which were already high before the war—creating a significant problem for farmers.

So the impact on food-importing countries is twofold—they face a steeper food import bill and a higher cost of fertilizers. That is our major concern today. Because the cost of fertilizers has in some cases quadrupled, many farmers cannot afford them anymore, and that will be affecting the harvest this year and next year.

**F&D: What is the impact on vulnerable economies?**

**MTC:** In the case of Africa, the key net food importers are northern African countries—more than 50 percent of their wheat imports come from Russia and Ukraine. Sub-Saharan Africa is different, as it doesn't have wheat as a main staple. They have cassava and rice. However, maize and wheat are used for feedstock.

In the 62 most vulnerable countries in the world, we are talking about a roughly \$25.4 billion increase in the food import bill compared to last year. And this is affecting 1.7 billion people.

**F&D: What are your main concerns if the war in Ukraine continues?**

**MTC:** If the war continues, in 2022 and 2023 we could potentially have a food access problem coupled with a food availability problem, because Ukraine and Russia would significantly reduce their exports, including fertilizers. This is a situation we have to avoid. Under the current conditions, we estimate Ukraine could reduce their exports of wheat and maize by around 40 percent, and Russia might do something similar.

We are also observing that, because of the increase in the cost of fertilizers, rice production has been affected for next year, and prices are starting to rise. In addition, a poor monsoon season is potentially affecting rice sowing in India. These developments

pose risks because rice is a key staple around the world, including in sub-Saharan Africa.

If I had a say in which countries should have access to fertilizers, the key exporters of rice would be a priority, because they will supply the rice we need to minimize food access problems in the next year.

**F&D: Your research shows that conflict accounts for 72 percent of the increase in food insecurity since 2016. How do you ensure that countries in conflict have access to food?**

**MTC:** Countries in conflict are the most vulnerable because they are net food importers, in addition to having balance of payments problems. We are proposing a food import financing facility, which we hope the IMF will operationalize. Why is this so critical? Because it's an issue that affects 1.7 billion people.

What we are observing in these conflict countries is, first, they are not importing what they need. Second, some are importing foods with low calorie content, which could create significant problems. Third, they don't have access to finance because they are already too indebted. I am referring to Afghanistan, Burkina Faso, Burundi, the Central African Republic, the Democratic People's Republic of Korea, Eritrea, Ethiopia, The Gambia, Guinea, Liberia, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Syria, Togo, and Yemen.

We believe a food import financing facility could help support these countries immediately by supplementing their balance of payments, so they can import what they need this year and minimize the risk of social unrest, which could exacerbate the situation. They can later repay the cost of the import gap, which is \$24.6 billion.

**F&D: What are countries doing that may be worsening the situation?**

**MTC:** Since these commodities are concentrated in key exporting countries, export restrictions are extremely damaging. More than 20 countries put in export restrictions by end-July, and we have 17 percent of calories being trade-restricted. The duration of this export restriction level is longer than what we had in 2007–08, when trade-restricted calories were 16 percent.

If we have rice shortages, many countries will start imposing export restrictions, and that will only make things worse.

**F&D: Given so much dependence on rain-fed agriculture in food-crisis regions, what would**

**it take to help producers find alternative means to increase agricultural output?**

**MTC:** Climate change has two potential impacts. One is extreme situations, like droughts or flooding, and the other is variability. What we can do with farmers is to increase their resilience. One way is to insure them. In developed countries, farming insurance is highly subsidized. Poor countries, on the other hand, don't have the resources to provide this level of subsidies or adequate information for insurance companies to calculate losses properly.

We need innovative mechanisms to help insurance companies lower their cost. For example, Mexico started to implement weather index insurance, initially with a significant subsidy. Now, companies compete, and the subsidy has been reduced to a minimum. Also, figuring out the science—for example, knowing what the more weather-resilient seeds are—will help farmers determine what to plant to avoid crop losses.

**F&D: How do we prevent the current crisis from becoming a full-blown global humanitarian disaster?**

**MTC:** I wouldn't say we are in a food crisis right now. I think we have a very serious food access problem. If things get worse, and we have a food access and a food availability problem, then we will be in a very bad situation.

We recommend, of course, continued support of the humanitarian response. But we need to link that to the provision of inputs and cash to maintain critical production systems and support the supply chains of countries in deep emergencies, which includes Ukraine.

For the whole system, the first urgent step is to help countries cover the gap in the food import bill. Then we have to accelerate the process of efficiency gains. We need to keep trade open; the level of export restrictions we have right now is extremely risky. We need to increase transparency of information, and that is where our Agricultural Market Information System comes into play. Then we need to increase efficiency in the use of fertilizers.

We also need to identify where the new hot spots of food insecurity are so that social protection programs can be retargeted to be more effective and efficient. **FD**

*This interview has been edited for length and clarity. Listen to the full conversation at <https://apple.co/3zFdVnd>.*

# HALL OF MIRRORS

A deeper understanding of how consumers think about the economy would help policymakers control inflation

Carlo Pizzinelli



**W**ith inflation rising to levels unseen in decades, households across the world are asking themselves how much more they can expect to pay for gasoline, groceries, and other necessities. Their answers may help them make important personal financial decisions. Should they go ahead and buy that new refrigerator, rather than wait until later and risk seeing the price go up? Should they ask their boss for a raise to make up for the loss of purchasing power?

The answers won't affect just individual households but the economy as a whole. The reason: central bankers and academic economists view inflation partly as a self-fulfilling prophecy. If consumers believe prices will rise at a faster pace, they may behave in ways—buying a refrigerator or asking for a raise—that will fuel more inflation. More money chasing a fixed number of refrigerators will drive up their price, and more people asking for a raise will prompt employers to mark up the prices of goods or services they sell to make up for higher labor costs. Federal Reserve Chairman Jerome Powell expressed that concern at a recent press conference, when he announced a half-point increase in the Fed's key interest rate: "We can't allow a wage-price spiral to happen," he said. "And we can't allow inflation expectations to become unanchored. It's just something that we can't allow to happen."

Powell's statement explains why policymakers carefully monitor households' and firms' inflation expectations, measured through regular surveys, at different time horizons. In particular, increased forecasts for inflation in three to five years signal that expectations are becoming unmoored and that an interest rate increase may be needed to keep inflation under control. This also explains why central banks try to shape the public's expectations of future developments by explaining their current and future policies. Indeed, the success of policymakers' actions crucially relies on their ability to convey the intended effect to households and steer their expectations accordingly.

## Coffee, gasoline

All this raises an important question for academics and policymakers alike: How well do we understand households' expectations? Over the past decade, a



large body of behavioral economics research has dug deep into this question. The main findings are that households hold very disparate views on inflation and tend to perceive it as higher and more persistent than it usually is. Consumers also tend to disagree on the outlook for inflation more than experts do, they change their view less often, and they often rely on a few key products they consume regularly—such as coffee and gasoline—to extrapolate changes in the overall cost of living. Furthermore, individual expectations are strongly correlated with demographic characteristics including sex, age, education, and political orientation. For instance, women and people with less education or lower incomes tend to expect higher inflation. Finally, past experiences—such as living through the Great Depression or the 1970s Organization of the Petroleum Exporting Countries (OPEC) oil embargo, which drove inflation sharply higher, can strongly shape people’s perceptions of inflation for the rest of their lives (Malmendier and Nagel 2016; Weber and others, forthcoming; D’Acunto, Malmendier, and Weber, forthcoming).

While these results characterize the richness and complexity of households’ expectations, they do not quite break down *how* those expectations are formed. When nonexperts read news about monetary and fiscal policy or economic events, how do they factor that information into their expectations for inflation and other key indicators? Is it safe to assume, for effective policymaking and for theoretical models, that laypeople form expectations in the same way

as experts? Knowing the answers to these questions would help policymakers better guide consumers’ expectations regarding the effects of their actions.

In a recent paper, my coauthors and I set out to search for answers (Andre and others 2022). We conducted surveys to measure people’s beliefs about the effects of economic shocks on unemployment and inflation. From 2019 to 2021, we collected answers from samples of 6,500 US households broadly representative of the population. Separately, over the same period, we surveyed 1,500 experts, including staff at central banks and international financial institutions, professors and PhD students, and financial sector economists. For the samples of the survey collected during the COVID-19 pandemic, we adjusted the questionnaire to ensure that the respondents’ expectations referred to how the economy functions in “normal times” rather than during the exceptional circumstances of the pandemic.

### **Hypothetical shocks**

We used the survey to shed light on how people think about the way the economy works—or in the language of economists, their “subjective models.” We asked respondents to consider four hypothetical shocks to the US economy: a sharp increase in crude oil prices as a result of falling world supply, a rise in income taxes, a federal government spending increase, and a rise in the Federal Reserve’s target interest rate. These shocks are widely studied in macroeconomics but are also conceptually understandable by



nonexperts. To make sure that all the respondents based their answers on the same information, we provided current figures for the rates of inflation and unemployment and asked them to give their forecasts for the two variables over the following year. We then provided news about one of the four hypothetical shocks and asked them to make new predictions for inflation and unemployment.

Their responses showed that beliefs about the effects of economic shocks were widely dispersed, with large differences within our samples of households and experts and between the two groups. In some cases, households and experts even disagreed on whether a particular shock had a positive or negative impact on inflation and unemployment. Most strikingly, households on average believed that a rise in the central bank's policy interest rate and a rise in income taxes would *increase* inflation, contrary to predictions of a decrease by experts and many textbook models (Chart 1).

In the second part of the survey, we investigated the origins of disagreement between experts and

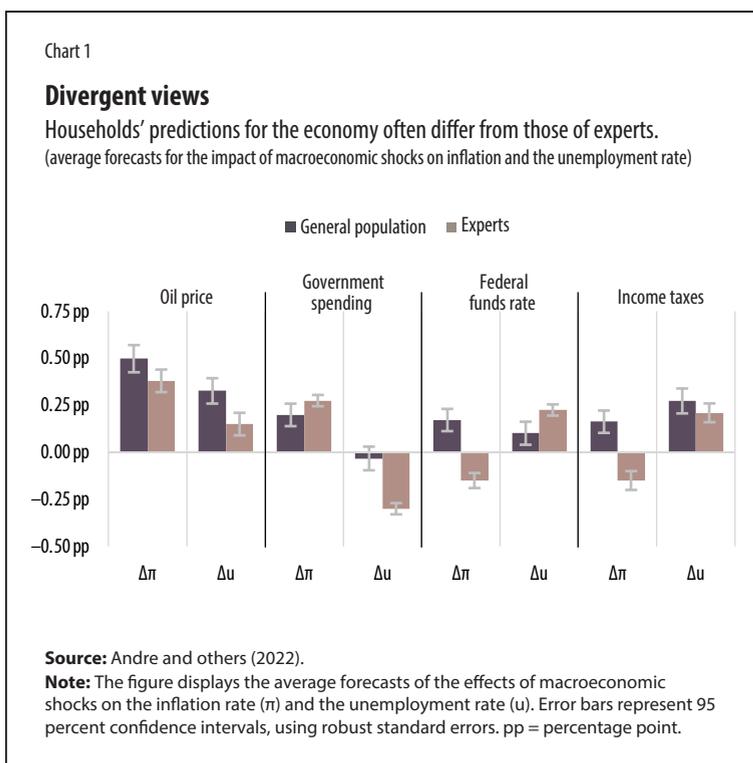
households and within the two groups. Part of the disagreement seems to arise because respondents think the shocks work through different transmission channels—in particular, demand- versus supply-side mechanisms. Using a set of multiple-choice questions and open text boxes, we asked respondents to describe what they were thinking when they made their predictions. We found that these associations explained a substantial part of the differences in forecasts. Unsurprisingly, experts were most likely to rely on their technical knowledge, using frameworks taken from their everyday toolkits and often making direct reference to theoretical models or empirical studies. By contrast, households drew on a broader range of approaches in making their predictions. They were more likely to rely on personal experiences, be influenced by political views, or simply guess how a given shock might affect the economy.

Moreover, when households think of specific shock propagation mechanisms, they often come up with very different channels than experts. This in turn partly explains why their predictions for some shocks differ so markedly from those of experts. For instance, households more often thought about the impact of higher interest rates on firms' costs of borrowing capital, which are passed on to consumers via higher prices. On the other hand, experts mostly considered the canonical demand-side channel, which predicts a decline in inflation in response to higher interest rates as consumers spend less and save more (Chart 2).

### Contextual cues

Are these results bad news for central bankers? If the general public interprets an interest rate hike as a harbinger of higher inflation, might central banks find it more difficult to succeed at keeping inflation at bay? One final result from our exercise points to effective communication of policy actions as a solution. Contextual cues can shape which propagation channels individuals think of and thereby which forecasts they make. We saw that households that were prompted to think about demand-side channels before making their forecasts were more likely to predict an effect of monetary policy shocks in line with that of experts.

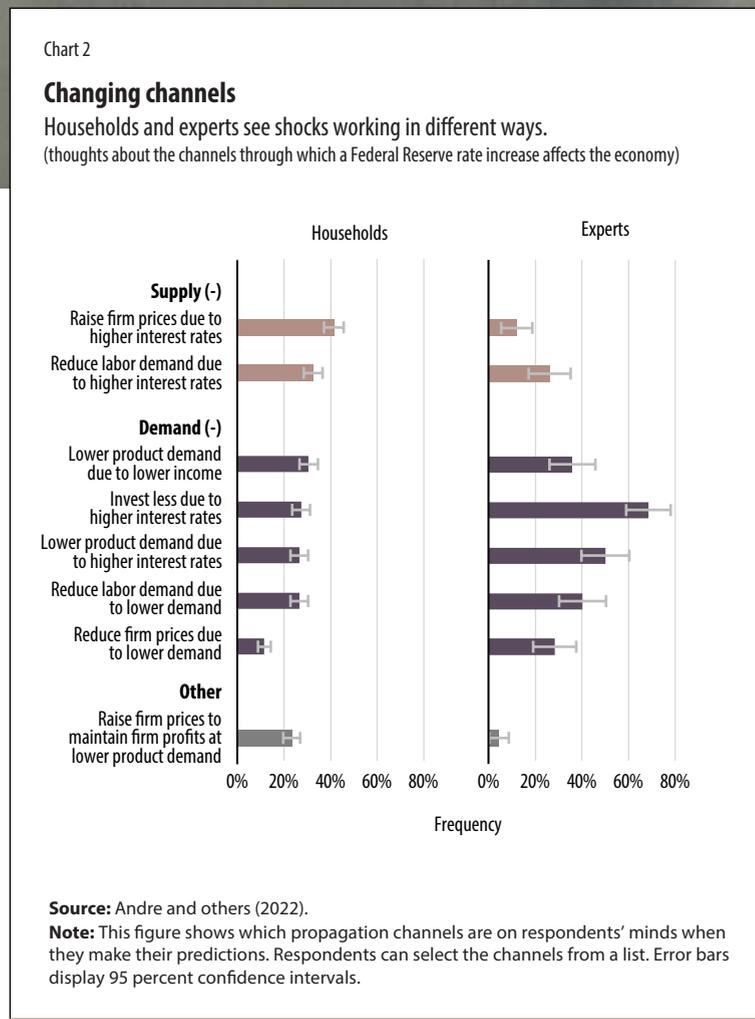
Encouragingly, while central bankers have long been aware of the power of their carefully crafted



statements to guide market expectations, it seems they are now focusing more on making their communication accessible to a wider audience. For instance, Gardt and others (2021) show that, as part of a broader strategy to expand the reach of their message, in recent years the European Central Bank has built a presence across social media platforms and has used simpler language in speeches and monetary policy statements.

The results of our study also provide some empirical guidance in a different but related direction. Canonical macroeconomic models crucially hinge on the assumption of “rational expectations,” according to which households base their individual decisions—on how much to save, consume, and work—on expectations about the uncertain future state of the economy. These expectations in turn are consistent with the way the economy eventually evolves. The assumption does not mean that households have perfect knowledge of the future. But it does imply that if households see the central bank raising interest rates unexpectedly, and they believe this will lower inflation, their subsequent actions will ultimately lead to a decline in inflation. While this approach to modeling expectations has often been criticized as too strict or unrealistic, deciding the appropriate way to depart from it is not straightforward. To be meaningful, any departure from this pillar of modern macroeconomics must realistically reflect how households actually form expectations. Our study thus provides a preliminary direction for macroeconomic models to incorporate behavioral aspects of households’ expectations that are grounded in empirical evidence.

A growing research effort—spearheaded by prominent academics in the field—aims to use insights from behavioral economics to embed behavioral features of the way households form expectations in macroeconomic models and depart from classic rational expectations assumptions. This field, known as behavioral macroeconomics, is expanding fast but faces some significant challenges. It is math-intensive, which may limit its immediate use in everyday policy work. Moreover, it relies crucially on empirical evidence of how households reason about the macroeconomy and form expectations, which behavioral economists can solidly build only through numerous and careful studies. However, it has the



potential to fundamentally shape both theoretical macroeconomics and real-world policymaking in the years to come, and it will most likely find a key role for communication in influencing expectations. **FD**

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Russell shook her head. "I know it's to get a caravan? It would cost at least if we had one, Daidy couldn't get us up our minds to do without a holiday trip: we'll all go to Southern for the day lunch and tea with us and have a splenda. Then we can bathe again," said Bob; "I y and ride," he added unexpectedly. "I y," he continued, sighing deeply as he a friend let him share his little Dartmoor outland is nothing but heaves and poops his place; and oh! Mamma, I do so b," she added pitiously; and she sho the tears in her eyes. "ever mind, darling, you shall have with easy vagueness. ally was not very comforting, and it moment a car stopped at the do



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# THE NEW ECONOMICS OF FERTILITY



People and economies will prosper if policymakers help women combine career and family  
**Matthias Doepke, Anne Hannusch, Fabian Kindermann, and Michèle Tertilt**

**F**ertility in high-income countries has been declining for a hundred years, with few exceptions, and in many areas, it is now extraordinarily low. In Germany, Italy, Japan, and Spain fertility has been well below 1.5 for more than two decades—lower than the average of just over two children per woman needed to maintain a stable population size. This means that each new generation is less than three-quarters the size of the preceding one. Such ultralow fertility makes for a rapidly rising older population and poses challenges for governments, economies, and the sustainability of social security systems.

Substantial economic research on individual fertility decisions has naturally focused on the pervasive trends associated with this demographic transition—primarily negative relationships between fertility and income and between female labor

force participation and income. Economists have proposed two main explanations.

The first is known as the quantity-quality trade-off. It suggests that as parents get richer, they invest more in the “quality” (for example, education) of their children. This investment is costly, so parents choose to have fewer children as incomes rise. Historically fertility and GDP per capita are strongly negatively related, both across countries and over time.

The second explanation acknowledges how time-consuming it is to raise children. As wages increase, devoting time to childcare—time that could otherwise be spent working—becomes more costly for parents, and especially for mothers. The result is a decline in fertility and greater female labor force participation. There is in fact historically a strong negative association between female labor force participation and fertility over time and across countries.

## New fertility facts

The data show that these relationships are no longer universally true. Despite a continued negative income-fertility relationship in low-income countries (in particular in sub-Saharan Africa), it has largely disappeared both within and across high-income countries. The same is true for the relationship between fertility and female labor force participation. In a recent survey (Doepke and others 2022) and a VoxEU column (June 11, 2022), we outline these new empirical regularities and discuss the key factors that explain fertility outcomes in recent decades.

For a long time, high per capita income in a country reliably indicated low fertility. In 1980, fertility was still well above two children per woman in poorer countries, such as Portugal and Spain, but just 20 years later, fertility in the same set of countries had changed substantially (Chart 1). In fact, in 2000 the United States, the second-richest country in the sample, exhibited the highest fertility rate.

The fertility pattern across families in high-income countries (such as France, Germany, and the United States) has changed as well. Historically, the relationship between female education and fertility is clearly negative, consistent with higher wages increasing the opportunity cost of raising children. Yet this negative relationship is weaker for US women of recent birth cohorts (Chart 2). Although highly educated women with more than 16 years of schooling had the lowest fertility rate in 1980, this no longer held true in 2019 (see also Hazan and Zoabi 2015).

## Career-family compatibility

The recent empirical regularities point to fertility behavior in high-income countries today that is driven by factors not immediately captured by the quantity-quality trade-off nor the opportunity cost of time. Researchers across disciplines had to contemplate alternative mechanisms responsible for within- and across-country fertility patterns in high-income countries (see Rindfuss and Brewster 1996 and Ahn and Mira 2002 for early contributions). A common theme has emerged from this broad scholarly discussion: the compatibility of women's careers and families.

There has been a fundamental economic transformation: in many high-income countries women now participate in the labor force for much of their lives. The earlier pattern of a woman entering the labor market but dropping out following marriage

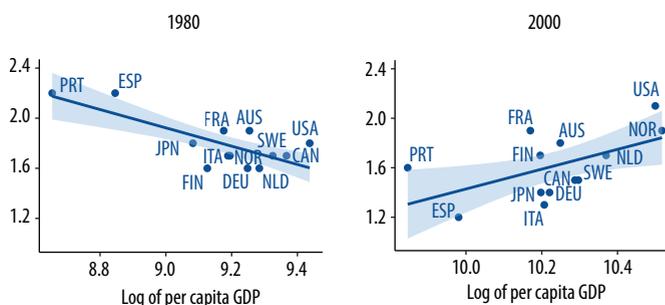
and children is now the exception rather than the norm. Most women today want the option of both a fulfilling career and a family. From a historical perspective, we can interpret this shift as a convergence of women's and men's overall life plans after a long period of sharply divided gender roles.

Chart 1

### Births and economic growth

In just 20 years, the relationship between per capita income and fertility rates changed dramatically.

(total fertility rate [births per woman] and GDP per capita in selected OECD countries)



Source: Doepke and others (2022).

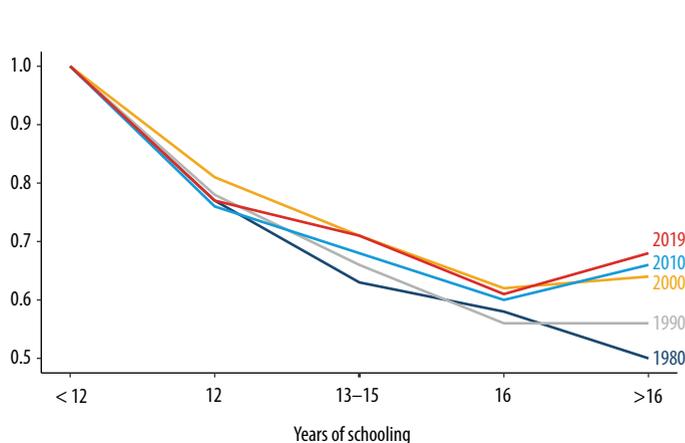
Note: OECD = Organisation for Economic Co-operation and Development. Data labels use International Organization for Standardization (ISO) country codes.

Chart 2

### Education and fertility

Highly educated US women with more than 16 years of schooling had the lowest fertility rate in 1980, but by 2019 this no longer held true.

(normalized hybrid fertility rate, births per woman)



Source: Doepke and others (2022).

Note: The normalized hybrid fertility rate (HFR) was obtained by dividing all HFRs by the HFR for the lowest education group in each decade.

## CHEAP AND EASILY AVAILABLE CHILDCARE FREES UP WOMEN'S TIME AND ALLOWS THEM TO COMBINE MOTHERHOOD WITH A CAREER.

While the shift in women's career plans is shared across high-income countries, there is still substantial variation in how compatible women's careers and families really are. Four factors explain the variation in career-family compatibility across countries: family policies, cooperative fathers, favorable social norms, and flexible labor markets.

A key determinant of career-family compatibility is women's access to affordable alternatives to the time devoted to caring for children, time historically provided exclusively by mothers. In some countries, such as the United States, these alternatives are largely organized in private markets, while many European countries offer publicly provided childcare. Cheap and easily available childcare frees up women's time and allows them to combine motherhood with a career, which ultimately increases fertility. In countries such as Sweden and Denmark, where public childcare is widely available for children of all ages, female employment and fertility rates today are higher than in countries where childcare is sparse. Not surprisingly, these countries also spend a larger fraction of their GDP on public early childhood education. Other policies that influence career-family compatibility include parental leave policies, tax policies, and the length of the school day.

Fathers can of course care for children as well. Although historically fathers have spent little time caring for children, the data show an increase in recent decades. The division of childcare between parents has important implications for fertility when parents contemplate the decision to have children. Doepke and Kindermann (2019) show that in countries where fathers engage more in childcare and housework, fertility is higher than where such labor falls disproportionately on women. Japan, where men share little in caring for children, bears this out: fertility there continues to be ultralow.

A third influence on modern fertility decisions is social norms regarding a mother's role at home and in the workplace. Low fertility can be a result of traditional social norms. For example, the characterization of a full-time working mother as a *Rabenmutter* (bad mother) is still common in Germany and imposes an implicit penalty on mothers who aspire to both family and career.

Finally, labor market conditions also affect career-family compatibility. In Spain, for example, a country with a two-tier labor market where jobs are often either temporary or for a lifetime, women tend to postpone childbearing in hopes of landing a stable job first. Such labor market conditions naturally dampen fertility. More generally, when unemployment is high, temporary jobs are common and permanent jobs are hard to obtain—even taking temporary leave to start a family can have long-term repercussions for women's labor market prospects. Fertility rates may consequently be lower than in a setting where secure, long-term jobs are easy to find.

### Policy implications

For policymakers concerned about ultralow fertility, the new economics of fertility does not offer easy, immediate solutions. Factors such as social norms and overall labor market conditions change only slowly over time, and even potentially productive policy interventions are likely to yield only gradual effects. Yet the clear cross-country association of fertility rates with measures of family-career compatibility shows that ultralow fertility and the corresponding fiscal burden are not inescapable, but a reflection of a society's policies, institutions, and norms. Policymakers should take note and take a career-family perspective. Investing in gender equality—and especially the labor market prospects of potential mothers—may be cumbersome in the short run, but the medium- and long-term benefits will be sizable, for both the economy and society. **FD**

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# Governance, Assistance, and Interference

**THE GUARDIANS OF THE GLOBAL ECONOMY** may be established fixtures today, but their roots in Allied supply management during World War I were once controversial.

That's the starting point for Jamie Martin's comprehensive history of the formation of international financial institutions, which opens at the close of the Great War, a quarter century before Bretton Woods. His book is a deeply researched contextualization of what led to the 1944 New Hampshire conclave that birthed the IMF and World Bank.

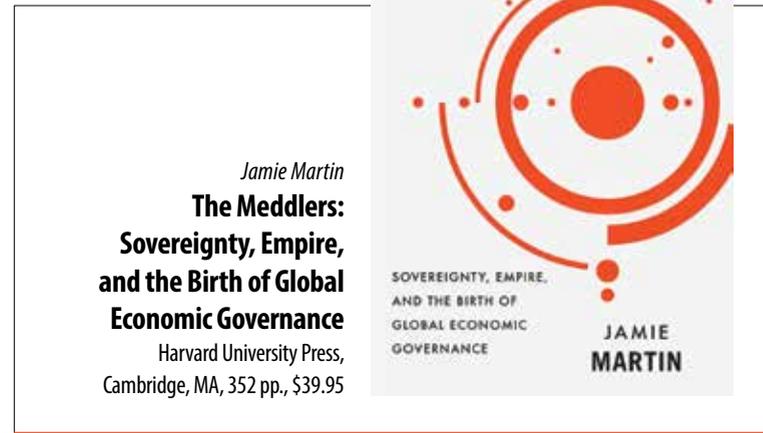
Martin, an assistant professor of history and social studies at Harvard, is critical, but global economic governance supporters and detractors can learn from his tracing of predecessors like the League of Nations and Bank for International Settlements (BIS), created amid war and depression.

He begins with wartime supply councils, and the questions they raised about autonomy for governments. The London-based Nitrate of Soda Executive, for example, was a body led by a British merchant and staffed by government representatives of European allies and the United States. It was formed to dominate buying of a key ingredient of explosives and fertilizer from neutral Chile, the world's main supplier.

The League of Nations Economic and Financial Organization, prohibited from interfering in member nations' domestic affairs, gained the ability to do so in the 1920s with new types of conditional lending, Martin writes, detailing the resulting resistance from Albania to Austria. As the global Depression loomed, the creation of the BIS fueled dispute over sovereignty itself, and whether governments or supposedly apolitical financial bodies should control monetary policy.

A thorough account of what are, ultimately, bureaucracies could be tedious, but Martin isn't. Instead, he brings alive forgotten figures who shaped our world—and links future IMF chief (1956–63) Per Jacobsson and top economist Jacques Polak to their earlier work at the League.

One fascinating chapter revolves around tin, mined mainly in British colonies such as Malaya



Jamie Martin  
**The Meddlers:  
 Sovereignty, Empire,  
 and the Birth of Global  
 Economic Governance**  
 Harvard University Press,  
 Cambridge, MA, 352 pp., \$39.95

for everything from arms to autos. Martin illuminates production and trade controls as “the final interwar innovation in economic governance,” regulating tin markets in colonies and countries. The arrangement, a precursor to the Organization of the Petroleum Exporting Countries, endured until 1985.

The final chapter frames the IMF origins as part of the reversal of global apex power. Washington's Lend-Lease Act provides London with warships in exchange for eased “imperial preference” in trade across territories—and even wheat production controls—while the international monetary institution proposed by John Maynard Keynes ends up more like the vision of his overshadowed American counterpart Harry Dexter White.

Martin emphasizes unequal sovereignty, which suggests that tweaks to existing bodies like the IMF and World Bank “may be insufficient to produce a more stable reconciliation of global governance and democratic politics,” and that “ambitious thinking” can supersede 20th century institutions and imperial legacies. His answer may be a future book, as it isn't revealed.

“Governing the world economy needs to be dramatically rethought if it is to be made fully compatible, for the first time, with real economic self-determination and democratic self-governance,” Martin concludes, “and for all states, regardless of their histories of sovereignty and imagined standings in a hierarchical global order.” **FD**

**JEFF KEARNS** is on the staff of *Finance & Development*.

## Making Progress

**THE LONG MARCH** of progress is marked by revolutions, struggles, economic crises, liberations, injustices, and regressions—the “turning points where social conflicts are crystalized and power relationships are redefined,” explains Thomas Piketty in his surprisingly optimistic account of human progress toward equality. Building on his previous works and drawing on the sweeping historical record, Piketty brings his larger argument about the origins of inequality and the political, social, and institutional contexts of its evolution into sharp relief. He shows that human societies have moved toward measurable improvements in the quality of life and fairer distribution of income and assets, but that it will take novel solutions to address today’s inequities.

in the face of economic shocks—expenditures that disproportionately benefited lower- and middle-class people.

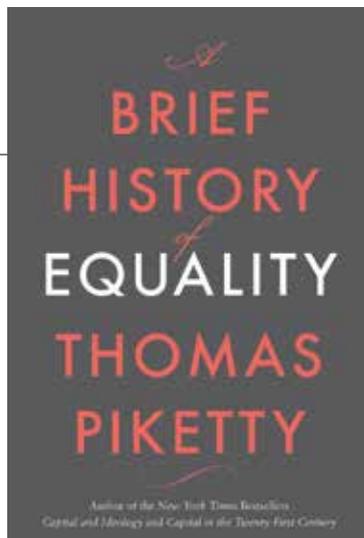
This “leap forward” was made possible by unprecedented revenue mobilization: from less than 10 percent of national income in 1910 to between 30 and 40 percent by the century’s middle decades. Progressive taxation lowered the massive concentration of wealth and economic power at the top, leveling both pre- and posttax inequalities and garnering collective acceptance for the new social and fiscal contract.

Piketty calls this an “anthropological revolution,” occurring as it did during the gradual erosion of exclusive control by the dominant political classes. Universal suffrage and electoral competition, spurred by an independent press and the labor union movement, he notes, were instrumental in ensuring majoritarian prosperity. In addition, the liquidation of colonial assets and cancellation of public debts accumulated during the interwar periods freed up resources for reconstruction and redistribution.

The sharply rising concentration of incomes and wealth since the 1980s and persistence of inequity in all its forms speak to the urgency of the need for transformation. Piketty questions the centrality of growth to economic prosperity, arguing that financial liberalization, deregulation, and loopholes in the international tax system have favored the largest fortunes to the detriment of others, including in the global South. The result is a system where political power and economic resources have increasingly coalesced.

His proposed solutions include a return to greater fiscal progressivity: significantly steeper income tax rates on high earners, a global wealth tax on the well-off, basic income programs, and cancellation of debts. Progress would be marked by publicly financed elections, worker involvement in the management of large enterprises, a welfare state that extends beyond national borders, and revision of global treaties to address climate change and the unequal distribution of wealth. Past experience, Piketty notes, offers hope that such “a profound transformation of the world economic system” is possible. **FD**

**ERA DABLA-NORRIS**, assistant director, IMF Asia and Pacific Department



*Thomas Piketty*  
**A Brief History of Equality**  
 Translated by Steven Rendall  
 Belknap Press, Cambridge, MA, 2022  
 274 pp., \$27.95

The two world wars and the dislocation of the Great Depression are the backdrop of Piketty’s “great redistribution”—the dramatically reduced income and wealth inequalities across much of the Western world between 1914 and 1980, thanks to the rise of the welfare state and progressive taxation of income and wealth. The welfare state boosted equality of access to education and health care, transportation, old-age pensions, and insurance

## Leading the Way

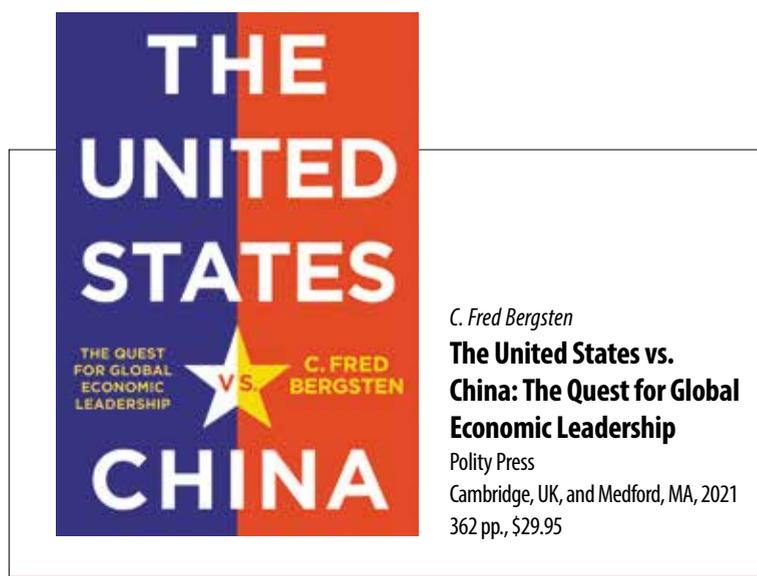
**CHINA'S DRAMATIC GROWTH** and its implications for the world economy have fueled new books at a pace commensurate with the subject. A recent wave includes an important book by C. Fred Bergsten, founder of the Peterson Institute for International Economics and an established Washington elder, on global economics.

Bergsten focuses on what China's growing role in the international economy means for US leadership in the post–World War II global economic order, whose pillars are cooperative international institutions (including the IMF), avoidance of beggar-thy-neighbor policies, and reliance on markets and the rule of law.

Bergsten argues that the United States inevitably will have to share global economic leadership with China. He rejects as fanciful such notions as “containing” China or persuading China to adopt Western views. The relevant question is which shape a sharing of leadership may take. Bergsten proposes an approach he calls “conditional competitive collaboration,” comprising collaborative US-China leadership on key global economic issues, conditional on each country's fulfilling its obligations in the international economic system. The countries should consult closely on systemic matters involving global public goods (such as climate change), be flexible about the balance of leadership on specific issues (with China having greater sway on development finance, for example, and the United States on international financial and monetary issues), and differentiate between the global and regional arenas.

Bergsten recommends the United States seek to uphold, with other major countries, the collaborative international economic system. Economic leadership should be decoupled from issues such as national security and values, traditional alliances should be restored to strengthen the international consensus on key global matters, and a multilateral trade reform package should be completed with China involved in writing the rules.

Regarding international financial institutions and cooperation, Bergsten envisions a need eventually for broad equivalence between China and the United States at the IMF, including on quotas and voting parity, with countries accepting related



*C. Fred Bergsten*

**The United States vs. China: The Quest for Global Economic Leadership**

Polity Press

Cambridge, UK, and Medford, MA, 2021

362 pp., \$29.95

obligations and requirements. He discusses several relevant questions for the Fund, including its location, governance, and the role of the IMF's Special Drawing Rights (SDRs) in global finance. Bergsten supports US integration into China-led institutions (such as the Asian Infrastructure Investment Bank) and vice versa, and—perhaps presciently—a complementary rather than confrontational approach to projects such as the Belt and Road Initiative.

The book calls for domestic reforms to underpin the outward orientation of US economic policy and its global economic role, including stronger social safety nets and mechanisms to address the inequalities associated with globalization, which provides large aggregate gains but distributes them unequally.

Bergsten's book is important for its breadth of perspective and depth of knowledge. While it deals extensively with foreign policy and history, it is on international economic issues that it is most insightful and perhaps most relevant for F&D readers. A caveat is that the issues are seen from an essentially US perspective. The lay of the land may look different when viewed from China or, for that matter, Europe, Japan, or elsewhere. There is much to learn from the literature that has emerged around the world on these issues by Yukio Hatoyama, Robert Kagan, Yan Xuetong, and others, and Bergsten's book is a good addition. **FD**

**VIVEK ARORA**, deputy director, IMF African Department, and former IMF senior resident representative in China

## Taking Digital Currencies Offline

*In many regions, internet-free access may be a make-or-break feature for central bank digital currencies*

**John Kiff**

**AS THE WORLD'S CENTRAL BANKS RUSH** to develop digital currencies, almost all the research and trials focus on internet-based technology. What will happen when the web goes down in a war or a natural disaster? And what about the 75 percent of the world's adult low-income population that doesn't even have internet access (World Bank Findex Database)?

That's where a little-noticed but long-running push to develop offline digital payment systems comes in. Some of this work goes back 30 years, to a time long before smartphones. In fact, the future of offline central bank digital currencies (CBDCs) may lie in the technological past.

But wait. Why do central banks in developing economies like Ghana or Uruguay want to give people some fancy digital currency to replace their cedis or pesos?

There are several compelling reasons. One is better risk management as digital currencies may be harder to steal than bales of paper money. Much of the world's consumer commerce already takes place digitally—well over 90 percent of it

in places like China and Sweden. Central banks don't want to leave billions of transactions in the hands of internet payment platform operators. And it's an issue of financial inclusion for millions of people who can't afford to use the conventional banking system or don't have internet access.

### Offline digital currencies

Offline digital payment systems could verify availability of funds and validate transactions without the need to check in with an online ledger. They could use old-tech, non-internet-driven mobile phones or something like a souped-up stored-value card.

Back in 1993, the Bank of Finland launched its Avant stored-value card. It was capable of offline payments using a custom-made card reader device, but it never caught on and was dropped in 2006. National Westminster Bank in the United Kingdom tested a similar stored-value payment platform called Mondex in 1995. Avant and Mondex showed that the technology worked, but not enough merchants acquired the required point-of-sale devices. And even though both allowed peer-to-peer transactions, users had to access it through special devices.

Recently, several enterprises have launched updated versions of the Avant and Mondex concepts that are capable of handling offline payments. Users send and receive funds by exchanging multi-digit authorization codes, either manually or using near-field communication (NFC) connections. Some require intermediary devices such as mobile phones or online connections to fully settle transactions, but that is to keep the device costs down and eliminate the need for internal battery power.

For example, the 170-year-old German banknote company Giesecke+Devrient is testing an offline CBDC platform with the Bank of Ghana based



PHOTOS: COURTESY OF WHISPERCASH; URBAN COW GETTY IMAGES

*WhisperCash's credit-card-sized device: The company is the first to develop a battery-powered card for offline CBDC payments.*



on a stored-value card. It is configured to allow for unlimited consecutive offline transactions but uses an intermediary device. The eCedi can be used by anyone with either a digital wallet app or a contactless smart card that can be used offline. The People's Bank of China has reportedly been experimenting with similar hardware wallets as part of its trials of the digital yuan.

The cost of some of these devices may put them out of practical reach for many people. For example, the fintech company WhisperCash offers a sophisticated battery-powered credit-card-sized device for conducting digital currency transactions that costs about \$70.

But the company has also rolled out an offline platform that piggybacks on text-based, non-internet-enabled mobile phones. Known as “feature phones,” they can be had for as little as \$5. The WhisperCash system involves a \$2 device that's attached to the phone's SIM card.

Even in low-income countries, 66 percent of adults own at least such a phone. In 2017–18 the Central Bank of Uruguay conducted a successful six-month test of a CBDC that users could access using feature phones (Sarmiento 2022).

Offline devices typically rely on tamper-resistant hardware to maintain integrity. Policy constraints,

like limits on transaction amounts and balances, need to be protected because modifying them could allow the misuse of funds. Such limits also play a role in enforcing financial integrity regulations. On-device analytics or periodic synchronization with a trusted verification service could be used to allow identification of suspicious transactions.

The Bank of Canada is exploring such universal access devices intended to incorporate attributes of cash and prevent the interruption of digital transactions in case of an infrastructure failure. In its exploratory work on a digital euro, the European Central Bank is considering offline functionality.

Whether any of these ideas will go into full operation is an open question, but it does seem that in many regions offline access may be a make-or-break feature for central bank digital currencies. [FD](#)

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**JOHN KIFF** is a retired IMF senior financial sector expert focusing on fintech and digital currencies. Now he works as a consultant to central banks; his clients include WhisperCash.

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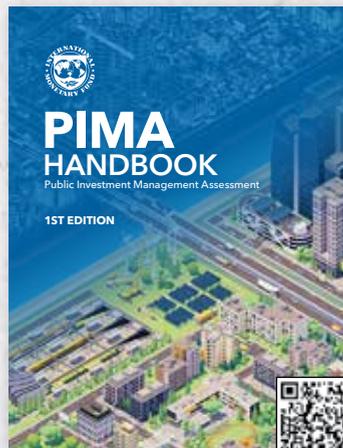
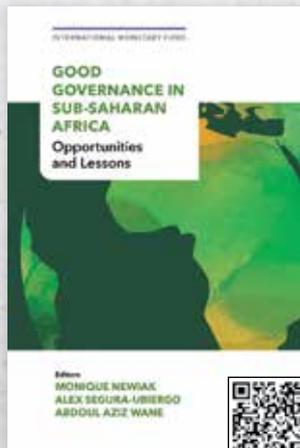
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