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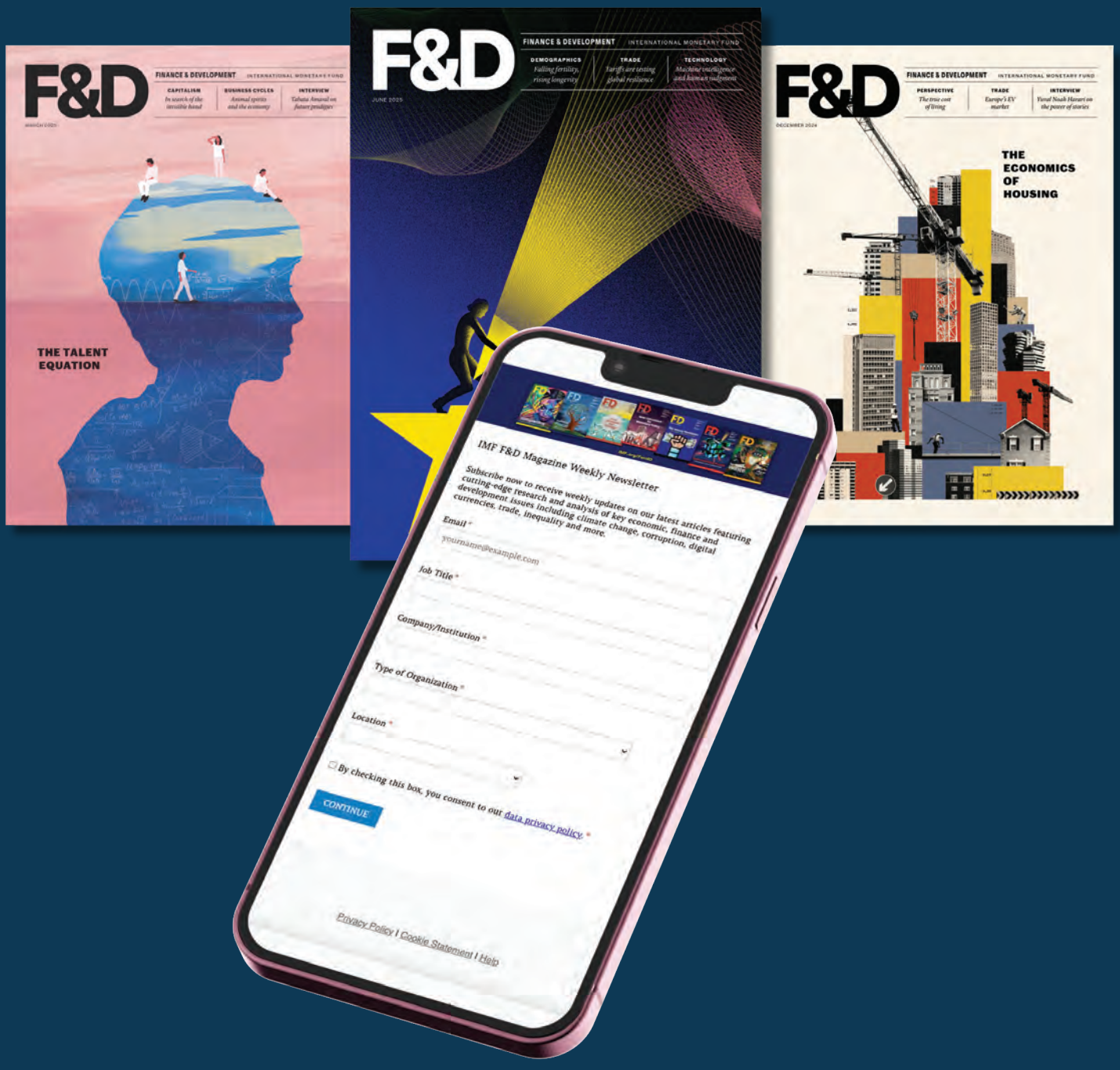

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FSC FPO

Editor's Letter

Technology, Payments, and the Rise of Stablecoins

THREE YEARS AGO, *Finance & Development* devoted a full issue to anticipating "The Money Revolution," driven by innovations in finance, such as crypto assets. That revolution is now unfolding.

This issue of F&D looks at the new frontiers of finance, where technology, data, and changing societal values are reshaping how people and institutions move money and trade financial assets, who provides liquidity, and where new risks are brewing. We bring together academics and policymakers to assess this complex and politically charged landscape, one that generates excitement and anxiety in equal measure.

Stablecoins are one of these frontiers, a form of digital asset backed by currencies or government bonds. Stablecoin companies have racked up millions of users globally, transacting across borders 24/7 at very low cost. New legislation in the US and other countries may further boost their growth.

Hélène Rey, a professor at the London Business School, assesses the macroeconomic and geopolitical implications of widespread adoption of US dollar–denominated stablecoins around the world. On the positive side: faster and cheaper cross-border payments. On the negative: risk of dollarization, capital flows and exchange rate volatility, potential weakening of the banking system, money laundering and other financial crimes. While it's hard to forecast how the use of this technology will play out, it's "likely to create major financial stability risks," she writes.

Yao Zeng of the University of Pennsylvania Wharton School identifies one potential source of risk: "The global financial landscape has changed, yet the rules remain largely unchanged." He puts stablecoins in the context of broader changes in financial markets. For example, lightly regulated nonbanks are providing more liquidity. And lenders are increasingly relying on AI and big data to speed loan approvals, reduce collateral requirements, and reach borrowers traditional banks often overlook. One thing is clear, he writes. "Stablecoins may function well in good times, but they can falter under stress."

Stablecoins are only one facet of the revolution. The public and the private sector alike are driving innovation. Some governments and central banks have responded to private payment initiatives by sponsoring systems that respond to consumer demand for fast, efficient payments. IMF researchers examine the case of India's Unified Payments Interface, which interconnects hundreds of banks, platforms, and apps and carries out more than 19 billion transactions a month.

"New entrants like fintechs and big techs, and new products like crypto and stablecoins, are challenging incumbent financial institutions."

At the same time, central banks and supervisors must contend with disruptive innovation. New entrants like fintechs and big techs, and new products like crypto and stablecoins, are challenging incumbent financial institutions. Iñaki Aldasoro, Jon Frost, and Vatsala Shreeti, from the Bank for International Settlements, explore how competition among the new entrants and incumbents might unfold. They conclude that forward-looking public policies must accompany radical innovation to achieve the most impactful breakthroughs.

Preventing crime is another area in which public authorities need to stay alert. Criminals, unfortunately, were among the earliest adopters of crypto, and all payment systems need to balance privacy and speed with the need to stop tax evasion, money laundering, and terrorism financing. Stanford's Darrell Duffie and coauthors lay out a practical approach to getting ahead of the curve.

Clearly, there is a lot of room for innovation in payment systems and financial markets in general. Users demand it. The key is to balance the risks and benefits through clear regulation that protects consumers and investors and limits spillovers. Who knows what new possibilities such innovations will unlock along the way? F&D

Gita Bhatt, editor-in-chief

Kaleidoscope

A global view, in brief

THE BIG PICTURE: Gita Gopinath, the IMF's first deputy managing director, has stepped down from her position to return to Harvard University. She was formerly the IMF's chief economist. "Gita has been an outstanding colleague—an exceptional intellectual leader, dedicated to the mission and members of the Fund, and a fabulous manager," the IMF's managing director, Kristalina Georgieva, said in announcing the move. *Above, Gita Gopinath speaks at an IMF event. IMF Photo/Lewis Joly.*

Trade and Tensions

GLOBAL GROWTH is projected at 3.0 percent for 2025 and 3.1 percent in 2026, according to the IMF's July 2025 *World Economic Outlook Update*. This upward revision from the April forecast reflects front-loading in anticipation of higher tariffs, lower effective tariff rates, easier financial conditions, and fiscal expansion in some major economies.

Global inflation is expected to fall, but US inflation is predicted to stay above target, the flagship report notes. Downside risks from potentially higher tariffs, elevated uncertainty, and geopolitical tensions persist.

Restoring confidence, predictability, and sustainability remains a key policy priority, according to the report.

Pierre-Olivier Gourinchas, the IMF's economic counsellor and Research Department director, noted that "projections remain about 0.2 percentage points below our pre-April forecasts, indicating that the trade tensions are hurting the global economy."

"A breakdown in trade talks, or renewed protectionism, could dampen growth globally and fuel inflation in some countries," Gourinchas said. However, he added that "on the upside, breakthroughs in trade negotiations could boost confidence, and structural reforms could lift long-term productivity."

> "Financial conditions have eased, but they could tighten abruptly, especially in the case of threats to central bank independence."
>
> —Pierre-Olivier Gourinchas, IMF economic counsellor

Overheard

"The needs of the poorest and most fragile countries, in particular—who are often hit hardest by global shocks—demand our attention, and for these countries concessional financing remains of critical importance."

—Nigel Clarke, deputy managing director of the IMF, speaking at the Fourth International Conference on Financing for Development

"The IMF plays a central role in casting a rigorous and independent eye over the economic and financial systems of individual countries, and the world as a whole, providing timely warnings of where problems are being stored up for the future and giving its members sound advice on how to mitigate risks."

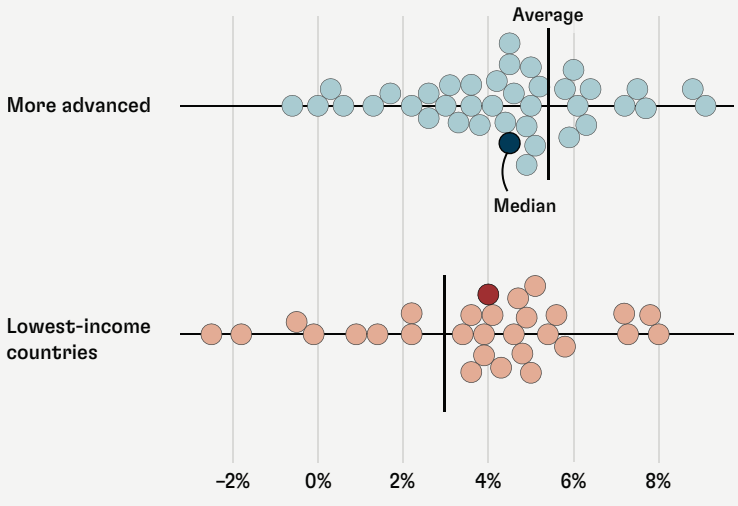
—Andrew Bailey, governor of the Bank of England, speaking at Mansion House, London

IN THE NEWS: Mauritius recovered from the pandemic on the back of buoyant tourism, social housing construction, and financial services, but is facing high public debt, significant public investment needs, low productivity, and an aging society. The IMF's recent annual economic health check of the island nation offers policy options to achieve fiscal sustainability. *Above, locals and tourists gather on the beach to watch the sunset. AbdulKarim/iStock by Getty Images.*

By the numbers

Even among low-income countries, growth paths are diverging.

REAL GDP GROWTH, 2022–24



SOURCES: IMF, *World Economic Outlook;* and IMF staff calculations.
NOTE: Lowest-income countries = countries with per capita income below the World Bank's International Development Association cutoff (currently $1,335).

Back to Basics

Tokens Are Finance's Newest and Oldest Innovation

Money has taken many forms over millennia; digital tokens are the latest

Itai Agur

THOUSANDS OF YEARS AGO, long before coins, paper money, credit cards, and banking apps, our ancestors bought and sold goods using cowries, a type of seashell. These shiny physical *tokens* were humankind's first financial innovation. What made them especially useful was that they were easy to verify: When someone handed you a cowrie shell, you could see it, feel it, and trust that it had value. You didn't need a middleman to verify the transaction.

Cash still works this way today. When you pay someone with a banknote, the deal is done—no delays. But when it comes to digital transactions, payments only seem instant. Behind the scenes, banks and credit card networks take over as *intermediaries*, approving and settling the transaction later. They take on the *settlement risk*—the danger that one party will renege on its end of the bargain. Intermediaries ensure that both parties keep their promises.

It takes time to manage settlement risk through intermediaries. This matters in cases where settlement delays are costly, especially when trading stocks, bonds, or other securities in financial markets. A *clearinghouse* collects the seller's asset and the buyer's payment and exchanges them one or two days later. In places like Wall Street, time is money. J.P. Morgan estimates that asset management costs could be cut by about a fifth if the settlement of trades and the reinvestment of sale proceeds were immediate.

Financial innovators aim to cut intermediation costs by bringing the immediacy of exchanging physical tokens to the digital world. The challenge is that when transacting parties don't meet face-to-face, they cannot see the assets they are trading before completing an exchange. *Programmability* provides a solution—a piece of code that ensures the buyer's money and the seller's asset are locked in and then exchanged at the same moment. The funds received can be reinvested automatically, saving valuable time and money.

Digital intermediaries

Tokenization creates assets on a programmable ledger, a recordkeeping system for financial transactions that market participants can trust and share access to. Assets such as a stock or bond can be issued directly on the ledger, or they might be a representation of an asset that exists outside the ledger, such as stock on the New York Stock Exchange. In the latter case, an intermediary still needs to hold the represented asset safely in the background.

Tokenization can spur competition between intermediaries. To trade in financial markets, investors are often required by regulation to use brokers. Switching assets from one broker to another is a hassle that requires the services of a specialized clearinghouse. Alternatively, an investor can sell all assets owned through one broker and repurchase them through another, but that comes with a trading cost. Tokenization, however, allows data to be transferred among brokers with the click of a button. It makes it simpler for investors to shop around and switch between brokers for the best price.

Tokenization does not cut out all middlemen, but it is reshaping the financial industry and reducing the need for certain roles. *Registrars* are intermediaries that manage asset ownership records and transmit payments

DALE CROSBY-CLOSE

such as dividends or interest from a firm to the asset owners. On a token ledger such payments are made directly to the token holders, automating the role of registrars and putting them out of a job.

Tokenization works best when money and assets flow smoothly. If different companies build their own token ledgers that don't work together, the financial system could fragment into silos. It is possible to design ledgers so that they can talk to each other, but this *interoperability* requires planning and coordination. This is why policymakers want to make sure that tokenized systems stay open, connected, and stable.

Flash crashes

Tokenization's greater efficiency does not come without risk. Faster driving can save time, but it also makes crashes more likely to occur and more serious when they do. The same is true for financial markets. Faster, automated trading has already led to sudden crashes, known as "flash crashes," such as the 2010 Wall Street flash crash, when an estimated $1 trillion was briefly wiped off the value of stocks listed on the exchange. By making it easier to program and instantly execute automated trading rules, tokenized markets can be riskier and more volatile.

Financial crises often unfold like falling dominoes, with one failure setting off the next, as occurred during the 2008–09 crisis, when global giants Bear Stearns, Lehman Brothers, and AIG all collapsed within the space of six months. On a token ledger, chains of programs can be written on top of each other, acting like a programmed set of falling dominoes during a crisis.

Tokenization and programmability also make it easier to create complex financial products, with risks regulators may not understand fully until it's too late. This was true of the nonprogrammable assets that soured during the 2008–09 crisis and led the Financial Crisis Inquiry Report to conclude that a "complexity bubble" burst at the same time as the real estate bubble. "The securities almost no one understood, backed by mortgages no lender would have signed 20 years earlier, were the first dominoes to fall in the financial sector," it says. Programmability adds to an already complex financial landscape and makes it harder for regulators to keep tabs on potential risks.

How much debt participants in a financial market owe each other has often made the difference between a financial ripple and a tsunami. Debt amplifies shocks because it implies a promise to repay—and nothing rocks confidence like broken repayment promises. Tokenization can make it easier to build up debt, because investors or institutions can use tokens as collateral to borrow and then invest that money elsewhere. If one part fails—if a token loses value, say—it could trigger losses across the system.

Hybrid technology

Financial assets started off as paper records and evolved into digital ledgers and programmable tokens. This trend is now expanding to nonfinancial assets such as real estate and potentially even agricultural collateral like farmland and livestock. But physical assets cannot be fully digitalized—they still require physical care to maintain their value, as a farmer tends to a herd of cattle or the pasture where they graze. The tokenization of nonfinancial assets is best seen as a hybrid between physical and financial technology.

From the ancient world's cowrie shells to today's digital tokens, human society has come to accept different mediums of exchange. The latest innovations offer clear rewards by speeding transactions and making trading cheaper. But there are risks, too. Speed, complexity, and risky debt have all contributed to previous financial crises—and tokenization adds to all of them. As with any innovation, digital tokens should be handled with care. F&D

ITAI AGUR *is a senior economist in the IMF's Research Department.*

This article draws on an IMF Fintech Note, "Tokenization and Financial Market Inefficiencies."

"Financial crises often unfold like falling dominoes, with one failure setting off the next."

Point of View

Why Europe Needs a Digital Euro

Philip R. Lane

It would safeguard monetary stability, fend off private payment monopolies, and stand as a potent symbol of European unity

ECB/SANZIANA PERJU

The digital euro project has a simple motivation: to ensure that people in a digital world retain the option to make or receive payments in central bank money. Supplementing physical cash with digital cash will support the modernization of the traditional two-tier monetary system that allows both cash and bank deposits as a medium of exchange.

The evolution of the two-tier monetary system over the past 300 years has provided a strong foundation for the operation of the broader financial system and has enabled central banks to deliver price stability effectively. While it is possible to theorize about alternative monetary systems in which central bank money plays only a wholesale role, prudence suggests that the retail role should be preserved, including through the introduction of a digital euro.

Central banks have a mandate to safeguard monetary stability in all circumstances. This calls for a cautious yet forward-looking approach that takes into account not only baseline scenarios but also tail risks of the future development of the monetary system. A digital euro will minimize the likelihood of adverse economic outcomes in the future and ensure the resilience of the monetary system in an increasingly digital world.

Cash issued by the central bank has historically played a critical role in maintaining trust in the convertibility of commercial bank money to central bank money. While convertibility is largely taken for granted, it's not obvious that the two-tier monetary system would necessarily remain stable if ongoing digitalization meant that convertibility to physical cash lost relevance and a digital cash option was not made available.

Monopoly power

Compared with other services, payment instruments exhibit exceptionally strong network externalities—they gain value as more people use them. This is one reason using central bank money for payments improves economic efficiency: It limits the scope for commercial payment systems to exploit monopoly power by charging excessive fees. As the share of digital transactions increases, the option to make payments in digital euros can limit the potential monopoly power of the firms at the center of private sector payment networks.

In addition, public access to central bank money provides a reliable fallback option to using commercial bank money for some types of transactions if there is disruption of the commercial banking system, whether from technical problems or a cyberattack. This is one reason policymakers want a digital euro to work offline as well as online.

Illustration by Chantal Jahchan

"If banks and other payment service providers carry out the necessary know-your-customer checks, maximum privacy will be maintained, and the central bank will not be privy to individual account details."

Some argue that an alternative approach in adapting the monetary system to a digital age would be to promote stablecoins, issued and operated by private sector intermediaries. However, stablecoins are best understood as expanding the private money universe—as another substitute for bank deposits—rather than as a true substitute for central bank money. A stable value of a stablecoin in terms of currency is not intrinsic (unlike a liability of the central bank). Even a highly liquid backing portfolio does not guarantee convertibility under all scenarios.

By contrast, a well-designed digital euro promises to modernize the two-tier monetary system without destabilizing financial institutions or disrupting monetary policy implementation or transmission. Among other features, appropriately calibrated limits on digital euro holdings can provide people sufficient digital cash for transactions while preventing excessive outflows from commercial banks and outsize expansion of the central bank balance sheet.

Moreover, since people will set up digital euro accounts primarily via their banks (or other payment service providers), close interconnection will continue between central bank money and commercial bank money. If banks and other payment service providers carry out the necessary know-your-customer checks, maximum privacy will be maintained, and the central bank will not be privy to individual account details.

Unifying fragmented markets

For the euro area, a digital euro offers additional benefits in a multicountry monetary union. Among other factors, the euro area payment system is highly fragmented along national lines: Customers must typically rely on non-European card or e-wallet providers to make payments across the euro area. By mandating acceptance of a digital euro, instant network effects would help unify the currently fragmented market.

A digital euro would reduce costs for merchants and businesses by providing the network infrastructure for an area-wide payment system on a not-for-profit basis. It would increase bargaining power vis-à-vis international card networks for both in-person transactions and e-commerce. A digital euro thereby promises to enable an area-wide fast payment system at the point of interaction (POI) between customers and merchants. With conflicting incentives across operators of legacy national payment systems, such an area-wide POI fast payment system will not likely develop without a digital euro.

A digital euro would also provide an important foundation for fintech innovation across the continent. A standardized, pan-European platform would allow private providers to innovate while benefiting from the economies of scale of the underlying digital euro network, ultimately reducing costs for consumers and businesses alike.

In particular, by linking customers and merchants across the euro area via a system of digital euro accounts, card and e-wallet providers could focus on additional payment services while the underlying payments travel via the rails of a digital euro system. Separation of the basic plumbing of the payment system (the digital euro network) from the delivery of add-on services also lowers the risk of lock-in effects—when one private payment network with a transitory technological advantage suppresses subsequent innovation in order to keep the upper hand.

Symbol of unity

To sum up, a retail role for central bank money is arguably integral to the sovereign foundations of the monetary system. In particular, the singleness, effectiveness, and stability of the monetary system are ultimately underpinned by the sovereign (or, in the case of the euro area, the joint sovereignty of the European Union's member states). The monetary role of the sovereign spans the institutional foundations of the monetary system (including the definition and enforcement of legal tender), the maintenance of the budgetary discipline required to ensure that monetary policy is insulated from fiscal dominance, and the delegation of various monetary tasks to the central bank.

A retail role for central bank money maintains the direct monetary relationship between the sovereign and the citizen. It reinforces public understanding that monetary stability is intrinsic to sovereignty. This consideration is especially relevant in a European context, with the common currency seen as a critical mechanism for greater economic and political integration among member countries. Beyond its economic and monetary roles, the euro is an important symbol of European unity. This must be maintained in a digital age. F&D

PHILIP R. LANE *is chief economist and a member of the executive board of the European Central Bank.*

Behind the Veil of Tariff Fixation

Michael Pettis

The world needs a broader conception of trade policy that considers how economies allocate income

In the heated debates over trade policy in Washington and beyond, tariffs are often portrayed as the primary—or even the sole—instrument by which governments intervene in global commerce. They are easy to quantify, easier to politicize, and readily wielded in bilateral negotiations.

But this focus on tariffs is misleading. It obscures the more fundamental mechanisms by which countries shape their trade relationships with the world. Because a country's internal imbalances between consumption and production must always be consistent with its external imbalances, anything that affects the former must affect the latter, and vice versa. Tariffs are just one of many tools a government can use to change a country's internal imbalance.

Like most such tools, tariffs work by shifting income from consumers to producers. But because of their visibility, they are often among the most politically contentious of these tools. By contrast, many of the most powerful trade interventions in today's world occur not as tariffs but as policy choices that don't appear to be related to trade at all. Fiscal decisions, regulatory structures, labor policies, and institutional norms can all affect how income is distributed, and how economies are balanced between consumption and production, with far-reaching implications for global trade.

To understand why tariffs receive such disproportionate attention, it helps to consider their visibility. A tariff is a line item in a trade negotiation affecting the price of an imported good. It's easy to identify, easy to weaponize, easy to reverse, and very obviously linked to trade. But the very simplicity that makes a tariff politically salient also makes it a poor proxy for trade policy as a whole.

Income transfer

At its core, a tariff is a tax on imports. By making foreign goods more expensive, it gives domestic producers a pricing advantage. This can benefit certain industries and preserve jobs. But those benefits come at a cost: Consumers pay more for goods and services. The net effect is to transfer income from households to businesses, and it is this transfer that, by reducing the household share of GDP, reduces overall consumption relative to production.

This shifting of income from consumers to producers is the essence of trade intervention. Whether through a tariff, a tax subsidy, or a wage-suppressing labor law, the result is a change in the internal distribution of income that also has external implications. If consumption is taxed and production is subsidized, net exports are likely to rise. Conversely, if policies shift income from producers to consumers, net exports are likely to fall. In this sense, any policy that affects the balance between household consumption and total output will also

COURTESY MICHAEL PETTIS

Illustration by Chantal Jahchan

affect the balance between domestic saving and domestic investment, and so is effectively a trade policy.

Consider currency policy. When a country intervenes in foreign exchange markets to keep its currency undervalued, it achieves the same goals as a tariff. A weaker currency makes imports more expensive and exports cheaper, subsidizing production and taxing consumption. Like tariffs, this represents a transfer of income from net importers (the household sector) to net exporters (the tradable goods sector), but it occurs through exchange rates rather than in the form of tariffs.

Financial repression can have the same effect. In countries in which the banking system serves mainly the supply side of the economy, suppressing interest rates is effectively a tax on the income of net savers (the household sector) and a credit subsidy for net borrowers (the producing sector). By transferring income from the former to the latter, it creates a domestic imbalance—just like the one created by tariffs or an undervalued currency—between consumption and production. This shows up in the form of higher net exports.

Strategic subsidies

Tax and regulatory policies can work similarly. Governments might provide direct or indirect subsidies to strategic industries, including by building infrastructure tailored to manufacturing clusters. These measures may not violate international rules on trade intervention, but they change relative incentives within the economy in ways that mirror traditional protectionism. By making it cheaper or more attractive to produce than to consume, they achieve the same end: an internal shift that produces an external effect.

Even labor market structures and social institutions can function as tools of trade intervention. In China, for example, the *hukou* system—a household registration system that limits rural migrants' rights in urban areas—has long served to depress wages and reduce household consumption. Although designed mainly to manage urbanization, the hukou system directly affects China's trade balance by limiting the growth of domestic demand relative to domestic supply.

> "As John Maynard Keynes argued at Bretton Woods in 1944, the fact that a diversified economy runs persistent trade surpluses is usually sufficient evidence of trade-distorting interventions."

Similar effects can be seen in policies that encourage environmental degradation (by increasing business profitability at the expense of health care costs), restrict labor from organizing, hold down minimum wages, or reduce the bargaining power of workers. By suppressing wage growth and limiting consumption relative to productivity growth, these policies create the same kinds of imbalances as tariffs, but they do so far more quietly.

This broader perspective helps explain why some countries have run persistent trade surpluses even as they maintain relatively low tariffs. These economies have long emphasized production over consumption, whether through institutional structures, saving incentives, or export-oriented industrial policies. The result is the same: If domestic demand is too weak to absorb national output, these countries must externalize the cost of weak domestic demand by running trade surpluses.

The point is that trade imbalances are not just about what happens at the border. They are a consequence of how economies are structured internally—how income is distributed, how much households spend relative to what businesses produce, and how governments balance the competing demands of producers and consumers.

Implicit intervention

When governments pursue policies that favor investment over consumption, or capital over labor, they are engaging implicitly in trade intervention—whether they intend to or not. And as surplus countries implement domestic policies that prioritize producers over consumers, the deficit countries with which they trade are effectively prioritizing consumers over producers, whether they choose to or not.

A narrow focus on tariffs is misleading. It distracts from the underlying drivers of trade imbalances and invites counterproductive responses. As John Maynard Keynes argued at Bretton Woods in 1944, the fact that a diversified economy runs persistent trade surpluses is usually sufficient evidence of trade-distorting interventions. Whether or not these distortions are created by tariffs is largely irrelevant; in fact, to the extent that tariffs in deficit economies can force down trade imbalances, they may actually promote freer trade.

Rather than railing against tariffs, the world needs a broader conception of trade policy—one that moves beyond the surface-level debate over tariffs and looks inward at how economies allocate income. If trade imbalances are ultimately the result of internal choices about who gets what, then fixing them will require more than bilateral deals or protectionist gestures. It requires a change in how countries structure their economies. It requires power and resources to shift toward those whose spending drives sustainable demand. F&D

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Multilateralism Can Survive the Loss of Consensus

Danny Quah

International cooperation can advance, even when the most powerful players are at odds

Can adversarial nations work together for the common good? It's natural to despair over prospects for international cooperation given the state of the world order. Geopolitical competition is straining the multilateral system, which has helped maintain global stability since the Cold War. The most powerful nations cannot seem to agree on how to solve urgent global problems, from the climate crisis to governing economic competition and international trade to regulating artificial intelligence.

Geopolitical competition doesn't naturally advance international cooperation. The economic historian Charles Kindleberger showed how a lack of global leadership and international cooperation prolonged the Great Depression. Yet at other times geopolitical competition has, paradoxically, raised international cooperation. During the Cold War, for example, Presidents Dwight Eisenhower and John Kennedy advanced US leadership in open markets, free trade, and other global public goods to counter communism.

Multilateralism is splintering today—not because of geopolitical competition alone—but because it's an expensive global public good. It benefits all humanity but distributes costs unevenly across nations.

Even in today's polarized world, geopolitical rivals can still agree on common goals—the planet should be hospitable to human beings, the next pandemic should be controlled and confined through sensible public health safeguards, global economic policy should yield prosperity for all. Nations might disagree on how to achieve these goals—arguing that one approach or another unfairly benefits a rival—or they might accuse others of free riding by failing to contribute toward solving a common problem.

Carbon, for example, has been accumulating in the atmosphere for centuries. How should we divide the burden of tackling climate change between past and present emitters? Or how should we share responsibility for providing financial stability and restoring global growth? An advanced economy might expend considerable resources to ensure growth and stability while others fail to behave prudently.

Middle powers

If great powers refuse to support the international system, can others take their place? Global public goods are costly to provide. Small poor economies don't have the resources to patrol the seas to keep shipping lanes safe for international commerce or to pump trillions into the world economy when markets fail. But middle powers—those with sufficient economic and financial firepower—may be candidates to take over the role of great powers. And middle powers that are not on the front lines of great rivalries and are committed to rules-based order are in fact playing an increasingly consequential role.

Without continuing US leadership, rules-based free trade agreements have already emerged. Consider the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, the 12-member free trade pact that rolled

COURTESY DANNY QUAH

Illustration by Chantal Jahchan

out after the US failed to ratify its precursor, the Trans-Pacific Partnership. This new agreement even includes the United Kingdom, not a Pacific nation: Open economies appreciate arrangements built on a predictable rules-based system.

Middle powers can afford to provide global public goods more easily than can small states. But they are just as likely as great powers to be swayed by diminishing incentives and are just as unlikely to uphold multilateralism if they see no net benefit. Support for multilateralism must align with their self-interest. Their actions must, in other words, be incentive compatible.

If the international system is to endure, it must have more than just great- or middle-power leadership. Incentive compatibility must replace the idea that size matters and will add more to the resilience of the international system than explicit contractual collaboration agreements. All nations must contribute in a way that delivers visible gains for everyone. But how is this possible without goodwill or consensus between critical actors? I propose three pathways.

Inadvertent cooperation

First, policymakers should seek opportunities for inadvertent cooperation. Cooperation emerges naturally when countries agree on a common solution to a problem and can lay out explicit articles of collaboration. Inadvertent cooperation, however, means that countries cooperate even when they disagree: It's about doing the right thing even if for the wrong reason.

Inadvertent cooperation is most evident when there are positive spillover benefits. During the COVID pandemic, nations raced to find a vaccine. Faster vaccine development was made possible by a combination of mRNA technology and competition between companies in different countries. The process meant building on what others had discovered, but competition yielded vaccines that benefited everyone.

Consider the energy transition. If one country considers that a competitor is unfairly subsidizing production of electric vehicles, it could subsidize its own production rather than slapping tariffs on its adversary. Such subsidies are a sharp riposte to its adversary but also increase the supply of affordable clean-energy vehicles, which reduces carbon emissions. It's a good outcome for all, even though everyone is acting for the wrong reasons.

> "If the international system is to endure, it must have more than just great- or middle-power leadership."

Prisoners' dilemma

Second, policymakers in smaller nations should nudge the international system out of gridlock. When all countries seek their own self-interest, a prisoners' dilemma can result: Every country acts in ways that are individually optimal but mutually destructive when taken collectively. No country can free itself from the dilemma: If it tries to do so unilaterally, others take advantage. When great powers get caught this way, a small nudge can persuade them to change course and pursue a collectively preferred outcome.

Advanced economies, for example, often hesitate to grant emerging economies greater access to their markets. Instead they put up barriers to trade, depriving developing economies of opportunities to become richer, which in turn drives outward migration. This ratchets up political tensions on all sides. If developing economies can persuade advanced economies to act as a group, the impact of freer trade is minimized; imports are spread across the advanced economies, and rising incomes in developing economies reduce the incentive to migrate. Nudging can help great and middle powers do what they want to do but cannot for fear of losing out to adversaries.

Pathfinder multilateralism

Third, policymakers should strive for pathfinder multilateralism. When some nations turn their backs on multilateralism, subgroups of countries that favor it can still work together. The World Trade Organization's Multi-Party Interim Appeal Arbitration Arrangement (MPIA) provides an independent appeals process to resolve trade disputes when the main appellate body can't function for lack of a quorum. MPIA membership has tripled to more than 50 nations since 2020. In pathfinder multilateralism coalitions act together to overcome problems. While the focus is different, these arrangements resemble what the IMF has called "pragmatic multilateralism."

The Regional Comprehensive Economic Partnership is another example. The 15-nation free trade agreement is committed to rules-based order; it's an inclusive arrangement and, as well as members of the Association of Southeast Asian Nations (ASEAN), includes countries as politically diverse as Australia, China, Japan, New Zealand, and South Korea. Even as multilateralism is in retreat elsewhere, ASEAN countries continue to promote it in the Asia-Pacific region.

International cooperation through multilateralism may seem impossible now, with consensus falling, particularly between geopolitical rivals. Yet inadvertent cooperation, overcoming the prisoners' dilemma, and pathfinder multilateralism can restore the best of the international system. F&D

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GLOBAL BALANCES WIDEN

Wider external gaps in key economies point to the need for policy adjustment at home

GLOBAL CURRENT ACCOUNT balances—the surpluses and deficits arising from cross-border trade, income flows, and current transfers—are widening again after narrowing in recent years. They fell to a postpandemic low of 3 percent of world GDP in 2023, but widened to 3.6 percent last year. Adjusting for volatility from the pandemic and Russia's war in Ukraine reveals a notable reversal of the narrowing since the global financial crisis. This may signal a significant structural shift.

As the table on this page shows, several major economies have seen their surpluses or deficits expand, contributing to the growing divergence in current account balances.

Excessive deficits and surpluses can be sources of risks. Large, persistent imbalances often signal vulnerabilities. They typically reflect distortions—for example, a mismatch between a nation's saving and investment—that leave economies more exposed to shocks.

The IMF's external assessment shows that current account balances were out of line with fundamentals in several major economies in 2024, underscoring the need for adjustment. History demonstrates that global imbalances can unwind abruptly and painfully. To avoid such a scenario, a gradual correction is needed through concerted domestic macroeconomic policies.

Deficit countries should curb excess spending and improve competitiveness to narrow their external gaps, while surplus countries should boost domestic demand and investment to better absorb their output. Such steps would gradually shrink imbalances and foster more balanced, resilient global growth. F&D

This article draws on the IMF's 2025 External Sector Report.

Balance check

Current account balances, expressed as a percent of GDP, reveal that surpluses and deficits widened in 2024 for several major economies, pushing global balances further apart.

Deficit 0 Surplus

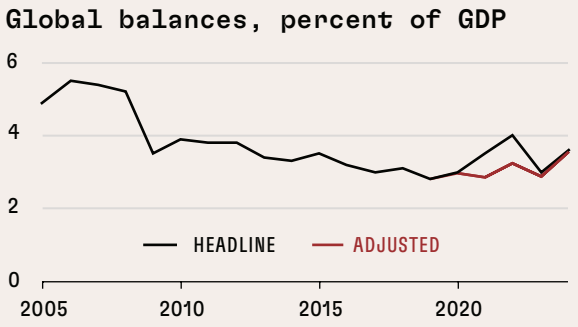
Advanced economies	2022	2023	2024
SINGAPORE	18.4	17.7	17.5
HONG KONG SAR	10.2	8.5	12.9
THE NETHERLANDS	6.6	9.9	9.9
SWEDEN	4.7	7.0	7.4
GERMANY	3.8	5.6	5.7
KOREA	1.4	1.8	5.3
SWITZERLAND	8.7	5.2	5.1
JAPAN	2.1	3.8	4.8
SPAIN	0.4	2.7	3.0
ITALY	-1.7	0.1	1.1
FRANCE	-1.2	-1.0	0.4
CANADA	-0.3	-0.6	-0.5
BELGIUM	-1.3	-0.7	-0.9
AUSTRALIA	0.4	-0.3	-1.9
UNITED KINGDOM	-2.1	-3.5	-2.7
UNITED STATES	-3.9	-3.3	-3.9

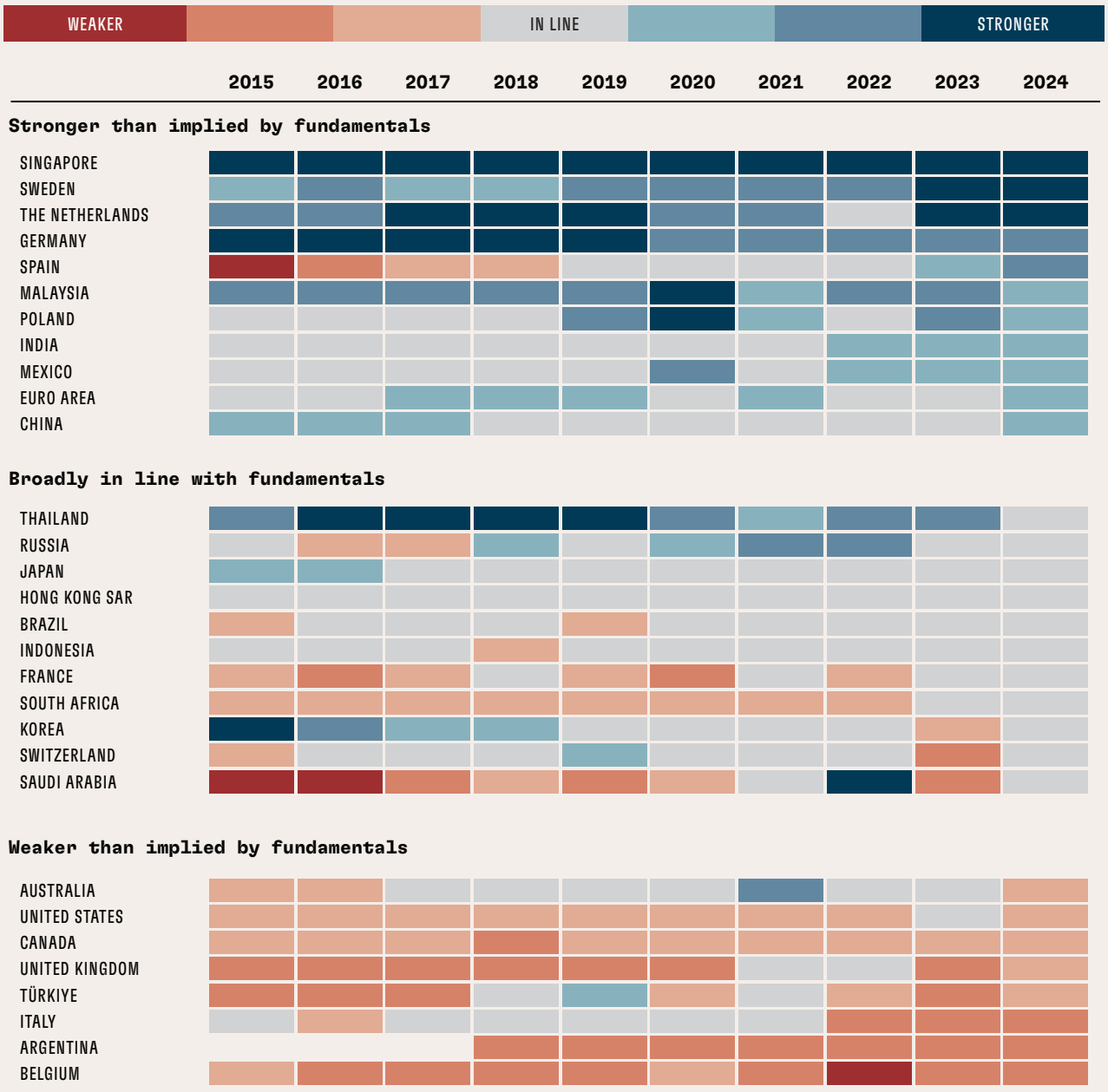
Emerging market and developing economies	2022	2023	2024
RUSSIA	10.4	2.4	2.9
CHINA	2.4	1.4	2.3
THAILAND	-3.5	1.4	2.1
MALAYSIA	3.2	1.5	1.4
ARGENTINA	-0.6	-3.4	1.0
POLAND	-2.3	1.8	0.2
MEXICO	-1.2	-0.3	-0.3
SAUDI ARABIA	12.1	2.9	-0.5
INDONESIA	1.0	-0.1	-0.6
SOUTH AFRICA	-0.5	-1.6	-0.6
TÜRKIYE	-5.1	-3.5	-0.8
INDIA	-2.0	-0.7	-0.8
BRAZIL	-2.2	-1.3	-2.8

SOURCE: IMF, 2025 *External Sector Report*. **NOTE:** For India, data are presented on a fiscal year basis.

External snapshot

Global current account balances widened to 3.6 percent of world GDP in 2024, reversing recent narrowing and raising concerns about a structural shift. Persistent surpluses and deficits can signal vulnerabilities and the need for policy adjustment. External sector assessments, which use a wide range of indicators to evaluate each economy's external position, show that several major economies are out of line with underlying fundamentals.





SOURCE: IMF, 2025 *External Sector Report*. **NOTE:** Order based on economies' excess imbalance during 2024. Coverage of Argentina started in 2018. Global current account balances are the sum of the absolute values of current account surpluses and deficits.

FINANCE CHANGED,

RISKS DIDN'T

New technologies are rewiring liquidity, payments, and economic stability

Yao Zeng

Illustration by Keith Negley

More than 15 years after the global financial crisis, the banking and financial system looks safer. But it's also evolving in ways that are reshaping who provides liquidity, how money moves, and risks to economic and financial stability. As a result, the next shock may begin not in a bank, but in the new infrastructure underpinning the system.

After 2008, regulators moved swiftly to raise capital standards and introduce new supervisory tools such as stress testing. Banks rebuilt their balance sheets and retreated from risky lending and arbitrage businesses. Asset managers were blamed for the financial turmoil at the onset of the pandemic, but not banks.

Yet even as regulators fortified banks, postcrisis innovations reshaped the financial landscape. Asset managers provided more liquidity as banks stepped back, nonbank start-ups built new risk assessment tools for institutional lenders, developers introduced a wider array of crypto assets, and central banks and governments established real-time payment systems.

These developments cut costs, broadened access, and accelerated transactions. Yet they also caused significant shifts in the structure of financial intermediation. Liquidity, credit, and payments—the core of the banking system—gravitated toward asset managers, tech platforms, and decentralized networks.

This reshaping of finance itself now raises big questions. What happens when critical finance functions lie outside the regulatory framework? How should we ensure stability in a faster, flatter, and more fragmented financial system?

From banks to asset managers

Banks were once the protagonists of liquidity creation for financial markets. Yet today, it is nonbank asset management funds, not banks, that contribute a growing share of the system's day-to-day liquidity to households and investors (Chart 1). Open-end mutual funds and exchange-traded funds (ETFs) let investors redeem money on demand, even though these funds hold assets such as corporate bonds that are anything but liquid. They promise daily liquidity but hold underlying assets that can't always be sold—just as banks do, but without deposit insurance, capital buffers, or access to the central bank.

This isn't theory. It's happening. My research with Columbia University's Yiming Ma and Kairong Xiao shows that bond mutual funds alone now supply sizable liquidity compared with the entire banking system, and this share is rising. Yet when markets turn volatile, mutual funds can be shock amplifiers rather than absorbers. They may be forced to sell illiquid assets in a falling market, deepening the stress.

ETFs add complexity. On paper, most ETFs are passive vehicles. More than 95 percent track an index, such as the S&P 500 or Bloomberg US Aggregate Bond Index. But in practice, many are surprisingly active. There are now more ETFs than underlying assets. For many asset classes, investors can choose among plain-vanilla trackers, sector-specific funds, smart beta strategies, and even thematic products like AI-, robotics-, and green-focused ETFs.

Behind the scenes, ETF sponsors must actively manage portfolios to meet investor flows and keep prices in line with the value of the underlying assets. Bond ETF managers frequently deviate from their stated benchmarks, as my work with Naz Koont of Stanford University, Lubos Pastor of the University of Chicago's Booth School of Business, and Columbia's Ma shows. Bond ETFs, especially, trade like liquid stocks but hold underlying illiquid bonds. They rely on a network of specialized intermediaries, called authorized participants, to arbitrage price discrepancies between ETFs and underlying assets.

These participants are also bond dealers and use the same balance sheets both in their role of managing ETFs and to serve their trading clients. When dealer balance sheets get tight, or when bond markets seize up, ETF arbitrage can break down. Prices drift, and liquidity thins. And investors who expected stock-like flexibility may be left holding something closer to a closed-end fund.

The new ecosystem of liquidity provision is more market based, broader, and potentially cheaper than the old one. After all, bankers face greater constraints in providing daily liquidity, and asset managers step in to fill the gap. But the new ecosystem plays by a different rule book, with different risks when markets freeze.

AI and big data

Lending, once the province of bankers and loan officers, increasingly relies on AI and big data. Nonbank fintech platforms use payment records and

"Small merchants relying more on cashless payments have access to better loans. Digital footprints are the new credit scores."

machine learning to cut search costs, bypass collateral requirements, speed loan approvals, and reach borrowers that traditional banks often overlook. Data, in turn, flows more freely between borrowers and lenders, training increasingly precise and adaptive machines. My research with the Indian Institute of Management's Pulak Ghosh and Harvard's Boris Vallee shows how this plays out in India. Small merchants who rely more on cashless payments with detailed and traceable paper trails get better access to working-capital loans. They pay lower interest rates and are less likely to default. In effect, digital footprints are the new credit scores.

This credit-data feedback loop has boosted the power of Big Tech. Platforms such as Alibaba's Ant Group, Amazon, and Latin America's Mercado Libre now bundle payments, e-commerce, and credit. The size of their consumer and small-business loan books now exceeds that of many banks. Scale delivers convenience, but also concentration: The platform that controls the checkout button can steer borrowers and merchants away from rival bank lenders, raising difficult questions about competition.

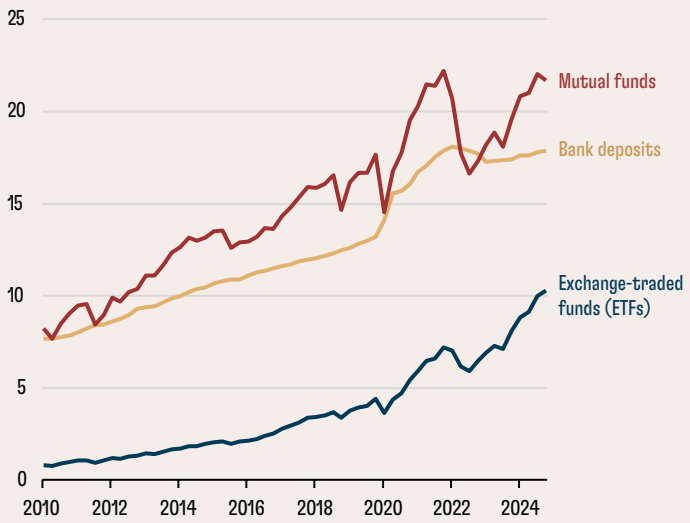
Size is not the only concern. Because Big Tech sits outside traditional safety nets, traditional capital, liquidity, and resolution rules do not yet apply. In 2024, Amazon abruptly discontinued its $140 billion in-house lending program to small businesses, illustrating how platform credit can vanish just when firms need it most. As AI- and data-driven lending pushes ever more credit through a few digital gateways, more questions crop up alongside the emergence of too-big-to-fail tech monopolies.

CHART 1

Smaller bank share

Banks' share of US liquidity provision is falling relative to mutual and exchange-traded funds.

(US dollars, trillions)



SOURCE: Federal Reserve Data on the Financial Accounts of the United States.

Crypto and instant payments

Also at the core of this changing banking landscape is the evolution of payment intermediation. Bitcoin was released in 2008 during the financial crisis as an alternative form of money for payments. Built on blockchain technology, Bitcoin aimed to bypass commercial banks and central banks, offering a decentralized way to move money without relying on trust in institutions. For good or ill, Bitcoin never fulfilled that promise. It's slow to settle, costly to use, and highly volatile. For most crypto believers, it is less digital dollar and more digital gold: a speculative asset, not functional money.

Stablecoins, a close cousin of Bitcoin, emerged to fix this (Chart 2). Like Bitcoin, stablecoins are blockchain assets designed to provide payment services. New US legislation, including the GENIUS and STABLE acts, may further boost their growth. An important difference from Bitcoin is that stablecoins are pegged to real-world currencies, usually the US dollar. Issuers like Circle (USDC) and Tether (USDT) hold reserves in bank deposits, Treasury securities, and corporate bonds to maintain that peg. Avoiding the huge volatility of Bitcoin, stablecoins have shown promise as a cheap and borderless payment alternative. Stablecoins have become lifelines in Argentina, Türkiye, and Venezuela,

where inflation is high; ordinary people in these economies now use stablecoins for saving, sending remittances, and settling transactions. They are steadily moving into mainstream payment flows as big banks and giant merchants contemplate issuing their own stablecoins.

But just like mutual funds and ETFs, stablecoins lack traditional safeguards such as deposit insurance and direct access to central bank support. In March 2023, when Silicon Valley Bank failed, Circle's USDC temporarily lost its peg after losing access to reserves. The previous year, the collapse of Terra's algorithmic stablecoin triggered widespread losses. My research with Columbia's Ma and Chicago Booth's Anthony Lee Zhang highlights a core dilemma facing stablecoins: The more effectively they maintain stable prices, the more they resemble banks—yet without deposit insurance or a lender of last resort, making them more vulnerable to runs. These observations make one thing clear: Stablecoins may function well in good times, but they can falter under stress.

Alongside the rise of private crypto payment alternatives, government-sponsored fast payment systems offer a different path. After all, people value speed and efficiency in payments, yet crypto assets are neither as fast nor as cheap as they claim. Brazil's central bank introduced Pix, a fast, free payment system built on traditional bank payment rails and always available. It processes more daily transactions than cash, credit, and debit cards combined. More than 90 percent of Brazilian households and businesses have adopted it. India's Unified Payments Interface followed a similar trajectory (see "India's Frictionless Payments" in this issue of F&D).

"Liquidity, credit, and payments—the core of the banking system—gravitated toward asset managers, tech platforms, and decentralized networks."

These systems deliver what crypto promised—faster, more inclusive payments—but in a far less disruptive way. They have attracted growing international attention, including praise from the Bank

for International Settlements, for promoting financial inclusion while preserving monetary stability.

Despite the merits, however, fast payment systems come with trade-offs. My new research with the Massachusetts Institute of Technology's Ding Ding, the Central Bank of Brazil's Rodrigo Gonzalez, and Columbia's Ma shows that payment systems like Pix force banks to hold more liquid assets to meet unpredictable outflows, reduce bank lending, and—perhaps surprisingly—increase credit risk. This is because the convenience of fast payments to consumers comes at the expense of banks' losses in delaying and netting payment flows. Fast payments increase banks' need to hold liquid assets such as cash and government bonds over extending illiquid loans. When banks hold more liquid low-yielding assets, in turn, it exacerbates their yield-seeking incentives in extending riskier loans. In a sense, the payment system becomes faster, yet fast payments may inadvertently make the banking model narrower and potentially riskier.

Macro-financial implications

Banks are safer thanks to stronger capital requirements, tighter supervision, and regular stress tests. But we have not necessarily protected the macroeconomic environment.

First, the financial system is more fragmented. Key functions, payments, credit, and liquidity have shifted outside the regulatory perimeter. Mutual funds, ETFs, and stablecoins mimic deposits. Robots and platforms extend credit. But unlike banks, they operate without deposit insurance, lender-of-last-resort access, or systemic oversight. This, combined with geoeconomic rivalries, increases the possibility of a more fragmented financial system, posing challenges to global regulatory coordination, as highlighted by the European Central Bank's Christine Lagarde and the People's Bank of China's Pan Gongsheng. The risks didn't vanish. They just moved.

Second, capital flows have accelerated. Real-time trading, credit-data loops, and fast payments may all amplify shocks. What once took days now happens in minutes. Yet the tools for absorbing stress, liquidity backstops, and market interventions haven't caught up. The plumbing is faster, but the stabilizers aren't.

Third, the policy toolkit may have gradually become misaligned. Central banks built their frameworks for a bank-dominated system in which deposit rates influence lending and lender-of-last-resort facilities calm depositors. But when money resides with asset managers or as on-chain transactions or moves through apps, traditional barometers are less effective. It's harder to see where risk builds, and harder to stop it when it breaks.

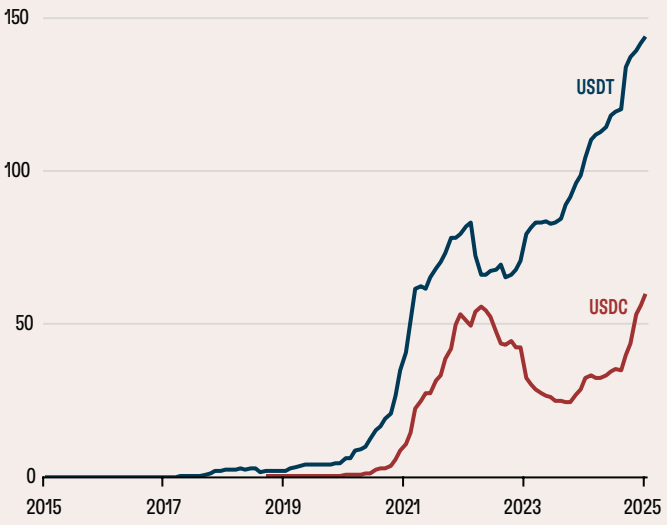
The global financial landscape has changed, yet the rules remain largely unchanged—and that mismatch may be the biggest risk of all. F&D

CHART 2

Rise of stablecoins

The world's two largest stablecoins have combined capitalization of more than $200 billion.

(market capitalization, US dollars, billions)



SOURCE: CoinDesk.

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STABLECOINS, TOKENS, AND GLOBAL DOMINANCE

Hélène Rey

Technology is reshaping capital flows and currency dominance; data integrity is essential for financial stability

Technology is poised to shake up the international monetary and financial system. How that happens depends on whether technologies are shaped by the public sector or the private sector sets standards first. Also at play are regulations, international cooperation, and the resilience of new technologies to cyber risk. The effects on capital flows are hard to assess, but they could have a surprisingly large impact on fiscal accounts, geoeconomic fragmentation, exchange rate volatility, and the internationalization of major currencies.

Stablecoins are one of the most relevant innovations, increasingly embraced amid US introduction of a legal framework designed to boost adoption and solidify the dollar's role as the main international currency. Tokenization plays a role as well. It is the process of recording claims on assets that exist on a traditional ledger—or native assets (that is, only issued digitally)—on a programmable platform, where they can be transferred (Agur and others 2025).

These new technologies could unleash new functionality, such as programmability, and enlarge the set of feasible policies, as well as deeply unify the way capital flows across bor-

BRIAN STAUFFER

ders and asset classes if many private and official actors use the same platform. But they also could threaten government revenues and take us back to a 19th century world of private money issuers competing for seigniorage, which would fragment and destabilize the international financial system.

Implications of stablecoins

Stablecoins issued by the private sector bridge the conventional financial system and the crypto ecosystem. They promise stable value relative to fiat currencies, mainly by holding liquid assets such as US Treasuries, and operate on blockchains. They share some features with money market funds and with "narrow banking"—also known as 100 percent reserve banking—though they typically do not, so far, offer an interest payment. Almost all stablecoins are pegged to the US dollar, but most transactions happen outside the United States. Stablecoins tend to be used as on- and off-ramps to crypto assets, in which case they are probably vehicles for speculative investments. But increasingly, they are also a cross-border payment instrument. They are useful where the domestic financial system is weak or costly to use or when international financial transactions are regulated, either because of capital controls or externally imposed sanctions.

In a world where stablecoins, particularly those pegged to the dollar, become an important global payment tool, we must brace ourselves for substantial consequences. On the negative side are dollarization and its side effects, financial stability risks, potential hollowing out of the banking system, currency competition and instability, money laundering, fiscal base erosion, privatization of seigniorage, and intense lobbying. On the positive side, cross-border payments may be quicker and cheaper, which matters especially for remittances. And citizens of countries with poor governance would have access to more stable and convenient means of payment and store of value than their domestic currency. Who gets payment data and US dominance when it comes to imposing sanctions will be affected as well. Clearly these possibilities warrant more discussion.

Capital flows and intermediation

US dollar stablecoins inherit some characteristics of their parent, the most important international currency. Tied to the dominant unit of account, they can benefit from the dollar ecosystem's network externalities and from its credibility and hence have the potential to be an important medium of exchange worldwide, facilitating transactions and remittances. By superseding the system of correspondent banking and messaging systems such as SWIFT, they may speed up and lower the costs of cross-border transactions, improving efficiency. But some of this decrease in cost may result from a lack of know-your-customer and anti–money laundering compliance—that is, if regulatory authorities do not catch up. Stablecoins are certainly also an attractive way to get around sanctions and engage in illegal transactions. They are more stable than Bitcoin and Ether, which have been used precisely for those purposes (Graf von Luckner, Reinhart, and Rogoff 2023; Graf von Luckner, Koepke, and Sgherri 2024). Unbacked crypto assets and stablecoins could thus help channel money linked to illicit or sanctioned activities and substantially erode the tax base of many countries. Crypto users are likely to find off-ramps to conventional financial systems in some jurisdictions, offshore or even onshore.

If the use of US dollar stablecoins increases massively worldwide, it could hollow out banking sectors because of competition for deposits. If banks themselves issue stablecoins, it could curb lending and increase US Treasury holdings—assuming these are the main assets backing the stablecoins—on the asset side of the balance sheet, a development akin to narrow banking. The effects on systemic risk, as well as the potential questionability of some actors' backing of stablecoins and the ensuing run risks, bear a close look. And the classic cost of dollarization around the world should be kept in mind: It can alter the transmission channels of monetary policy and hinder macroeconomic stabilization.

Privatization of seigniorage

For the rest of the world, including Europe, wide adoption of US dollar stablecoins for payment purposes would be equivalent to the privatization of seigniorage by global actors. Along with easier flows linked to tax evasion, fiscal accounts could be affected. On the asset side, the backing of stablecoins means that increased international adoption of those pegged to the dollar could lower demand for non–US government bonds and raise demand for US Treasuries. The magnitude of this effect will depend on substitution patterns between dollar-backed crypto assets and money market funds and deposits in local currencies and dollars. Tether and USDC already hold collectively more US Treasuries than Saudi Arabia, as shown in Chapter 2 of the IMF's July 2025 *External Sector Report*. Thus, by increasing the demand for Treasuries and the stock of US external safe liabilities, US dollar stablecoins could reinforce the "world banker" balance sheet of the United States and help stabilize US finances and external deficits. These stablecoins could constitute a digital pillar strengthening the exorbitant privilege of the US dollar.

> "In a world where stablecoins, particularly those pegged to the dollar, become an important global payment tool, we must brace ourselves for substantial consequences."

Another consequence of growing US dollar stablecoin flows, leading to the privatization of global seigniorage, is significant wealth accumulation by what is likely, given the strength of network externalities, to be a few companies and individuals. From a political economy perspective, this will usher in increased lobbying for deregulation and opacity of international capital flows. Such an outcome would defy the public good dimension of the international monetary system. Unfortunately, data collection efforts on crypto capital flows by international organizations and country authorities are still in their infancy. There are two valuable contributions in recent IMF research that describe these challenges (Reuter 2025; Cardozo and others 2024). Since the emergence of cryptocurrencies may threaten core macroeconomic policies and the financing and provision of national and global public goods, measuring their flows, use, and global regulation should be a policy priority.

Tokenization and integration

Tokenization could integrate messaging, reconciliation, and asset transfer on a unified ledger where central bank digital currencies (CBDCs) also play a major role. Different countries' CBDCs could be linked for efficient cross-border transactions, according to the Bank for International Settlements. Global capital flows could be reshaped by such tokenization and a blockchain that allows

money, assets, and information to move securely and automatically without traditional banking or clearing systems.

Access to foreign assets has historically been restricted by barriers such as capital controls, regulation, and inefficient cross-border payments. Interoperability and new trading platforms for global assets such as stocks, bonds, and commodities could open up access for individual investors, wherever they are. Decentralized finance (DeFi) platforms could amplify these benefits with peer-to-peer transactions, cutting out intermediaries such as banks and brokers. Tokenization may thus expand financial integration, bringing both advantages and well-known challenges.

Currencies and financial stability

Such a system could mean more substitutability across currencies and therefore more competition, leading to large portfolio shifts across currency networks. Increasing returns to scale will play out in this larger international arena, as will forces pushing for a single unit of account; the incumbent dollar has a head start. But the strategic value of payment data and the desire for sovereignty in different jurisdictions' payment systems could fuel fragmentation and even restrictions on the use of some currencies. The emergence of programmable capital controls and granular restrictions on wallets is possible, and a more multipolar international monetary system could follow. The coexistence of multiple connected networks could even fracture the monetary and financial system if several private issuers gain market share and tokenization platforms proliferate. But such a world is inherently fragile. History tells us that private monies are unstable for all the traditional reasons linked to lack of credibility. When they are not well regulated and not backed by a sovereign that can tax and enforce contracts, private monies often lead to runs. Sovereign currencies themselves may be unstable when the credibility of their institutions—in particular, their fiscal institutions—is questioned. International policy cooperation and regulation are essential to prevent excessive fragmentation and financial fragility.

Integrity privilege

This new world will risk even greater instability if loss of credibility also comes from *loss of data integrity*. The US Commerce Department's National Institute of Standards and Technology warned in 2016 that quantum computers may soon solve problems conventional computers have trouble managing and, as emphasized by Fusa (2023), will be able to break many of the public key cryptosystems currently in use. This problem is often ignored. The development of *post-quantum cryptography,* secure against both quantum and classic computers and interoperable with existing communications protocols and networks, is progressing, but the outcome is uncertain given the race for computer power. Hence the currency networks most exposed to hacking and to losing their integrity will see massive confidence crises and capital outflows, which could spur financial crises. In such a world, the currency network with the *smallest attack surface* for hackers should harvest a premium and reduce its financing costs—this could be called an "integrity privilege."

To conclude, the impact of technology on the international monetary and financial system will be profound but is hard to forecast: It will be shaped by unpredictable innovations, regulatory policies, and lobbying groups. Major financial stability risks, including increased volatility in exchange rates; threats to public finances in many economies; and competition across currency networks are likely. It may result in large wealth transfers, which will alter the political economy of regulation. International policy cooperation is therefore essential. Finally, new technologies may reshuffle international currency dominance and result in the emergence of an integrity privilege. F&D

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TECH MEETS FINANCE

Iñaki Aldasoro, Jon Frost, and Vatsala Shreeti

Fintech companies will compete against, and cooperate with, traditional banks; public policy must provide direction

Digital innovation often starts with a radical idea. It can be a new way to store and process information, a new business model, or a new service. But the idea is just the start: Realizing the benefits of innovation requires hard work, sufficient investment, and user adoption.

Disruptive innovation has been the name of the game in the financial sector over the past decade. New financial technology (fintech) firms have emerged, large digital platforms (big techs) are offering payment services and credit, crypto assets and stablecoins are growing in value, and many institutions are adopting artificial intelligence. Each of these is challenging traditional financial intermediaries, like banks, insurers, and asset managers, and the services that they provide (Ben Naceur and others 2023).

Digital innovations can both complement and substitute for services in the traditional financial system. Many services seem to offer a stark alternative to existing intermediaries and services in the short term. But in the medium term, they often complement existing services, leading to even greater competition and a more diverse financial system. Still, innovations don't always lead to the best outcomes on their own: Things can, and frequently do, go wrong. Harnessing the benefits of digital innovation often requires forward-thinking public policy.

Disruption in payments

Payments are the gateway to financial services. For individuals, a transaction account is often a prerequisite for accessing credit, buying an insurance policy, or starting to save and invest. For new entrants to the financial system, like fintechs and big techs, it is common to start by handling payments and then branch out into other areas of finance.

In the past decade, the way we pay has changed dramatically, with so-called fast or instant payment systems taking off in many countries, especially emerging markets (see Chart 1). They allow for real-time (or nearly real-time) transfers between end users (Frost and others 2024). Fast, 24/7 payments

Illustration by Marie Emmerman

are provided by fintechs, big techs, and existing banks. They use smartphone apps and quick response (QR) codes, even operating on lower-tech phones. They have generally allowed disruptors to provide services that directly compete with incumbents.

The most well-known success stories come from public infrastructures, such as systems operated, or overseen, by central banks. In Brazil, for instance, the central bank introduced its fast payment system Pix in November 2020. Now, over 90 percent of Brazilian adults use the service for daily retail payments, such as food or travel, and even for recurring payments like utility bills. In India, the Unified Payments Interface (UPI)—operated by the National Payments Corporation of India and regulated by the central bank—promotes services by incumbent banks, fintechs, and big techs on one platform (see "India's Frictionless Payments" in this issue of F&D). Similar successes include Thailand's PromptPay, which is privately run but with a key role for the central bank, and SINPE Móvil in Costa Rica, operated by the central bank.

These successful public infrastructures stand in contrast to the situation in many economies where there are multiple private sector fast payment systems inaccessible to users of other financial institutions. For example, in the US, someone using only Venmo cannot pay someone who uses only Zelle. Similar "walled gardens" have also arisen in China, with competing wallets by Alipay and WeChat Pay, and in Peru, where the wallets Yape and Plin compete for users (Aurazo and Gasmi 2024). In the case of China and Peru, policy intervention was needed to make payment systems interoperable.

Often, what begins as a substitute (fintech and big tech challengers) can complement existing services operating in the same market. Users get cheaper, faster payments, which can also support financial resilience and higher economic growth. The disruptors—and public policy—help improve the system, serve new clients, offer new services in the same market, and push incumbents to enhance their offerings.

A digital credit metamorphosis

Beyond payments comes the need to borrow. Companies need credit to make productive investments, and people need it to buy a house or a car or to pay for education.

In the early days of the fintech revolution, it looked like new lending platforms could end up replacing many functions of banks. Crowdlending and other new credit platforms grew quickly, often using alternative data for credit scoring and connecting borrowers and lenders in streamlined, digital processes. This was soon overshadowed by new lending by big tech providers, such as merchant lending by Amazon in the US and Alibaba in China. The volume of big tech credit boomed (Cornelli and others 2023).

These new platforms have narrowed gaps in credit markets and enhanced financial inclusion. In Argentina, for example, Mercado Pago has stepped in to support small merchants spurned by banks. In China, big tech credit has been less sensitive to home prices than bank credit, potentially reducing the importance of collateral. In the US, fintech small business lenders have targeted areas with high unemployment and bankruptcies, where banks are less likely to lend. Overall, the impact of fintech and big tech varies widely from country to country.

But banks are very much still in the picture, competing now with a new set of intermediaries. They changed their business models to look more like platforms, and to use alternative data. Conversely, many challengers, such as the UK's Revolut and Brazil's Nubank, obtained licenses and became banks themselves.

Crypto and DeFi

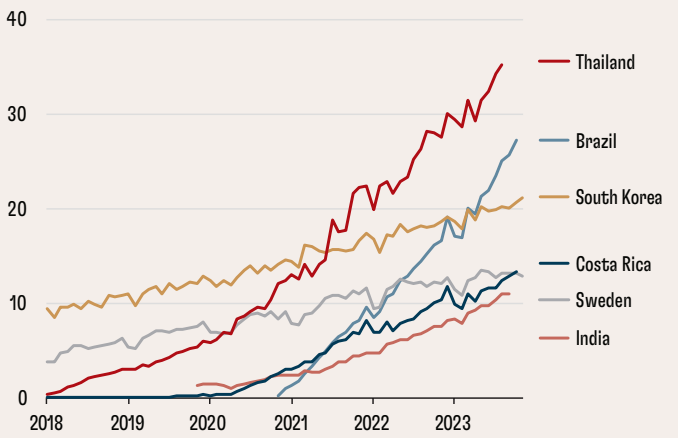
While big techs challenge incumbent financial institutions at their own game, crypto assets and decentralized finance (DeFi) promise to reimagine finance, based on trust in code rather than in insti-

CHART 1

Digital payments take off

The volume of fast payment transactions has grown rapidly, especially in emerging markets.

(number of transactions per capita)



SOURCES: Bank for International Settlements, CPMI Redbook statistics; Frost and others 2024; International Monetary Fund; National Payments Corporation of India; World Bank; and individual central banks.

tutions. Global crypto adoption is on the rise again, despite its long history of volatility, mostly for speculative investment purposes, but also thanks to political support for these assets in some countries.

Crypto was intended to foster decentralization, but it hasn't really turned out that way. Crypto exchanges, traditional banks, investment funds, and others entering the market mean that the market remains intermediated and often centralized. More important, unbacked crypto assets often have limited usability because they can be extremely volatile.

Stablecoins, which tie their value to the fiat currencies that crypto ostensibly challenged, emerged as an alternative. The largest stablecoins are issued by centralized entities that hold assets such as US Treasury bills and bank deposits to back stablecoins in circulation. But even with these new intermediaries, and with the growing presence of stablecoins, the crypto sector remains riddled with risks, including widespread fraud, scams, money laundering, and terrorism financing. In addition, stablecoins fall short of providing necessary elasticity in the monetary system. Because more than 98 percent of stablecoins by value are tied to the US dollar, they can also undermine monetary sovereignty in many jurisdictions.

Still, crypto and stablecoins provide a glimpse of functionality that may have broader applicability. For example, programmability and tokenization could improve existing functions and enable new ones within the existing monetary system, based on central banks at the core and commercial banks interacting with clients. In cross-border payments, for example, tokenization could rewire the correspondent banking system, allowing for messaging, reconciliation, and asset transfer in a single action. New functions like simultaneous ("atomic") settlement and enhanced collateral management could dramatically improve the functioning of capital markets. These functions could lay the foundation for a future tokenized financial system.

Public policy to guide innovation

These radical innovations have significantly changed the financial system over the past decade. Stark challenges that threatened to substitute for existing services have often evolved into something new that is complementary to those services—frequently fostering competition. And by and large, this has helped lower consumer prices and made services more efficient. But innovation may not always lead to the best outcomes on its own.

Forward-looking public policies allowed for some of the biggest, most impactful breakthroughs. The adoption of fast payments, and the significant progress in access to payment accounts, has been possible thanks to an interplay of public sector infrastructures and private innovation. Proactive steps by public authorities, even in the face of initial reluctance by incumbents, helped improve payment services and financial inclusion, as most notably shown with UPI in India and Pix in Brazil. This helped bring hundreds of millions of people into the financial system worldwide.

Meanwhile, important risks are emerging from innovation that could erode financial stability. For instance, shocks from the crypto sector could spill over to the traditional financial system, potentially even posing risks to the US Treasury market (Ahmed and Aldasoro 2025).

To harness the potential of innovation and mitigate the risks, radical new ideas are necessary, but not sufficient. Also needed are public infrastructures, sound regulation, and practical experimentation in the public and private sectors to yield new insights and inform private investment and public policy. Finally, the public and private sectors need to coordinate to guide digital technologies toward applications that truly benefit people and businesses and lay a solid foundation for prosperity. A recent example of this type of coordination is Project Agorá, which brings together central banks and commercial banks to explore a unified ledger to leverage the benefits of tokenization for cross-border payments. F&D

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THE STABLECOIN BALANCING ACT

Darrell Duffie, Odunayo Olowookere, and Andreas Veneris

Fighting financial crime doesn't have to come at the cost of privacy

Legend has it that gangster Al Capone hid the illicit origins of his wealth by using laundromats as a front. Ever since, authorities have worked to track and seize "laundered" money from criminals and, more recently, terrorists.

These efforts are even trickier today because of digital assets such as stablecoins, which can be washed through many accounts beyond the reach of law enforcement. But the need to stop bad actors must not trammel the privacy rights of law-abiding people nor the efficient processing of billions of dollars in payments and transfers every day.

These goals may seem unreachable, but we argue that technology may actually make this objective feasible.

"Smart-compliant" payment systems that fight crime, protect privacy, and work efficiently are within reach. These systems can be built directly into the blockchains of stablecoins—digital assets pegged to traditional money.

How would this work in practice? Say Alice wants to pay Bob. Once she taps "send" in her phone app, previous verification of their identities is confirmed, the transaction is reviewed by a decentralized algorithm for suspicious activity, and the operation is completed—all on a blockchain. Flagged transactions would automatically be reported to law enforcement. The identities of Alice and Bob, however, could be unmasked only with a warrant or through another legal process.

With anticipated advances in technology, this compliance-by-design vision *could become* a practical *reality* for large-scale payment systems.

Illustration by Jasu Hu

Balancing privacy and transparency

New attempts at regulating blockchain-based finance do not resolve the fundamental tension between the protection of privacy and legal compliance. In payment systems, compliance and privacy are traditionally competing forces. Stablecoin payment systems exemplify this tension. But they may also offer a natural compromise since their decentralized and programmable architecture allows compliance mechanisms to be built in, and their pseudonymity helps keep privacy risks low.

This article explains how a "compliance-by-design" approach (Duffie, Olowookere, and Veneris 2025) could make it possible for decentralized stablecoin payment systems to protect privacy and enforce anti–money laundering (AML) and countering the financing of terrorism (CFT) regulations and sanctions. Compliance enforcement would take place as transactions occur, based on predefined criteria and risk indicators, instead of reactively, as is the case today. This approach is in line with the 2023 IMF–Financial Stability Board policy framework for crypto assets, which calls for compliance measures for stablecoin providers.

In such an environment, stablecoin users are likely to split into two groups. If institutions and individuals value both compliance and confidentiality, they are likely to select a compliance-by-design payment network. Others may continue using legacy approaches to stablecoin payments that are based on pseudonymity and relatively loose compliance constraints.

Before going deeper, let's define privacy interests in the context of stablecoin payments. For individuals, a major concern is the protection of personal information, including names, home addresses, and phone numbers. For corporations and institutions, privacy concerns may include transaction metadata—such as amounts, time stamps, patterns, and counterparties—which may be commercially sensitive. For businesses, maintaining confidentiality is not only strategically important, it is often also a legal requirement.

Compliance involves know-your-customer (KYC) standards and monitoring of payments for illegal activity. Currently, stablecoin providers delegate compliance tasks to centralized exchanges and other custodians that provide on-ramps and off-ramps for conversion between stablecoins and traditional currencies.

However, the ability to mint stablecoins and move them between multiple accounts with decentralized protocols, and the availability of "mixers" that obscure the trail of any single coin, makes it relatively easy to obscure transactions. Law enforcement has limited reach and is often reactive, triggered only after suspicious activity is detected. As a result, compliance with AML, CFT, and sanctions frameworks is relatively ineffective. Moreover, compliant users' privacy is limited because payments are publicly observable and transparently linked to the user's pseudonym.

Reconciling privacy standards with regulatory compliance calls for a model that better protects user data while reasonably enforcing the law. This requires a way to verify identities without exposing them.

Verification without exposure

In a compliance-by-design decentralized payment system, before Alice can pay Bob, both must have undergone identity verification by a licensed provider of such services (subsequently referred to as a credential issuer), as illustrated in Chart 1. Verification places Alice and Bob within the KYC perimeter of their chosen decentralized payment system. This verification is stored on the payment-system ledger as a "hashed" (cryptographically masked) certificate.

At this point, zero-knowledge proofs (ZKPs) come into play. These are cryptographic tools that can be implemented in a multiuser software platform, allowing a user to prove something without revealing what that something is. For example, a ZKP can establish which poker hand wins without revealing the cards of that player.

Likewise, ZKPs can allow users of a decentralized payment system to demonstrate know-your-customer compliance without revealing their personal data. It works by ensuring that each transaction that users initiate includes a ZKP proof of their eligibility to be inside the KYC perimeter of the payment system—without revealing their identity or any other underlying personal information.

This approach could be used in any decentralized payment system, in particular a system based on stablecoins. In principle, the same approach could be applied to decentralized payment systems based on central bank digital currencies and other digital representations of money.

Privacy is preserved unless specific risk indicators, such as unusual transaction patterns, transfers exceeding designated thresholds, or links to known high-risk wallets, are detected. Smart contracts embedded in the ledger monitor for these red flags. Smart contracts are automated software modules that enforce agreements on the ledger network without needing a middleman. When sufficiently suspicious activity is detected, the smart contracts generate suspicious activity reports (SARs) that are forwarded to regulatory authorities. Access by the authorities to underlying sensitive user data beyond that point follows a legal process that

depends on the jurisdiction, potentially involving court applications and procedures for warrants or administrative subpoenas.

This model enables layered detection and oversight. White-listed transactions (routine transfers between known parties) proceed seamlessly. Flagged transactions may be delayed or trigger automated SARs, and high-risk transfers involving known offenders may be blocked. These responses are enforced through smart contracts that can be dynamically updated to reflect evolving regulatory priorities, special cases, and insights obtained from the statistical analysis of payment patterns.

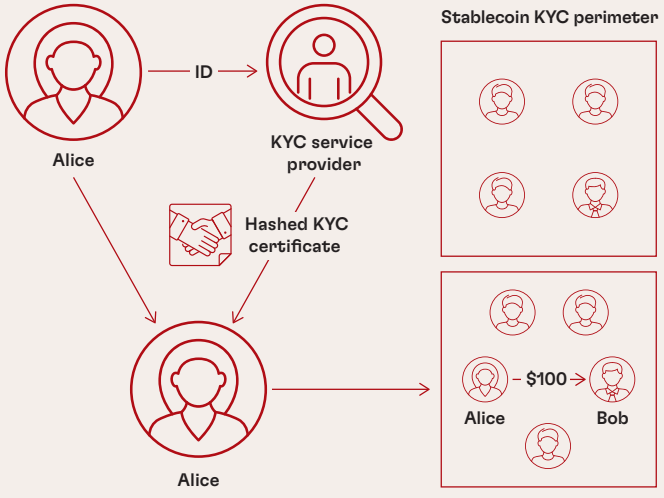
The KYC credential maintained by issuers secures databases of validated user credentials and allows them to be updated or revoked when compromised. If Alice's legal status changes—for example, as a result of a sanction—her compliance proof would fail and her transactions within the KYC perimeter would be blocked.

The stablecoin payment system we have described replaces time-consuming "off-chain" manual reactive reviews—common practice today—with proactive real-time "on-chain" algorithmic supervision. By leveraging smart contracts to apply compliance rules as transactions occur, this framework taps directly into the strengths of blockchain systems.

CHART 1

KYC for stablecoins

Alice joins the KYC perimeter after obtaining a hashed certificate from an authorized service provider.



SOURCE: Duffie, Olowookere, and Veneris 2025.
NOTE: ID = identification; KYC = know your customer.

Implementation

The KYC perimeter could be implemented using zero-knowledge KYCs (zkKYCs) (Pauwels 2021), which combine zero-knowledge proofs with selective disclosure. For example, Alice can prove that she meets specific identity checks (like being over 18) without revealing her age. Under this approach, a government agency or authorized financial institution issues Alice a verifiable credential derived from her official or government-issued identity documentation. A cryptographically protected version of this credential is stored in each user's private digital wallet.

During a transaction, a zkKYC token generated from this credential is embedded on-chain. This token proves KYC compliance without revealing user identities, and the underlying credentials remain securely off-chain with the credential issuer. For payments by natural persons, such as peer-to-peer or customer-to-business payments, identity spoofing can be mitigated by anchoring verifiable credentials to standardized legal documents such as passports or driver's licenses.

For example, when Alice initiates a payment to Bob, her wallet generates a zkKYC token that cryptographically proves that Alice has a verifiable credential. The token confirms that Alice has undergone KYC certification and belongs within the KYC perimeter. The token also indicates whether Alice is an individual or an institution and confirms the transaction amount, wallet thresholds, and other relevant data. This token need not reveal Alice's identity or transaction details to Bob or any third party unless Alice agrees, or unless a SAR is triggered and a legal basis for disclosure is established.

Automated compliance enforcement relies on ledger-embedded smart contracts that analyze encrypted information contained in zkKYC tokens for a match with specified SAR criteria. If a match is found, the contract automatically generates a SAR, allowing enforcement without significantly compromising the privacy of compliant users.

Technological and systemic challenges

Compliance by design offers a promising path forward but is not a silver bullet. The approach we have outlined involves a significant computational burden for a large-scale modern payment system. Smart contracts must be capable of interpreting complex and evolving regulations at a throughput rate that allows close-to-real-time payments. Going instead for a very simplistic approach could generate many false-positive and false-negative compli-

"Stablecoins hold significant promise for improving financial inclusion and the efficiency of payment systems. But they need to reach a much better balance between privacy and compliance."

ance checks, overwhelming enforcement authorities with noise and risking exploitation by bad actors.

Another challenge is the computational cost of privacy-preserving mechanisms, risking delays during peak-payment periods. Compliance-by-design payment systems may also add frictional costs and delays to moving funds between different payment systems.

One solution to the computational burden problem would be to allow regulated providers to license and manage smart contracts, providing compliance as a service. With this setup, users could grant limited access to their payment data in exchange for compliance services and other benefits, mirroring how privacy and consumer risk are managed by private firms today.

Further, as applied cryptography remains a fast-evolving field, new zero-knowledge-proof implementation promises to be faster. And new techniques, like multiparty computation, may help with the computational burden of administering smart contracts.

The road ahead

The compliance-by-design model presented here relies on sound governance. Establishing a trusted ecosystem of credential issuers is critical. Credential issuers and smart contract operators must be carefully licensed and must operate transparently and with accountability. Governments, banks, and certified financial technology firms could be the trusted nodes that anchor users to the compliance perimeter. Trusted credential issuers must follow uniform standards for KYC verification, and their verification should be interoperable across multiple ledgers. As with conventional payment systems, system-wide compliance quality hinges on the least rigorous credential issuers.

Laws may need to be adapted or applied in new ways. What justifies triggering a SAR? Under what conditions may authorities unmask a user's identity? Different jurisdictions would likely set distinct due-process thresholds. One country might require only administrative subpoenas while another demands judicial warrants.

Effective cross-border enforcement of compliance relies on cross-jurisdictional cooperation, as is true of conventional correspondent banking today. For example, Project Mandala is a proposal by the Bank for International Settlements for a compliance-by-design approach to coordinating compliance checks by banks and other financial institutions involved in cross-border payments. Analogous to the stablecoin compliance-by-design approach we have described, Project Mandala uses zero-knowledge proofs to establish the validity of a bank's compliance statement without the need to share that bank's compliance-related data with other banks involved in the payment.

We do not propose that stablecoin payment systems be required to adopt a compliance-by-design approach. In fact, even if some countries were to impose this approach as a regulatory requirement, it would be challenging to block domestic access to alternative offshore stablecoin systems that do not take this approach to privacy and compliance.

Stablecoins hold significant promise for improving financial inclusion and the efficiency of payment systems—and making life harder on modern-day Al Capones. But they need to reach a much better balance between privacy and compliance. The compliance-by-design approach we have outlined is one way to do that. F&D

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THE MONEY DIALOGUES

Tommaso Mancini-Griffoli

Three friends consider the meaning of money, innovation, and stability

JULIAN ELLIOTT PHOTOGRAPHY/GETTY IMAGES

Imagine three friends meeting in the Roman forum. One is optimistic about technology, one skeptical, and one is after the bigger picture. They start debating the role of money shaped by innovations such as stablecoins, tokenized deposits, central bank digital currency (CBDC), and digital financial infrastructure. In a world laced with uncertainty, dialogue is paramount. Let's listen in.

Optimus: Skeptimus, I just discovered an amazing new way to pay for things. From my phone, I can transfer money to anyone in the world. It's instant, cheap, and easy. To receive funds, just print a QR code or share a number. Even merchants can sign up. It's called a stablecoin.

Skeptimus: Oh, Optimus, there you go again. It's just another money-transfer app.

Optimus: No, no, no. You can also hold a balance in stablecoins. You don't need a separate bank account. The stablecoin *is* the bank.

Skeptimus: It's not a bank! Banks have vaults, they have offices, they insure deposits, they...

Optimus: OK, you're right, it's not a bank. But for good reason. Banks offer package deals. They issue money—our deposits. At the front end, they onboard customers and merchants, and build e-banking apps. At the back end, they run databases to track our money, message other banks to transfer funds, and offer services like fraud detection. Full service.

Skeptimus: So? I like my bank. I like paying by card. And banks are exploring tokenized deposits.

Optimus: Right, millions are like you. Stablecoin companies are a little different. They focus on providing a payment instrument—denominated in dollars, euros, yen, and potentially other currencies. They mostly leave front- and back-end services to others. Stablecoins are recorded and transferred on blockchains. And separate digital wallet providers take on customers and build apps. That frees up each firm in the chain to be more innovative. Of course, banks and asset managers are no bystanders. They too are exploring ways to make their deposits and other assets available on blockchains.

Skeptimus: What about fraud detection and ensuring transactions don't fund terrorists?

Previous page: The Temple of Saturn in the Roman Forum.

Optimus: That is clearly defined in the laws and regulations of each country. Depending on the specific regulations, various financial companies, including stablecoin providers, are required to "know their customer" and check for money laundering and criminal activity.

Skeptimus: OK, but what's in it for users?

Optimus: Stablecoin companies have racked up millions of users globally, transacting across borders around the clock at fairly low cost, and they can scale up. That was barely possible even five years ago.

Skeptimus: I see the creative energy, the growth potential, the extra competition—it's all good. Still, stablecoins remain small. They're mostly used to buy crypto assets like Bitcoin—they're the payment instruments of the blockchain world.

Optimus: True, but they could be used in retail payments if integrated into popular phone apps. They could be used for e-commerce, for cross-border transactions, to buy securities on blockchains. Money market funds and asset managers are starting to offer investment products, like exchange traded funds, on blockchains. And banks are exploring ways to make their deposits transferable on the same infrastructure.

Skeptimus: But are stablecoins safe?

Optimus: Well, the value of stablecoins fluctuates with the value of the assets held by the issuer as reserves. And that has motivated policymakers to phase in laws and regulations to make stablecoins safer.

Stability

Skeptimus: That's a good start, but just the first step. Is regulation sound? Will supervision be strict? Will enforcement curb dubious activity?

Optimus: Why not? Stablecoin companies want to be regulated and trusted.

Skeptimus: Not all. Some may try to appeal to bad actors by offering anonymity.

Optimus: Those shouldn't even be allowed to issue. They wouldn't meet regulatory requirements.

Skeptimus: Ah, but will users be able to distinguish stablecoins targeting a fixed value in, say, dollars or euros from those intended to represent riskier assets? The second type should certainly not be considered money—whether most people would

accept the first as money "no questions asked" is also debatable.

Optimus: Skeptimus, you underestimate my ability to tell good from bad!

Skeptimus: Sorry, don't take it wrong. Still, even for you, I see a risk. There have always been runs on private money. As you said earlier, the more stable the reserve assets, the more stable the stablecoins. Treasury bills are good backing assets. But even their prices vary as interest rates move. When prices decrease too much, users might run from stablecoins—especially if they question the exact assets being held.

Optimus: Even bank deposits are risky, as not all of them are insured. And stablecoin issuers can hold extra capital as a backup. Or what about holding even safer and more liquid assets, like central bank reserves?

Skeptimus: Yes, that would be safer. But central banks may not want to be involved, or to immobilize their reserves.

Currency risks

Vastus: Friends, sit down and cast your eyes on the horizon. I see two more risks. Even if stablecoins are safe and convenient—as you say, Optimus—citizens of countries with high inflation, weak currencies, or poor payment systems will jump on them. Finally, an accessible dollar. Individually, people may be better off. Collectively, they could drain deposits from their banks and undermine the ability of their central bank to conduct monetary policy and stabilize the financial system. What's the point of setting interest rates on a currency no one uses? Will stablecoins spell the end of weaker currencies?

Optimus: You're right, that is a problem. Then again, countries could require stablecoins to be held in domestically regulated wallets with limits on holdings.

Skeptimus: Easier said than done. People can hide their computer's location; enforcement is hard in a borderless market.

Optimus: True, but technology is both cat and mouse, Skeptimus. It could help enforce, not just avoid, limits. Of course, stablecoin issuers would need to cooperate with country authorities.

Vastus: Another risk is fragmentation—the difficulty of exchanging one stablecoin for another form of money or with another stablecoin. Say you hold Stablecoin A, Optimus, and Skeptimus holds Stablecoin B. Optimus, how do you pay Skeptimus?

Optimus: Click and go...

Vastus: Not so easy. Skeptimus doesn't trust coin A. He only wants B. And you can't just convert A to B, as A may be backed by a different pool of assets—perhaps because it's regulated differently in another country. Or suppose A is recorded on one blockchain and B on another, and the two are not compatible. There are solutions, but they're clunky and costly. Or perhaps you convince Skeptimus to hold coin A after all. But then you have an antitrust problem—everyone holding the same coin.

Central bank reserves

Optimus: Banks solved this problem long ago. Each holds some central bank reserves—a common, safe asset—and when one pays the other it transfers reserves over the central bank's payment system. Why can't stablecoins do the same?

Vastus: In that case, we're coming back full circle to central bank digital currency. If central bank reserves were available to stablecoin issuers within the day, just for payments, they could ensure interoperability, as Optimus says. Maybe in exchange for some additional oversight by the central bank. Fully backing stablecoins with reserves is a different possibility. It's but a small step away from fully exchanging stablecoins for CBDC.

Optimus: What? You'd do away with all the innovation and customer connections that stablecoin companies have built?

Vastus: Not quite. Keep the talent, the innovation, the new services. Just do away with the creation of money. Leave that to central banks, which know how to do it safely. But allow private firms to invent ways to distribute the money, to transact efficiently, to build financial services. Instead of obsessing about *the* killer application for CBDC, and putting that on the shoulders of central banks, give wings to the private sector to innovate—safely and passionately. It's a different approach—CBDC built for integration and innovation.

Optimus: That's my kind of optimism!

Skeptimus: It won't work. Without a balance sheet, or revenue from holding assets like Treasuries, stablecoin companies will close.

Optimus: Not necessarily. They're already rebating most of their revenue to users through incentives, and competition will augment that. Plus, they'd need to find other revenue sources when Treasury yields approach zero in downturns. They'll figure it out. And central banks could provide incentives to foster innovation.

Skeptimus: To grease the wheels of private firms, you mean...

The money road

Vastus: Now, now—we're just speculating. Money doesn't exist in a vacuum; except for cash, it is recorded on ledgers, the roads on which money travels. Roads have held together empires! Infrastructure matters.

Optimus: Blockchains are the new roads, Vastus. They are the ledgers on which stablecoins are recorded and transacted. And they can also record securities—any asset, really. When money and securities are on the same blockchain, you can pay for a security at exactly the time you receive it, lowering risks of remaining without either. It's also easier to automate, you can trade around the clock and across borders, and you don't need so many costly intermediaries.

Vastus: That assumes proper legal and regulatory foundations, which are still being hashed out. Hopefully these will be consistent across countries.

Skeptimus: The real risk is concentration. If a single blockchain offers so many advantages, will we end up with a massive national or regional blockchain recording all assets? Would a dominant stablecoin favor one blockchain, then impose its standards on everyone else?

Optimus: Stablecoins are independent of infrastructure. But plans may change. The same stablecoin can be reissued on different blockchains.

Skeptimus: That may be the future, though jumping chains is expensive and risky. That's where cybercriminals lurk. Then again, stablecoins aside, competition among blockchains is healthy, and diversity helps. One chain may be better for privacy, another for programmability, and a third for speed.

Vastus: The trick is compatibility. Code written for one chain—to establish ownership, swap assets, or check identities—should run on another chain. Compatibility alleviates the problems of concentration and fragmentation.

Skeptimus: Maybe there's a role for the public sector: to vet the stability and compatibility of blockchains and contracts written for them?

Optimus: Actually, I'd go one step further. If central bank money is needed on-chain to settle transactions for everyone's peace of mind, then central banks can be a catalyst for one blockchain standard over another. Everyone will want to be compatible with the central bank. Meanwhile, innovation can still happen on external, yet compatible, chains.

Skeptimus: Easier said than done. But that's the direction some central banks are exploring. Things are moving fast.

Optimus: Here's another idea, perhaps far-fetched, to avoid the downsides of concentration but still have a single, or few, blockchains and sufficient innovation: open-source code and decentralized ownership. Thousands of programmers innovating and proposing new features, and thousands of computers running the blockchain. No single entity in control but still seamless exchange of assets. And no one has to pay billions to develop their own blockchain.

Skeptimus: I would never hold an asset on a blockchain without a customer service number to call. Forget it. And what arrangements govern a decentralized community, even if well intentioned?

Optimus: Governance is an issue, so is privacy, but solutions are emerging. We must think differently. The phone number will be that of your wallet, of your broker, or the asset issuer. They could control the assets and take responsibility. Transaction rules could be hard-coded into the asset itself and automatically enforced. That way everyone could potentially transact; whether they're allowed to is another story.

Vastus: Optimus, you force us to look ahead. But perhaps too far, or too fast. We're talking about personal wealth, financial stability, institutional credibility. We may eventually get to where you gaze, or elsewhere. Do me a favor, walk hand in hand with Skeptimus. Together, you'll find the right pace and course of change.

Skeptimus: Wise words, Vastus.

Optimus: And yet, we must move... F&D

TOMMASO MANCINI-GRIFFOLI *is a division chief in the IMF's Monetary and Capital Markets Department.*

CASE STUDY

INDIA'S FRICTIONLESS PAYMENTS

Alex Copestake, Divya Kirti, and María Soledad Martínez Pería

The world's largest real-time payment system shows the power of interoperable platforms

You're in line at a café. When you reach the counter, you tap your phone to pay—only to be told, "Sorry, we only take Apple Pay. You're trying to use Google Pay." You sigh and leave without your coffee.

This minor frustration reveals a major challenge: Digital payments are not always as convenient as they sound. As is often the case with infrastructure—digital or physical—we notice only when it doesn't work well. What's missing here is interoperability: the ability of different payment apps, banks, and platforms to connect seamlessly.

Many digital payment systems are like walled gardens. If you and the person you are paying do not use the same payment provider, the transaction is not possible. Private platforms prefer to keep users within their domains, also known as closed-loop systems.

Interoperability turns walled gardens into public squares, where everyone can transact with anyone. You use your favorite app, and the other party uses theirs—and the payment goes through.

Our recent research shows that this freedom of choice drives two major benefits (Copestake and others 2025). The first is a better user experience. Consumers choose their favorite apps based on what they value, including ease of use, reliability, or language options. The second is more innovation. Providers must consistently deliver and improve, since switching is easy, and users are not locked in.

Digital acceleration

Our work draws on India's rapid transition to digital payments and finds that interoperability can empower consumers, foster innovation, and accelerate the shift away from cash.

In 2016, the country launched the Unified Payments Interface (UPI), which allows payments to be sent and received easily across all participating apps and banks. The system has transformed India's payment landscape and become the largest real-time payment system in the world by volume, processing more than 19 billion transactions every month.

Tellingly, most UPI transactions take place across different apps, which would not be possible if they operated only as closed-loop systems. At the same time, cash use has declined. UPI's is a story of digital acceleration unlocked by interoperability.

Many users initially joined UPI through trusted apps, often offered by their banks. The UPI operator also launched BHIM, a simple public app to help introduce the system to new users.

As UPI gained traction, more than 200 apps and most banks entered the market. And interoperability allowed users to move freely to newer, better apps—without having to persuade other users to shift at the same time.

This flexibility meant new entrants could both enter more easily and scale up more quickly. Incumbents had to raise their game. More reliable apps—as measured by transaction failure rates—pulled in more users. Over time, reliability improved across the board.

Driving growth

But was interoperability critical to the digital payment takeoff, or would it have happened anyway? Evidence from two important episodes using new, granular data reveals that interoperability did indeed play a central role in driving the growth of digital payments in India.

First, India's banknote demonetization in 2016 (when the government withdrew various banknote denominations from circulation) pushed many people to try digital payments for the first time. Users faced a choice between closed-loop apps and the interoperable UPI. They largely chose UPI, which saw much more rapid growth—driven by cross-app transactions made possible by interoperability.

Second, in 2017, after a regulatory push, a leading closed-loop provider joined UPI, resulting in the merger of two large preexisting payment networks. The result? In districts with the most initial fragmentation—and therefore the largest gains from this increase in interoperability—digital payments grew faster.

Users valued the combined network more than the sum of its parts: Both networks were used more, and transactions between them also picked

up. Total digital payments rose relative to proxies for cash usage.

Connected networks

Interoperability was a key driver of India's success in expanding digital payments. But several other factors contributed as well. These include a broad digital ID system, financial inclusion programs, and affordable mobile internet.

Countries seeking to expand digital payments can draw several lessons from India's experience. It starts with building open infrastructure. Interoperability can foster user choice and innovation. Next, invest in digital enablers. Affordable mobile data, national ID systems, and broad access to banking are essential. Governments can also support early adoption with a public app that helps build momentum.

It's also crucial to monitor the market and tailor regulation. In India, providers have found ways to nudge users—through QR code branding, bundled services, and other means—to stay within their walled gardens. Today, over 95 percent of UPI transactions are initiated using only three apps, and in about half of them, both payer and payee use the same app. Tracking usage patterns, app dominance, and switching costs is critical for authorities to identify the best ways to preserve user choice.

Back to the café. This time, you can use your preferred provider, pay instantly, and walk away with your coffee and a digital receipt. That small moment of ease—made possible by interoperability—is the foundation of a broader digital transformation. It is what allows digital systems to reach everyone on their terms, without creating new silos.

Done right, interoperability turns fragmented systems into connected networks. It strengthens trust, accelerates adoption, and levels the playing field. For countries building the future of finance, interoperability is not just helpful, it's fundamental. F&D

"India's UPI is the largest real-time payment system in the world by volume, with more than 19 billion transactions a month."

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REFERENCE

Copestake, A., D. Kirti, and M. Martínez Pería. 2025. "Growing Retail Digital Payments: The Value of Interoperability." IMF Fintech Note 25/004, International Monetary Fund, Washington, DC.

Woman uses mobile phone QR code to make payment at a café in Maharashtra, India.

MAYUR KAKADE/GETTY IMAGES

CASE STUDY

SOUTHEAST ASIA'S CROSS-BORDER PAYMENT PUSH

Nadine Freischlad

At the edge of Bali's Pura Tanah Lot, an ancient Hindu temple that towers above the ocean atop an outcrop of rocks on the Indonesian island's southwestern coast, a row of souvenir stalls invites tourists to shop for artwork, bracelets, sarongs, and other wares.

A $2 pair of sunglasses catches a shopper's eye. A buyer can use a mobile wallet app to scan a QR code: a faded black-and-white printout taped to a glass counter at the back of the stall. After keying in the amount and showing the stall owner the transaction confirmation screen, the sale is complete. No cash changes hands; no cards are swiped.

Seamless QR code payments are common across Southeast Asia. Mass adoption occurred during the COVID-19 pandemic, when governments urged merchants to move away from cash. These payments are convenient for customers and much simpler and cheaper for small businesses than a formal card-reading device.

QRIS, Indonesia's national QR code standard, established by the central bank and payment association in 2019, does not charge small businesses for processing payments below 500,000 rupiah ($30). Settlement is instant. Transactions above this threshold cost just 0.3 percent.

But there's a problem: QRIS transactions are still limited mostly to domestic use. With a mobile wallet from outside Indonesia, the sunglasses payment probably wouldn't have gone through.

Domestic instant payment systems were transformative for Southeast Asia, but regulators and businesses then "started to recognize the opportunity of connecting them," says Benjamin Lee, interim director of Singapore-based Nexus Global Payments (NGP), a nonprofit established by several central banks in April 2025 to improve cross-border connectivity.

Policymakers want seamless digital transfers between countries to be obstacle-free

On one hand, there's a growing number of bilateral links. Thailand and Singapore were the first to establish one, in 2021, linking their instant payment systems. Others, such as Singapore and India, Thailand and Malaysia, followed. Indonesia recently announced plans for a QR code link beyond the region, with China and Japan. On the other hand, there's an ongoing effort, spearheaded by NGP, to create infrastructure for multilateral connections to allow all manner of cross-border instant payments through a shared node and a common system.

Mobile payment innovation

After a decade of rapid digitalization, and inspired by China and India, Southeast Asia is pushing forward with mobile payment innovation. Smartphone adoption soared after 2010 and, with it, proliferation of digital platforms for rides, meals, and e-commerce, fueled by billions of dollars in venture capital.

But there was one major source of friction: payments. Card usage, especially credit cards, is low in Southeast Asia. This made it difficult to provide a secure environment for online transactions. And only a fraction of offline merchants had the means to install card readers. Most small-scale daily transactions used cash, even in major cities.

Digital platforms needed a better way to move money—not just between consumers and merchants, but within their own ecosystems of drivers, couriers, and sellers. If most ride-hailing drivers received cash from passengers, there was no easy way for the platforms to take a cut.

Digital wallets, such as those pioneered by Alibaba in China and Paytm in India, emerged as a solution for Southeast Asia. They allowed users to store money on their phones, making it easy to pay for rides, meals, or online orders without handling cash.

At first, each platform built its own closed-loop system. Payments worked smoothly inside the app and between its partners. This was efficient for platforms but fragmented for consumers and merchants. Regulators soon recognized the need for open, standardized infrastructure that would allow digital payments across platforms and providers.

Consolidation and standardization

Singapore pioneered this push. In 2017, its banking association introduced PayNow, an instant pay-

ment system (IPS) for peer-to-peer transfers. The aim, according to Kenneth Gay, chief fintech officer at the Monetary Authority of Singapore (MAS), was to "provide a safe, simple, and faster way for individuals and businesses in Singapore to make payment transactions."

Similar to India's Unified Payments Interface (UPI), PayNow enables the electronic transfer of money to people using only their mobile phone or national ID numbers, and to businesses using their unique entity numbers—in real time, 24/7, for free.

Singapore also expanded its existing Network for Electronic Transfers (NETS) to support QR code payments at regular offline stores. Together, these systems created a more open, connected payment landscape—one that didn't rely solely on cards or proprietary wallets.

Other countries followed. Malaysia introduced DuitNow and Thailand PromptPay, which both follow a similar approach to Singapore's and support UPI-style transfers; Indonesia introduced BI-FAST and QRIS. They all aim to unify domestic payments under national standards and establish public infrastructure that private fintech firms can use. But, says Gay, "Most cross-border payments remained slow, opaque, and inefficient, due to their reliance on multiple correspondent banks and other intermediaries."

Formally linking national instant payment systems across countries would eliminate fragmentation and, according to MAS, "carry over the benefits of cheap, fast, seamless payments from the domestic to the cross-border arena." Travelers and the many merchants that cater to them would appreciate the convenience of interoperability among standardized national QR code systems.

Allowing international fund transfers using a mobile phone or ID number via linked IPSs would be even more transformative, and a boon for the many families that rely on remittances from relatives working elsewhere in the region.

Project Nexus

Southeast Asia's regulators and central banks have started to realize that developing individual bilat-

NIKADA/GETTY IMAGES

Tourists shop at souvenir stalls in Ubud, Bali, Indonesia.

eral links is too resource-intensive. "Each linkage required a refresh in technical alignment between the respective two IPSs and alignment in domestic policies and requirements, such as on data privacy, security, and sanctions screening," says Gay. It took three years of extensive collaboration between multiple stakeholders to finalize the 2021 PayNow–PromptPay linkage.

Expanding IPS links to a broader network of countries becomes more efficient with a multilateral payment gateway solution—which is why central banks and regulators came together to form NGP, a gateway designed to standardize the way domestic IPSs connect to one another.

"The Project Nexus idea was originally conceived at the Singapore Innovation Hub," says Lee, referring to a Bank for International Settlements initiative that promotes new technologies for safer, faster, and more connected financial systems. Rather than building custom connections for every new country, an IPS operator need make only one connection to Nexus to reach all other countries in the network, he explained.

As with bilateral linkages, tapping into a single node through Nexus requires common technical standards, including common operating standards and processes that cover approaches to data privacy and money laundering safeguards, and a consistent commercial model that protects the interests of all stakeholders.

There's real momentum now, says Lee. "The region came together about two years ago, under the Indonesian G20 presidency, when the idea of regional payments connectivity was made a priority, and has now led to the establishment of NGP and a shared desire to scale this network globally to other interested and ready jurisdictions."

NGP is now focused on foundational work to build its capabilities and enable Nexus to go live. It is expected to appoint a technical operator to build and operate the network this year, according to MAS's Gay. "We expect to see the first live cross-border transaction on Nexus around 2027," he said, before expanding to other interested countries.

Glimpse of the future

Large-scale adoption of cross-border functionality depends on sustained collaboration between governments, central banks, and fintech players. Smaller banks too need to raise their game or risk being left behind amid rapid payment industry transformation.

Many banks in Southeast Asia still "operate on legacy systems," says Arun Kini, managing director for Asia-Pacific payments at fintech firm Finastra, which specializes in helping banks meet the latest technical and regulatory requirements. Banks can benefit from tapping into burgeoning IPSs, but their popularity has also "become a bottleneck for the banks," posing problems for those that don't have the technology to tap into them, says Kini.

So while there's progress, NGP's vision of a cross-border payment landscape in which people, banks, and fintech firms can effortlessly move money to each other across borders may take time. In the meantime, innovative technology is still popping up to meet everyday needs.

The latest invention to reach Southeast Asia from China and India? QR codes attached to portable 4G-enabled speakers. They deliver audio confirmation of the payment amount received, removing the need for merchants to do a visual check. It's ideal for mobile payments in busy settings like the bustling tourist stalls that line the approach to Bali's Tanah Lot temple. F&D

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CASE STUDY

FIGHTING TECH-FUELED CRIME

Chady El Khoury

The Department of Justice in June announced the largest-ever US crypto seizure: $225 million from crypto scams known as pig butchering, in which organized criminals, often across borders, use advanced technology and social engineering such as romance or investment schemes to manipulate victims. This typically involves using AI-generated profiles, encrypted messaging, and obscured blockchain transactions to hide and move stolen funds.

It was a big win. Federal agents collaborated across jurisdictions and used blockchain analysis and machine learning to track thousands of wallets used to scam more than 400 victims. Yet it was also a rare victory that underscored how authorities often must play catch-up in a fast-changing digital world. And the scammers are still out there.

Authorities must keep up and respond urgently as digital tools accelerate financial crime

Criminals are outpacing enforcement by adapting ever faster. They pick the best tools for their schemes, from laundering money through crypto and AI-enabled impersonation to producing deepfake content, encrypted apps, and decentralized exchanges. Authorities confronting anonymous, borderless threats are held back by jurisdiction, process, and legacy systems.

Annual illicit crypto activity growth has averaged about 25 percent in recent years and may have surpassed $51 billion last year, according to Chainalysis, a New York–based blockchain analysis firm specializing in helping criminal investigators trace transactions.

Bad actors still depend on cash and traditional finance, and money laundering specifically relies on banks, informal money changers, and cash couriers. But the old ways are being reinforced or supercharged by technologies to thwart detection and disruption.

Encrypted messaging apps help cartels coordinate cross-border transactions. Stablecoins and lightly regulated virtual asset platforms can hide bribes and embezzled funds. Cybercriminals use AI-generated identities and bots to deceive banks and evade outdated controls. Tracking proceeds generated by organized crime is nearly impossible for underresourced agencies.

AI lowers barriers to entry. Fraudsters with voice-cloning and fake-document generators bypass the verification protocols many banks and regulators still use. Their innovation is growing as compliance systems lag. Governments recognize the threats, but responses are fragmented and uneven—including in regulation of crypto exchanges. And there are delays implementing the Financial Action Task Force's (FATF's) "travel rule" to better identify those sending and receiving money across borders, which most digital proceeds cross.

Meanwhile, international financial flows are increasingly complicated by instant transfers on decentralized platforms and anonymity-enhancing tools. Most payments still go through multiple intermediaries, often layering cross-border transactions through antiquated correspondent banks that obscure and delay transactions while raising costs. This helps criminals exploit oversight gaps, jurisdictional coordination, and technological capacity to operate across borders, often undetected.

Safe payment corridors

There's a parallel narrative. Criminals exploit innovation for secrecy and speed while companies and governments test coordination to reduce vulnerabilities and modernize cross-border infrastructure. At the same time, technological implications remain underexplored with respect to anti–money laundering and countering the financing of terrorism, or AML/CFT.

Singapore's and Thailand's linked fast payment systems, for example, enable real-time retail transfers using mobile numbers; Indonesia and Malaysia have connected QR codes for cross-border payments. Such innovations offer efficiency and inclusion yet raise new issues regarding identity verification, transaction monitoring, and regulatory coordination (see "Southeast Asia's Cross-Border Payment Push" in this issue of F&D).

In India, the Unified Payments Interface enables seamless transfers across apps and platforms, highlighting the power of interoperable design. More than 18 billion monthly transactions, many across competing platforms, show how openness and standardization drive scale and inclusion. Digital

"Regulators and fintechs should be partners, and sustained multilateral engagement should foster fast, cheap, transparent, and traceable cross-border payments."

payments in India grew faster when interoperability improved, especially in fragmented markets where switching was costly, IMF research shows (see "India's Frictionless Payments" in this issue of F&D).

These regional innovations and global initiatives reflect a growing understanding that fighting crime and fostering inclusion are interlinked priorities—especially as criminals speed ahead. The FATF echoed this concern, urging countries to design AML/CFT controls that support inclusion and innovation. Moreover, an FATF June recommendation marks a major advance: Requiring originator and beneficiary information for cross-border wire transfers—including those involving virtual assets—will enhance traceability across the fast-evolving digital financial ecosystem.

Efforts like these are important examples of how technology enables criminal advantage, but technology must also be part of the regulatory response.

Modernizing cross-border payment systems and reducing unintended AML/CFT barriers increasingly means focusing on transparency, interoperability, and risk-based regulation. The IMF's work on "safe payment corridors" supports this by helping countries build trusted, secure channels for legitimate financial flows without undermining new technology. A pilot with Samoa—where de-risking has disrupted remittances—showed how targeted safeguards and collaboration with regulated providers can preserve access while maintaining financial integrity without disrupting the use of new payment platforms.

Machine learning

Several countries, with IMF guidance, are investing in machine learning to detect anomalies in cross-border financial flows, and others are tightening regulation of virtual asset service providers. Governments are investing in their own capacity to trace crypto transfers, and blockchain analytics firms are often employed to do that.

IMF analysis of cross-border flows and the updated FATF rules are mutually reinforcing. If implemented cohesively, they can help digital efficiency coexist with financial integrity. For that to happen, legal frameworks must adapt to enable timely access to digital evidence while preserving due process. Supervisory models need to evolve to oversee both banks and nonbank financial institutions offering cross-border services. Regulators and fintechs should be partners, and sustained multilateral engagement should foster fast, cheap, transparent, and traceable cross-border payments—anchored interoperable standards that also respect privacy.

Governments must keep up. That means investing in regulatory technology, such as AI-powered transaction monitoring and blockchain analysis, and giving agencies tools and expertise to detect complex crypto schemes and synthetic identity fraud. Institutions must keep pace with criminals by hiring and retaining expert data scientists and financial crime specialists. Virtual assets must be brought under AML/CFT regulation, public-private partnerships should codevelop tools to spot emerging risks, and global standards from the FATF and the Financial Stability Board must be backed by national investments in effective AML/CFT frameworks.

Consistent and coordinated implementation is important. Fragmented efforts leave openings for criminals. Their growing technological advantage over governments threatens to undermine financial integrity, destabilize economies, weaken already fragile institutions, and erode public trust in systems meant to ensure safety and fairness. As crime rings adopt and adapt emerging technologies to outpace enforcement, the cost is not only fiscal—it is structural and systemic. Governments can't wait. The criminals won't. F&D

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DIGITAL FINANCE LEXICON

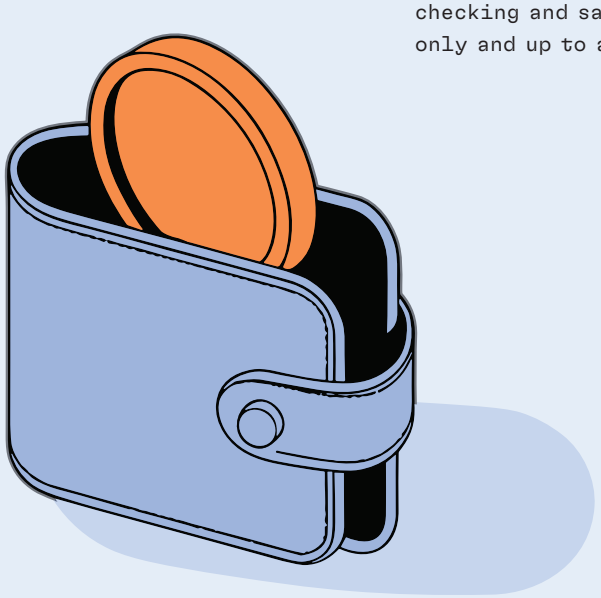
FINANCIAL

Nonbanks

Financial institutions (for example, hedge funds, pension funds, and insurance companies) that provide lending and investing services but usually don't take deposits. Some are more lightly regulated than banks. They typically don't have access to central bank liquidity and are more exposed to financial stress.

Arbitrage

The purchase of an asset in one market and the sale of it in another to profit from a price difference between the markets.



Exchange-traded fund

Financial product that allows investment in a group of assets—stocks, bonds, or commodities—through a single stock exchange purchase.

Market maker

Financial company with a mandate to engage in trading to ensure that a certain market remains liquid and active.

Deposit insurance

Government-backed protection for deposits in the event of a bank failure, funded by fees paid by banks. Typically covers checking and savings accounts only and up to a limit.

FINTECH

Token

Unique digital representation of ownership of a financial (money or bonds) or real asset (commodities) that exists on a distributed ledger.

Distributed ledger/ blockchain

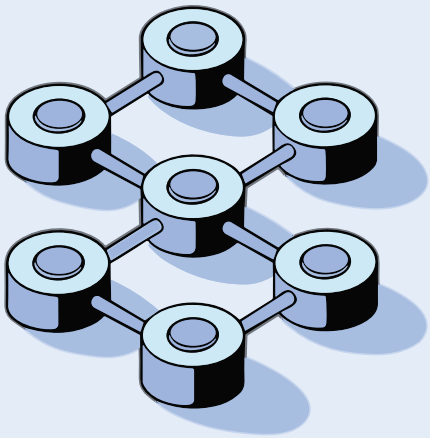
Database stored, shared, and synchronized across a computer network. Transactions are updated by consensus mechanisms among network participants. A blockchain is a specific type of distributed ledger that structures data in linked blocks.

Native crypto asset

Intangible virtual asset that originates on and derives its value from a distributed ledger.

Stablecoin

Crypto asset backed by, and aiming to maintain, a fixed value relative to one or more conventional assets, typically fiat currencies. Unlike native crypto assets, stablecoins don't depend on the distributed ledger where they were created.



PAYMENTS/INFRASTRUCTURE

Central bank digital currency (CBDC)

Digital version of fiat currency, issued by a central bank.

Decentralized finance (DeFi)

Ecosystem based on crypto assets and smart contracts running on a distributed ledger, providing financial services without centralized intermediaries.

Smart contract

Software that uses tokens and automatically executes financial operations once predefined terms are met—for example, selling an asset at a certain price.

Central bank and commercial money

Central bank money comprises banknotes in circulation, CBDCs where they exist, and reserves that commercial banks maintain at a central bank. Commercial money refers primarily to deposits in private banks. Physical cash is central bank money; cash deposited in a bank account is commercial money.

Clearance and settlement

Clearance means validating both sides of a transaction to ensure that the buyer can pay and the seller can deliver the goods or assets. Settlement is the actual and irrevocable transfer of money and assets between the parties.

Collateral

Asset that a borrower pledges to a lender as a guarantee. For example, banks pledge assets as collateral to a central bank in exchange for short-term liquidity.

Custodian

Institution that safeguards financial assets on behalf of a buyer and seller. It may provide other services during transactions and ensure compliance with regulatory and tax obligations.

Interoperability

Ability of different systems, platforms, or technologies to connect seamlessly—for example, the same terminal being able to accept cards from all banks and brands.

Zero-knowledge proofs

Cryptographic method that allows parties in a transaction to prove they know something without revealing what it is—for example, to demonstrate compliance with tax and anti-money laundering requirements without disclosing personal data.

How the Battle for Control Could Crush AI's Promise

Carl Benedikt Frey

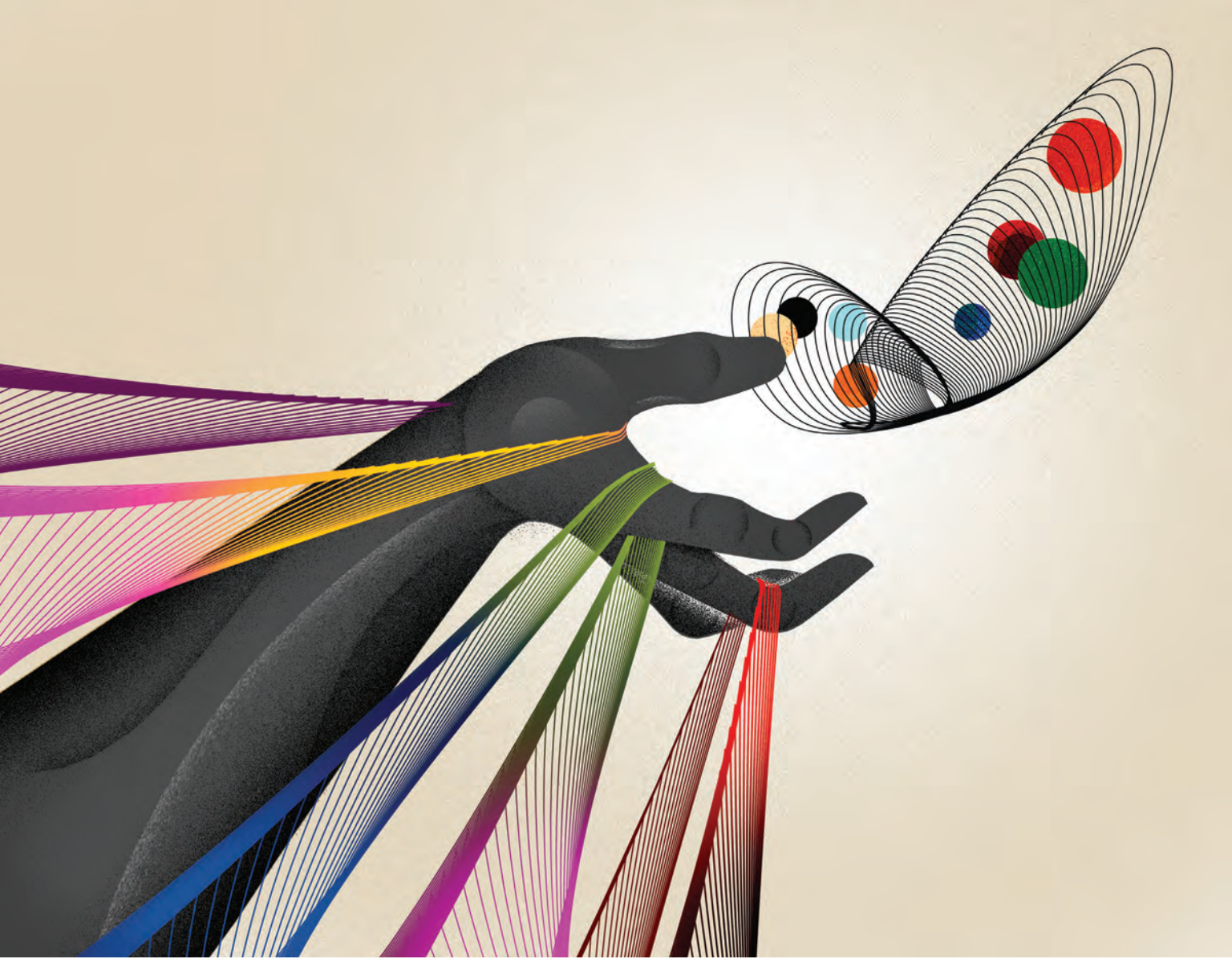
A SHIFT TOWARD CENTRALIZATION AND CONCENTRATION COULD SNUFF OUT TECHNOLOGY'S PRODUCTIVE POTENTIAL

In the mid-20th century, the Soviet Union's technological successes, notably launching Sputnik and sending Yuri Gagarin into space, convinced many observers that centrally planned economies might outperform market-driven ones. Prominent economists such as Paul Samuelson predicted that the USSR would soon overtake the United States economically, while Oskar Lange, a Polish economist and socialist, argued that emerging computer technologies could effectively replace the outdated market mechanism.

Yet, paradoxically, the USSR collapsed just as the computer revolution took off. Despite considerable investments—including Nikita Khrushchev's attempt to create a Soviet counterpart to Silicon Valley on the edge of Moscow in Zelenograd—the USSR failed to harness the promise of computing technology. The obstacle was not a shortage of scientific talent, but institutions inhospitable to exploration. Whereas Silicon Valley thrived on decentralized experimentation, with inventors job-hopping among start-ups running multiple concurrent experiments, innovation in Zelenograd was centrally controlled and orchestrated entirely by Moscow government officials.

As Friedrich Hayek argued, the main difficulty with central planning wasn't processing data but gathering essential local knowledge. Soviet planners could manage standardized operations but faltered during technological uncertainty, lacking benchmarks to monitor factory performance and punish slackers. Despite early rapid growth, the USSR stagnated, unable to adapt to new technological frontiers, and eventually collapsed.

These insights are still relevant, particularly as new forms of artificial intelligence again raise the question of whether centralized authority, such as China's AI-driven surveillance state, or corporate concentration—as among Silicon Valley's big tech companies—can leverage new technologies effectively to manage the economy and society.



Frontier innovation

Conventional theories of wealth and poverty that emphasize factors like geography, culture, or institutions struggle to explain dramatic economic reversals. Geographic conditions, which remained unchanged, cannot account for the USSR's shift from rapid growth to collapse. Cultural factors also evolve too slowly to explain swift economic booms and subsequent busts. While institutions such as laws and regulations can change more abruptly, institutional theories based on universal conditions are similarly incomplete; for instance, both the USSR and China experienced decades of rapid growth despite lacking secure private property rights. Ultimately, understanding economic progress requires examining how institutions and culture interact dynamically with technological changes.

Recognizing that economic performance is tied to this shifting interaction reframes the familiar policy debate over technological progress. One side advocates decentralized innovation driven by small firms in lightly regulated markets; the other promotes state-led industrial policy executed by powerful bureaucracies. However, both approaches are optimal only under certain conditions: Centralized bureaucracies effectively exploit accessible technologies and drive catch-up growth, whereas decentralized systems excel at pioneering innovations at the technological frontier. Over time, economic governance must adapt or risk stagnation.

Japan as Number One

Even when the Soviet Union dissolved in 1991, America's relief was tempered by a new anxiety: Many scholars and journalists believed that Japan would soon eclipse the US. Ezra Vogel's 1979 best-seller, *Japan as Number One,* had already warned of Tokyo's growing edge in computers and semiconductors, a gain seemingly as dramatic as its earlier rise in automobiles. Yet the computer revolution

Illustration by Brian Stauffer

that followed told a different story. From the early 1990s US software-driven productivity soared, while Japanese firms clung stubbornly to hardware.

Japan's ascent had rested on a tightly coordinated production system. Because Japanese firms could take equity stakes in their suppliers—something US antitrust law discouraged—they wove dense knowledge networks reinforced by just-in-time logistics, computer-aided design, and reprogrammable machine tools. The result was striking efficiency: Japanese autoworkers were 17 percent more productive than their US counterparts by 1980, leading Ford and GM to report steep losses.

The Japanese edge, however, came less from inventing new products than from refining Western ones. Color televisions, the Walkman, and VCRs became global hits only after Japanese engineers reengineered them for cost and durability. In a seminal study, economist Edwin Mansfield found that roughly two-thirds of Japanese R&D targeted process improvements—the mirror image of the product-heavy US effort—allowing faster translation of laboratory advances into cheap, marketable goods.

But those very strengths became limitations. Eminent observers such as Alfred Chandler Jr. had expected the computer age to reward hardware perfection and streamlined production—factors that favored Japan—but it was the dynamism of US start-ups like Apple and Microsoft that proved decisive. US antitrust policy, rooted in the 1890 Sherman Antitrust Act, pried open markets by forcing IBM to unbundle its hardware and software and by breaking up AT&T just before the commercial internet took off. Without a single gatekeeper, entrepreneurs could innovate freely, and the web expanded unimpeded.

Japan's looser competition rules, by contrast, fostered cartelization and entrenched keiretsu conglomerates. The same coordination that once sped incremental upgrades now slowed the leap to software and internet-based business models, crowding out new entrants. Japan's technological momentum stalled. Even within the US, regions organized around fierce competition, such as Silicon Valley, outperformed more hierarchical, vertically integrated areas like New England's Route 128 tech cluster.

End of coordinated capitalism

Japan is not an isolated example. After World War II, Western Europe's economy grew quickly by adopting US methods of mass production across a broad range of industries. This strategy worked well for several decades, but by the 1970s, Europe had exhausted the backlog of American technology. To maintain growth, it would need to shift toward a model based on innovation rather than merely catch up with existing technologies.

This shift proved challenging. Europe's economic institutions were shaped by a long history of industrial catch-up, established in the late 19th century to absorb British technology and reinforced during the postwar era when Europe was closing the gap with the US. These institutions were designed to support stable and predictable economic growth through careful planning, coordinated industries, and close cooperation between businesses, banks, and governments. Such coordinated capitalism was effective when the task was clear—catching up with established industrial practices—but became an obstacle when faced with the uncertainty and disruption caused by the computer revolution and new information technologies.

In France, the government's system of indicative planning, which set economic targets to coordinate investments, worked well with incremental and predictable technological progress. But with rapid technological change, planners were overwhelmed and unable to forecast accurately and direct resources effectively.

Similarly, Italy's state-owned enterprises, crucial during the postwar boom, proved rigid and unresponsive to a new age of technological turbulence. In Spain and Portugal, the heavy influence of the state, combined with entrenched interests, severely limited economic flexibility, hampering innovation and adaptation. Consequently, these Southern European nations experienced prolonged economic stagnation during the computer revolution, often referred to as "two lost decades."

DATA

17%

Tightly coordinated production helped Japanese autoworkers become 17 percent more productive than their US counterparts by 1980

From Hayek to Moravec

The lesson is clear: Economic miracles stall when the institutions that enabled past successes become misaligned with new challenges. The Soviet Union and much of Europe stumbled when rigid mass production models failed to adapt to the unpredictability of the computer age, while Japan faltered as the epicenter of innovation shifted from hardware to software. Today, China's growth is increasingly constrained by tightened party control, and the US faces a similar peril whenever monopoly power remains unchecked. The danger that centralization and concentration will snuff out innovation now hangs over AI. Because AI performance has historically improved mainly by scaling up computing power and data availability, many observers concluded that AI is a contest best left to a handful of "national champions." That belief is seductive—and mistaken.

As in the computer revolution, true breakthroughs come from exploring the unknown, not

from perfecting what is already formalized. Large language models (LLMs)—AI systems trained to generate and understand human language—grew 10,000-fold in scale between 2019 and 2024 yet still scored only about 5 percent on the ARC reasoning benchmark, a test that assesses advanced problem-solving abilities. Meanwhile, leaner approaches such as program search (which generates explicit programs to solve tasks) have topped 20 percent, and newer in-context learning methods (where models learn from examples without retraining) are racing ahead.

Nor will AI soon make human exploration obsolete. Hans Moravec's old observation still holds: What is effortless for humans (such as walking a trail) remains hard for machines, and vice versa. Language models trained on the entire internet still lack the sensorimotor experience of any four-year-old. Until we can encode that embodied knowledge, centralized AI systems will trail the decentralized experimentation billions of humans perform daily.

Ingenuity flourishes precisely where precedent is thin. Inventors, scientists, and entrepreneurs thrive on turning the unknown into opportunity. By contrast, large language models default to statistical consensus. Imagine an LLM trained in 1633—it would steadfastly uphold Earth as the universe's center; given 19th century literature, it would confidently deny that humans could ever fly, echoing the long list of failed trials that preceded the Wright brothers' success. Even Google DeepMind's Demis Hassabis admits reaching true artificial general intelligence may need "several more innovations."

Control and competition

Those are unlikely to emerge from centralized scale alone; they will come, as before, from widening the arena of experimentation and lowering the barriers to entry. However, in the age of AI, both China and the US are moving in the opposite direction, increasing central control and reducing competitive dynamism.

China's most dynamic sectors remain driven by private or foreign-backed firms, while state-owned enterprises lag. Yet Beijing is recentralizing authority: Licenses, credit, and contracts now favor politically reliable conglomerates, antitrust law is wielded selectively, and anti-corruption campaigns make loyalty a prerequisite for survival. Once-vital provincial experimentation has withered as officials chase crude indicators such as patent counts, flooding registries with low-value filings. Patronage is eclipsing transparent rules, and loyalty is displacing competence, eroding the state's capacity to nurture frontier-level innovation and pushing the economy toward slower, less-innovation-driven growth.

To be sure, China still benefits from a substantial talent pool and a government deeply committed to technological advancement. But as in Western countries, firms lacking strong political connections—such as the AI start-up DeepSeek—prove most innovative. Although authorities might permit these companies to operate with relative autonomy as long as their activities align with national goals, the absence of robust legal protections leaves them vulnerable to shifts in political priorities. Consequently, firms must invest resources in building political alliances, diverting attention and capital from driving innovation. And the government's control over critical information technologies frequently tempts authorities to strengthen their political dominance over society, potentially stifling grassroots innovation.

The US shows the same symptoms in different guise. Since the computer era of the 1990s, its industries have grown markedly more concentrated, undercutting the fluid competition that once characterized Silicon Valley. A web of non-compete clauses now hampers labor mobility, curbs the flow of tacit knowledge, and discourages scientists and engineers from founding rival firms. Because start-ups are central to translating laboratory insights into commercial products, this drag on talent circulation weakens the very mechanism—creative destruction—that reallocates market share toward fresh ideas. Economists Germán Gutiérrez and Thomas Philippon show that the trend is driven less by unavoidable scale economies than by incumbent lobbying that hard-codes regulatory advantages, from patent extensions to sector-specific licensing hurdles.

This pattern also threatens AI. Beneath today's veneer of intense competition, Microsoft's deep alliance with OpenAI already controls about 70 percent of the commercial LLM market, while Nvidia provides about 92 percent of the specialized graphics-processing units (GPUs) used to train these models. Together with Alphabet, Amazon, and Meta, these incumbents have also been quietly buying stakes in promising AI start-ups. Sustaining a policy regime that safeguards the competitive arena itself, rather than the fortunes of particular firms, is essential if the next generation of transformative innovators is to deliver the promised boost to productivity. That's as true for the AI age as it was for the computer era. F&D

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The Shifting Geography of Start-ups

Swati Bhatt

US ENTREPRENEURIAL ACTIVITY IS MIGRATING FROM TRADITIONAL HUBS LIKE CALIFORNIA TO MORE RURAL WESTERN AND SOUTHERN STATES

In Laramie, Wyoming, start-up Airloom Energy is reimagining traditional wind turbine design. Instead of three-bladed turbines atop tall towers, the company's system uses wing-like blades traveling along a horizontal oval track like a roller coaster. This technology is more compact and easier to transport than traditional turbines, with lower costs. The company plans to break ground this year on a pilot project.

Airloom is not alone. Wyoming, the least populous US state, has seen 50 percent growth in start-ups over the past decade. The state is one of the winners as entrepreneurial activity has dispersed geographically in recent years, spurred by the adoption of artificial intelligence technology (AI tech) and the shift to remote and hybrid work.

In the US, innovation hubs such as New York and California's Silicon Valley are giving way to new geographies. Small businesses are popping up across western and southeastern states, such as Wyoming and Georgia. Seven of the top ten states in entrepreneurial activity are south of the famed Mason-Dixon Line—the historic boundary between Northern and Southern states—or the 36th parallel, a more southerly demarcation line (Chart 1).

Start-up clusters

The decentralization of innovation has enabled smaller cities and rural areas to develop start-up clusters. Some of these reflect the proliferation of data centers in regions with abundant land, electric power, and water—and, crucially, friendly local regulations. Western states may lack water, but they more than make up for it with the regulatory environment tech companies want.

JPMorgan Chase and Starwood Property Trust have committed $2 billion for a 100-acre data center development in West Jordan, Utah, near Salt Lake City. JPMorgan Chase made a loan of $2.3 billion in January 2025 for a facility in Abilene, Texas. Meta plans to build an $800 million, 715,000-square-foot data center in Cheyenne, Wyoming. Amazon is building two data centers in Madison County, Mississippi, for a total cost of $10 billion. Google is building a $2 billion center in Fort Wayne, Indiana, and a $1 billion center in Virginia.

Data centers act as a focal point for start-ups, fostering an entrepreneurial culture that applauds and even encourages risk taking. Moreover, a sociocultural mindset stemming from geographic proximity of firms along the AI tech supply chain encourages entrepreneurs to experiment and innovate rapidly.

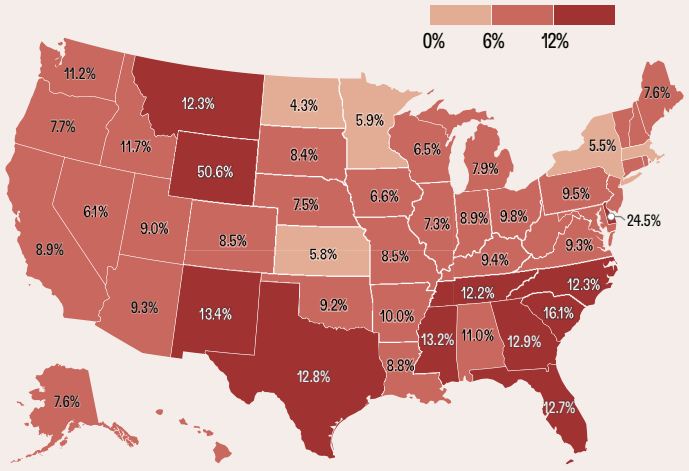
Illustration by Dan Bejar

CHART 1

Southern shift

Over half of the top 10 start-up states are in the South.

(average annual start-up growth rate by state since 2010)



SOURCE: US Census Bureau. **NOTE:** States are ranked by annual start-up growth from 2010:Q2 to 2025:Q1, relative to their 2010:Q1 levels. For example, a value of 12 percent means there were 12 more start-ups each year on average for every 100 that existed in 2010:Q1.

CHART 2

Start-up boom

The number of applications to register a new business in the US is about 50 percent higher than before the pandemic.

(seasonally adjusted applications for all businesses)

SOURCE: US Census Bureau.

Observing peers' success in taking risks reinforces experimentation and calculated risk taking.

Advances in AI tech have spurred the formation and growth of ancillary businesses. AI tech enables start-ups to perform tasks traditionally dominated by large corporations, such as analyzing massive datasets or automating complex processes.

Productivity increases

Innovation lies at the heart of productivity increases as new technologies encourage businesses to adopt new operational styles. For example, medical offices in Boise, Idaho, can use AI tech to read X-rays without the need for a large hospital. Manufacturing firms leverage advanced analytics to manage inventory. Workers in remote Wyoming use AI tech to streamline processes like data entry, scheduling, and email management. According to PitchBook, which maintains a database on global capital markets, AI start-ups racked up 22 percent of first-time venture capital financing in 2024.

Start-ups and new businesses have the agility to easily incorporate new technologies, unconstrained by legacy frameworks. According to Emin Dinlersoz and Nathan Goldschlag, writing for the US Census Bureau, "since the early fall of 2023, the smallest firms had a relatively high AI use rate, although the rate of increase was lower than for larger firms." Correspondingly, an increase in start-ups often leads to higher labor productivity and potentially higher wages.

The Census Bureau's Business Formation Statistics collect data on business applications, a good way of measuring idea generation that leads to business start-ups. As Chart 2 indicates, there has been an explosion in new business applications since the onset of the pandemic in 2020.

Another metric uses Bureau of Labor Statistics (BLS) data on planned wage payouts to measure the launch of new businesses. Whereas Census data highlight idea formation, the BLS data capture idea implementation. A key question in examining innovation is whether an idea becomes significant only when it leads to hiring or whether the birth of the idea itself qualifies as innovation.

The BLS data also show a sharp increase in entrepreneurial activity across the US during 2010–20 compared with the previous decade. Of the 15 top performing states, 10—California, Colorado, Idaho, Missouri, Montana, Nevada, South Dakota, Texas, Utah, and Washington—lie west of the Mississippi River. Conversely, the 15 weakest-performing states are located east of the Mississippi.

Economic dynamism

Before the pandemic, there was sizable entrepreneurial activity only in the Western states. That may

be changing though. Census data show that 7 of the top 10 states for start-up activity in 2010–25 were in the South, as the map shows.

The question is whether all this start-up activity is contributing significantly to job growth. Recent research published by the Federal Reserve suggests that the recent wave of start-ups is less likely than previous upsurges to contribute to employment growth. Young, high-growth start-ups accounted for less than 6 percent of employment in 2024, compared with almost 10 percent in 1985, according to the Fed. AI tech–driven start-ups tend to be capital- and skill-intensive, requiring fewer workers.

Productivity and wage increases manifest in the highest-skilled workers; automation reduces the wages of those engaged in routine tasks. Economic dynamism—whereby new businesses boost economic growth—may well reflect not so much large start-ups employing large numbers of workers as an increase in the number of start-ups, each one spawning more such firms thanks to a boost in the region's risk-taking culture.

This may help explain why population density is unrelated to entrepreneurial activity. Among the top 10 states for start-up activity, New Mexico and Wyoming have between 5 and 20 people per square mile. By contrast, Florida and Texas, also in the top 10, are among the most populous states, with 150 to 400 people per square mile.

In addition, larger firms often acquire start-up founders' ideas, which reduces the need for independent growth. For example, Microsoft acquired all of Inflection AI, and its entire 70-person workforce, in 2024, and in 2022 acquired Nuance Communications, a leader in speech recognition and conversational AI.

Targeted investing

This shift in activity from the Western states to the South Atlantic states in the postpandemic years is remarkable. Key reasons behind this trend include venture capital reallocation, aggressive state-led incentives (tax breaks and public-private R&D partnerships), cost-of-living advantages, enhanced ecosystem building (incubators), and remote work trends. The Southeastern states' more nuanced approach to investing—writing smaller, more directed checks to promising founders—has proved to be more resilient in the face of high exit rates for start-ups.

Manufacturing and research are important drivers. Automobile manufacturing clusters, led by Mercedes-Benz USA and Porsche North America, have headquarters in the Atlanta, Georgia, area. The 7,000-acre research cluster in Research Triangle Park in Raleigh-Durham, North Carolina, and Cummings Research Park in Huntsville, Alabama—the second-largest research park, with business incubators and Fortune 500 companies—have generated favorable spillover effects in the areas' business climate. Most of these start-ups are integrating AI tech into their normal business functions: It is a tool in the general toolbox, as illustrated by the multibillion-dollar deals made by OpenAI with gaming company Epic Games and the fintech OneTrust in 2020, both headquartered in the Southeast.

DATA

6%

Young, high-growth start-ups accounted for less than 6 percent of employment in 2024, compared with almost 10 percent in 1985

The case of Wyoming is unique. Wyoming has no state income tax or corporate income tax, low business formation costs and filing fees, and no citizenship or residency requirements. The state has strong privacy protections as it doesn't share business or personal records with outside agencies. In 2023, the Wyoming Banking Board approved a cryptocurrency bank. Small wonder that entrepreneurs consider Wyoming a top choice for start-ups.

Innovation and entrepreneurial activity are not inherently confined to historically established regions. Emerging areas can cultivate and adapt their entrepreneurial ecosystems to harness local potential and evolve into dynamic start-up hubs. This ability makes them a compelling model for less-developed economies seeking to stimulate economic growth through entrepreneurship. There are nevertheless challenges, such as the need to provide cheap energy and other resources to power data centers and other power-hungry facilities. Policymakers can play a critical role through targeted industrial policy—investing in infrastructure, education, and regulatory frameworks that foster innovation and lower entry barriers for new ventures in these regions. **F&D**

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Uncertainty about Uncertainty

Hites Ahir, Nicholas Bloom, and Davide Furceri

MEASURES OF UNCERTAINTY DON'T QUITE MEASURE UP

Amid this year's geopolitical rifts, one signal of uncertainty is flashing red; another, green; and a third, amber. Ordinarily, they tend to track one another.

This is no parlor game. High levels of uncertainty can freeze investment and consumption, tank markets, and help spark a recession.

What are we to make of this in assessing the direction of the global economy?

Let's start with a review of how economists, investors, and policymakers gauge uncertainty.

How high is uncertainty?

Measuring uncertainty is not easy. The questions are uncertainty about whom, over what, and for what time period. There is no single dominant metric for uncertainty.

The three main measures rely on textual analysis, financial markets, and business surveys. Text-based measures now show exceptionally high levels of uncertainty. Everything you read, from newspapers to country reports to official publications, seems to discuss uncertainty. Financial-market-based measures, meanwhile, show only moderate levels of uncertainty. And survey-based measures, which spiked during the pandemic, have largely flatlined.

Perhaps the best-known text-based metric is the Economic Policy Uncertainty (EPU) Index developed by Baker, Bloom, and Davis (2016). The index analyzes articles in hundreds of newspapers for mentions of terms related to economics, policy, and uncertainty. This century, the EPU for the United States has typically surged during crises, spiking after events like the 2008 financial crisis and the 2020 COVID pandemic (Chart 1). In 2025, the EPU reached a record high, indicating extensive discussions of uncertainty in national and local newspapers.

One concern with the EPU is that it may reflect media bias. We developed a second set of indicators based on the Economist Intelligence Unit's country reports (Ahir, Bloom, and Furceri 2022). These reports appear monthly and provide a detailed

discussion of political and economic conditions in 71 countries. By calculating the frequency of the appearance of the term "uncertain," we created the World Uncertainty Index (WUI). It shows a similar trajectory as the EPU, suggesting that perceptions of elevated uncertainty—across countries—are not solely media-driven.

Concerns about using textual data to measure uncertainty include the evolution of language, potential bias in sources, and inaccuracies in word counts as measures of intensity. An alternative approach is to examine financial market volatility. The 32-year-old Chicago Board Options Exchange Volatility Index, known as the VIX, embodies this concept. It calculates the one-month-ahead implied volatility of the S&P 500 Index of US stocks, based on a basket of put and call options.

Significant spikes in the VIX over the past three decades occurred around economic and political shocks, such as the Asian and Russian financial crises in 1997 and 1998, the 2008 financial crisis, the 2011 debt ceiling crisis, and the 2020 pandemic

"There is a growing body of research estimating the impact of uncertainty on businesses, consumers, and the overall economy."

(Chart 2). In 2025, the VIX has been elevated—reaching 32 in April—but that was not a large spike compared with previous jumps.

Other market-based measures—such as the Intercontinental Exchange Bank of America MOVE Index of implied volatility on bond yields—present a similar picture of increased but not extreme uncertainty.

In many ways, the most informative measure of uncertainty is how managers perceive future business conditions. Ultimately, it is uncertainty in the minds of executives that influences deci-

Illustration by Joey Guidone

sions about hiring and investment, which drive economic growth.

The US Survey of Business Uncertainty (SBU), administered by the Atlanta Federal Reserve Bank, queries almost 1,000 US businesses each month, collecting information about sales forecasts. As Altig and others (2020) show, these forecasts accurately predict business actions, including current and future hiring, investment, and sales.

This metric showed a significant surge in uncertainty during the pandemic, roughly doubling between January and May 2020, before slowly easing (Chart 3). Through June 2025, there was no uncertainty surge. One explanation is that businesses may not be following the economic or political news. However, the SBU panel did notably raise predictions for sales growth after the November 2024 election of Donald Trump. The forecasts declined in spring 2025 after the beginning of tariff wars.

The UK's Decision Maker Panel collects similar measures of company-level sales growth uncertainty. It polls about 2,500 businesses a month across the UK. As Chart 3 also shows, the UK sales uncertainty index followed a pattern similar to that of the US measure, with a surge during the pandemic but no recent increase.

It's a little puzzling that the survey-based metrics don't show a rise through June 2025, whereas the market-based measures increased moderately and the text-based indicators surged. These indices tracked each other remarkably closely over previous episodes, such as the pandemic and the financial crisis. One explanation is that text measures are excessively high because of the intense media focus on the Trump administration. Another is that because our financial and business measures are shorter term and US-focused, they may miss the rise in longer-term global uncertainty. Our sense is that the truth is somewhere in between—global uncertainty has risen, but not as much as text-based measures would suggest.

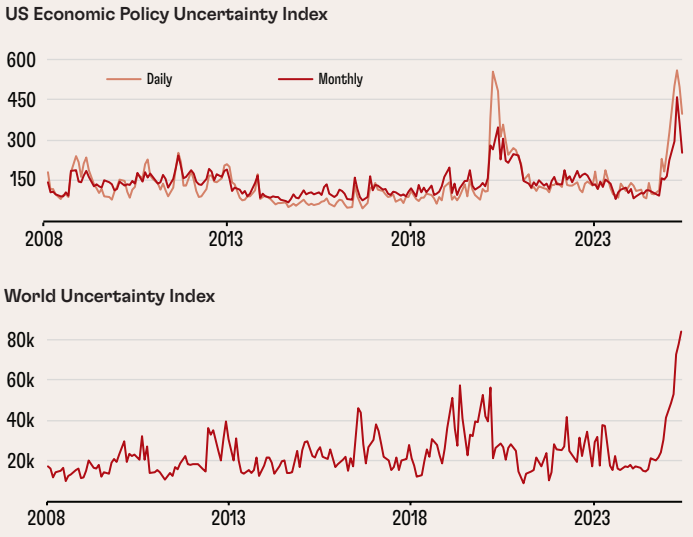
Uncertainty and growth

Economists have been developing theories for decades about the economic impact of uncertainty. One body of research focuses on "real options," or the idea that companies look at their investment choices as a series of options. For example, a supermarket chain that owns a plot of land has the option to build a new store there. If the supermarket becomes uncertain about the future because it is unsure whether a local housing development will proceed, it may opt to wait. In such a case, the option value of delay is high when uncertainty is high. Uncertainty makes businesses cautious about investment and hiring.

CHART 1

Words point to turmoil

Text-based measures of uncertainty reach new heights in 2025.

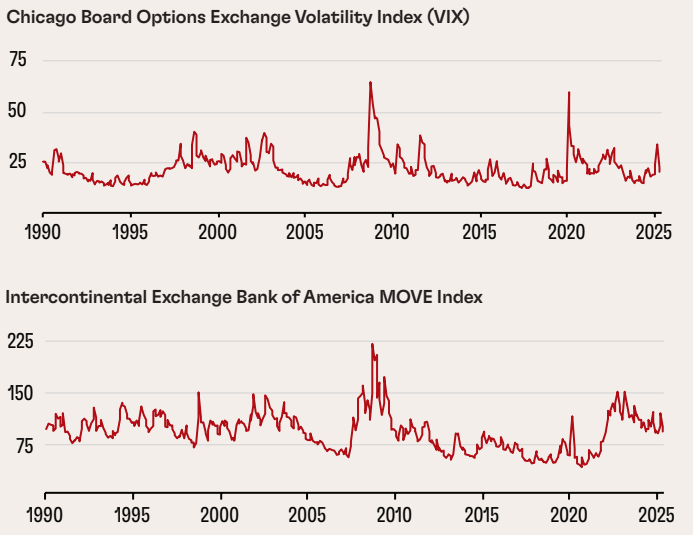


SOURCES: Baker, Bloom, and Davis 2016; and Ahir, Bloom, and Furceri 2022.
NOTE: An increase in the index means that uncertainty is rising and vice versa.

CHART 2

Markets stir, don't shake

Financial market measures signal modest rise in uncertainty.



SOURCES: Federal Reserve Economic Data; and Haver Analytics.
NOTE: The VIX measures expected stock market volatility and reflects investor fear about equity markets; the MOVE Index gauges volatility in US Treasury bond markets.

However, real-options effects are not universal. They arise only when decisions cannot be easily reversed. Even when uncertainty is high, businesses may be happy to hire part-time employees or rent rather than buy equipment. If conditions deteriorate, they can easily cut the workers and return the rented gear. High uncertainty tends to both reduce overall activity and shift it into more reversible choices.

Uncertainty can also push individuals to postpone consumption. People can easily delay decisions on buying durables like housing, cars, and furniture. Someone thinking about moving to another house could either do so this year or wait until next year. The option value of waiting will be much higher when income uncertainty is greater.

Finally, uncertainty can increase the cost of finance (Fernandez-Villaverde and others 2011). Investors want to be compensated for higher risk, and because greater uncertainty leads to higher risk premiums, it raises the cost of borrowing. Uncertainty also increases the probability of default.

There is a growing body of research estimating the impact of uncertainty on businesses, consumers, and the overall economy. Findings generally show that greater uncertainty has a strong impact on reducing investment and a weaker effect on lowering employment and consumption—while overall helping to drive business cycles. These effects seem to be magnified when financial conditions are tight: Uncertainty and financial frictions can have a multiplicative impact on each other.

Clearly, a surge in uncertainty of the size implied by this year's text-based measures could be extremely damaging for growth, potentially leading to a global recession. But a rise in uncertainty of the size signaled by financial markets might only slow growth without generating a recession. And, if the business surveys are correct, uncertainty has changed little over the past year.

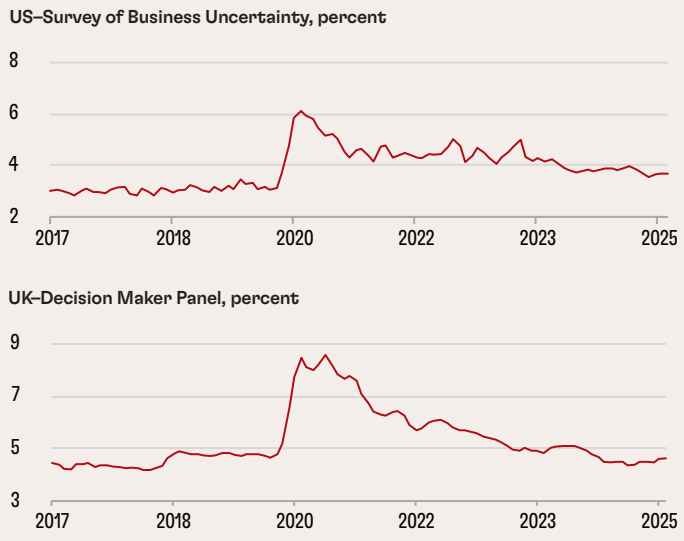
Our best guess is that uncertainty is not as high as indicated by the text measures, which may be distorted by the turmoil in US politics. But uncertainty is not as low as suggested by business surveys focusing on year-ahead sales. Many drivers of uncertainty are longer term or will not manifest in sales.

We see uncertainty as having risen above its long-term levels without reaching the peaks of the global financial crisis or the pandemic. As such, we think the 2025 surge in uncertainty will slow growth by reducing investment, hiring, and consumer spending on durable goods. This is likely to happen through 2025 and 2026 as the impact of uncertainty typically takes 6 to 18 months to slow growth (Caldara and Iacoviello 2022). But the rise in uncertainty is not large enough to induce a global recession. F&D

CHART 3

Surveys signal stability

Survey-based measures suggest uncertainty held steady.



SOURCES: Survey of Business Uncertainty (SBU); and Decision Maker Panel (DMP).
NOTE: SBU shows one-year-ahead sales growth uncertainty for US firms; DMP shows three-month average sales growth uncertainty for UK firms, based on chief financial officer surveys.

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When Free Trade First Faltered

Marc-William Palen

GLOBALIZATION'S FIRST AGE SOME 200 YEARS AGO HELD CONTRADICTIONS THAT SHED LIGHT ON TODAY'S TURN TOWARD ECONOMIC NATIONALISM

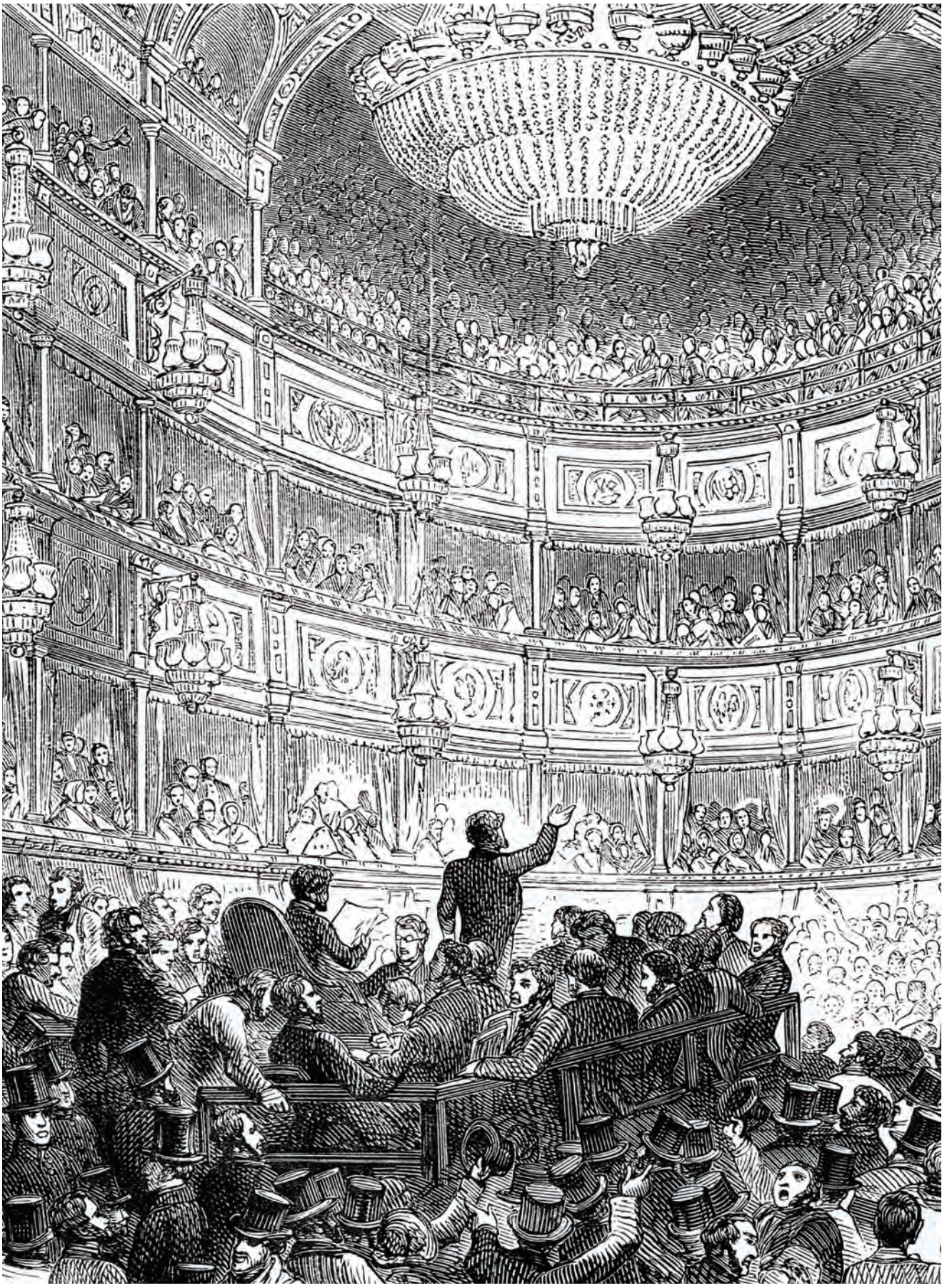
The "first age" of globalization was beset by contradictions. In the 60 years or so before World War I, global trade grew rapidly despite the ever-higher tariff walls built by the rising protectionist empires of the United States, Germany, Russia, France, and Japan. Geopolitical conflicts and trade wars grew more common even as markets became more integrated. These contradictions were at the heart of heated debates over free trade and economic nationalism that dominated the industrializing world at the time.

Emerging economic nationalism today eerily echoes the first age of globalization—and is an even bigger bundle of contradictions. Nationalist forces reemerged from the Great Recession of 2008–09 as a potent political and economic force across the globe. And yet ours is a world of extraordinary economic interdependence wrought from technological marvels, the likes of which the science fiction writer Jules Verne could only dream.

Between the 1840s and 1860s, trade liberalization appeared to be the name of the globalization game. Britain ushered in the mid-century flirtation with free trade, when the island nation's liberals successfully overturned the Corn Laws. These protective tariffs on foreign grain benefited landed aristocrats but forced the working-class poor to pay more to feed themselves. Britain's free-trade advocates made a compelling case to the public that getting rid of grain tariffs would usher in a new era of cheap and plentiful food for the hungry masses pouring into its industrial centers.

But they also made a compelling case that a peaceful and prosperous world of economic interdependence was possible—if Britain's imperial rivals also liberalized their markets. After all, why seize colonies or wage war over raw materials when the world's products could be purchased through peaceful market competition? As Richard Cobden, Britain's mid-century "apostle of free trade," put it, trade liberalization would so unite the world that militant landed elites could no longer "plunge their people into wars."

The Anti-Corn Law League meets in Drury Lane Theatre, London, 1838.



PRINT COLLECTOR/GETTY IMAGES

The national system

Some, like the German-American protectionist theorist Friedrich List, disagreed. During his US exile, List updated Alexander Hamilton's 18th century economic nationalist vision for the rapidly globalizing world of the 1840s. After returning to Germany, he published his 1841 magnum opus, *The National System of Political Economy*, in the hope of countering the cosmopolitan call of free trade.

The British had, he warned, relied on decades of protectionism to reach the industrial summit. They now sought to "kick away the ladder" so that others could not challenge their position as "manufacturer of the world." List called on Britain's imperial rivals to establish strong nation-states—with high tariffs to foster "infant" industries into adulthood and colonial expansion to exploit the raw materials of Latin America, Asia, and Africa.

List's imperial protectionist proposal fell on deaf European and American ears at the time. Advocates of trade liberalization seemed poised to win the day. In 1846, Britain's liberal free-trade visionaries celebrated the demise of the Corn Laws. Thanks to Cobden and his middle-class supporters, Britain became the first imperial power to unilaterally embrace free trade. Cobden's non-interventionist wing in Parliament also fought unsuccessfully against coercive mid-century free-trade policies in colonial spaces such as India and China.

Cobden and his followers next turned their free-trade attention to the US and the European continent. In 1846, the US followed Britain's lead and substantially lowered its tariffs. European trade liberalization, however, required more diplomacy. The 1860 Anglo-French (or Cobden-Chevalier) commercial treaty signaled that Europe's two biggest imperial rivals might be ready to turn their swords into ploughshares. The treaty's innovative inclusion of a most-favored-nation clause granted other European powers the same low tariff treatment if they responded in kind. About 50 or 60 trade treaties were signed, locking Europe into what was effectively its first common market.

Technological tools

A more liberal economic order was coming, and the technological tools of globalization's first age seemed well placed to tie it all together. Transoceanic steamship lines drastically lowered transportation costs and travel times. The transatlantic cable, successfully laid in 1866, meant that messages between Wall Street and the City of London took mere minutes. The opening of the Suez Canal in Egypt and the completion of the US transcontinental railway in 1869 shrank the world even further. These developments sparked the globalist imagination, including Jules Verne's *Around the World in Eighty Days* (1872).

But globalization's unprecedented interdependence soon landed the industrializing world in an unpredictable boom-bust economic cycle. Low transportation costs, mass industrialization, and trade liberalization cut costs for consumers, but the steep fall in prices also meant tighter profit margins, or even losses, for many of the world's exporters. The British-led gold standard greased the wheels of international trade, but its deflationary effects spelled doom for many debt-ridden agrarians and manufacturers.

The first age of globalization was facing the first Great Depression (1873–96), and protectionism and colonialism were the policies of choice of the industrializing world. Globalization's protesters grew louder. As is common during economic crisis, cries for national self-sufficiency drowned out calls for cosmopolitan comity. Free trade fell out of fashion among Britain's imperial rivals, who rediscovered the protectionist ideas of List, catapulting him from pariah to prophet.

Economic conspiracy

Imperial-minded economic nationalists across the globe began to revere List's national system as economic divination. Free trade was seen as part of a vast British conspiracy to thwart the industrialization projects of rivals—a self-serving trick to undermine emerging industries elsewhere. List-inspired economic nationalists saw geopolitics as a zero-sum game in which only the fittest would survive.

The technological tools of globalization that not so long ago promised to tie the world together in benign universalism now seemed better suited for binding colonies to imperial metropoles. Tariff walls grew ever higher, turning infant industries into monopolies, cartels, and trusts. Monopoly-induced market inefficiencies at home soon sparked an interimperial search for new markets to export surplus capital and acquire raw materials. Trade wars, military interventions, and the scramble for colonies in Africa and Asia picked up pace.

By 1880, economic nationalists had the upper hand. Their imperial protectionist politics moved ever more to the right. In the US, the Republican Party rebranded itself as the party of protectionism and big business, reversing the freer trade trend of the preceding decades. The 1890 McKinley Tariff, which imposed an unprecedented average rate of about 50 percent, plunged the country into trade wars with European trading partners.

But the Benjamin Harrison administration encouraged the tariff's passage with one particular imperial acquisition in mind: Canada. It hoped that

"The quarter century between the end of the Corn Laws in 1846 and the start of the global turn to protectionism in the early 1870s saw unprecedented trade liberalization, as did the 25 years after the end of the Cold War."

the British-controlled northern neighbor would seek admission to the US rather than pay the exorbitantly high tariff. Canada's Conservative Party instead established closer economic ties within the British Empire; the newly completed Canadian Pacific Railway made Canada a land bridge connecting Britain with its far-flung colonies in the Pacific.

In Germany, Otto von Bismarck, who was rumored to keep *The National System* as bedside reading, in Listian fashion consolidated the German states, erected tariff walls around them, and looked abroad for new colonies. His successor, Willhelm II, started construction of the Berlin-to-Baghdad railway to better connect them. And in Russia, Count Sergei Witte explicitly styled himself after List. Whether as director of railway affairs, finance minister, or prime minister, Witte remained well placed from the early 1890s to start construction of the Trans-Siberian railway to facilitate Russia's imperial designs on Manchuria. Similar economic nationalist stories played out within the empires of France and Japan.

Marginalized liberal defenders of free trade turned to grassroots organizing to stem the mounting protectionist imperial tide. In the US, Henry George, a San Francisco journalist, wrote *Progress and Poverty* (1879), an international bestseller and a road map for breaking up the land monopolies of the railway tycoons, aristocrats, and speculators, by imposing a tax on the potential value of land. His idea became known as Georgism, or the "single tax," because it promised to do away with all other forms of taxation, including tariffs.

The single-tax movement's promotion of an interdependent world of absolute free trade devoid of land monopolies found an international welcome. Russian writer and pacifist Leo Tolstoy became an ardent disciple, believing that the single tax was the antidote to the poison of serfdom. While residing in a single-tax colony in the US, a young Georgist radical named Lizzie Magie in 1904 patented a board game to teach young and old alike about the evils of exploitative land rents—giving birth to what is now the world's most popular board game, Monopoly. In 1912, the Republic of China's newly minted provisional president, Sun Yat-Sen, stepped down from the role to devote himself to promoting the "teachings of your single taxer, Henry George," and grow his nation into an "industrious, peace-loving, prosperous people."

Monopoly capitalism

Britain's Edwardian free traders sought to make sense of the symbiotic relationship between monopolies, protectionism, and imperialism—or "monopoly capitalism"—that had come to define the first age of globalization. The Georgist "Land Song" was a rip-roaring anthem sung at Liberal Party gatherings.

At the same time, the economist J. A. Hobson enunciated one of the most scathing critiques of monopoly capitalism and the scramble for colonies in *Imperialism: A Study* (1902). Eight years later, Norman Angell, a journalist, became so concerned about a looming global conflict that he warned of the "great illusion" that any nation could win from war: World markets were so interdependent that even the so-called winners would lose. The outbreak of World War I four years later proved him right.

The similarities between then and now are hiding in plain sight. The quarter century between the end of the Corn Laws in 1846 and the start of the global turn to protectionism in the early 1870s saw unprecedented trade liberalization, as did the 25 years after the end of the Cold War. And much as the 19th century liberal free-trade advocates underappreciated the political appeal of nationalism and economic self-sufficiency, so too were their intellectual successors in the late 20th century precipitous in predicting the end of the nation-state—and even the end of history.

Because history hasn't ended, it remains a useful guide. Today's cosmopolitan supporters of economic interdependence should understand how their counterparts more than a century ago fought to transform their economic nationalist era of globalization into a more peaceful and equitable free-trade world. Their longer-term successes are a testament to how international cooperation can counteract nationalist-driven conflict. F&D

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NOAH BERGER

People in Economics

A Causal Pioneer

Gary Seidman profiles Stanford economist **Guido Imbens**, who is reshaping how researchers establish cause and effect in the real world

THERE HAVE BEEN A COUPLE OF TIMES in Guido Imbens' life when he has been seriously underestimated. Once, as a diligent schoolboy in The Netherlands, young Guido was unceremoniously banished for weeks from his first economics class after clashing with a teacher over a textbook. Years later, during a faculty interview at Harvard University, a combative associate professor—who ultimately became Imbens' closest friend and corecipient of the Nobel Prize in Economics—voted against hiring him. "He thought the work I was doing in my thesis was boring," Imbens says. "It was very dry and technical," Joshua Angrist recalls with a chuckle three decades later.

There are some things in life and in economics that you can't fully know. Imbens shared the 2021 Nobel Prize with Angrist, of the Massachusetts Institute of Technology, and labor economist David Card, of the University of California, Berkeley, for transforming how economists understand cause and effect. Imbens and Angrist developed tools to answer life's *What if?* questions, not only to explain what actually occurred but also to use natural experiments to estimate what would have happened if circumstances had been different. Take a basic question: *Does going to college really cause people to earn more money over their careers?* You can't run a perfect experiment by sending the same person down two different life paths—one where they go to college and one where they don't—to see what happens. That's impossible. At the

Imbens' research on causation has significant implications across diverse fields, including economics, health, education, and other domains.

same time, you can't send two people down different life paths solely for the purpose of an experiment; that would be unethical.

So Imbens and his colleagues designed and tested sharper tools to work with real-world data—messy, imperfect, observational data—to estimate outcomes that otherwise can't be directly observed. They pioneered causal inference, which, for example, compares similar people who, by chance or circumstance, make different choices.

For instance, during the Vietnam War, a draft lottery randomly assigned young men draft numbers. Those holding low numbers were more likely to face conscription. Many young men could avoid military service by enrolling in college. The draft lottery thus created a kind of natural experiment, allowing researchers to compare outcomes, such as earnings, between similar individuals—some who served in the military and some who didn't—primarily because of their randomly assigned draft number and its influence on their likelihood of being drafted, rather than solely on personal motivation. Why does that matter? Because correlation isn't enough. If a government wants to expand opportunities and boost incomes, it needs to know whether college really causes higher earnings—not just that they often go together. Today, these methods help policymakers, doctors, businesses, and researchers make better decisions based on real-life evidence.

Fruitful friendships

The turning point in Imbens' career came in the early 1990s at Harvard, when—despite a rocky start—he struck up a collaboration and lasting friendship with Angrist. Their partnership took shape not in a classroom but in a local laundromat. The two were junior faculty members who often found themselves folding shirts and trading ideas to the hum of tumbling clothes dryers on Saturday mornings. "It's more fun to work with your friends," says Angrist. "I tell my students that you want to pick your collaborators as carefully and thoughtfully as you pick your spouse," he joked to NobelPrize.org. That friendship led to their most influential contribution, the development of the Local Average Treatment Effect (LATE) framework. It offers a rigorous way to estimate how an intervention—like going to college—affects people who experience it only because of some random circumstance, such as winning a scholarship.

Today, LATE is a standard tool for turning messy data into credible insights. Imbens describes it as a way to focus not on everyone, but specifically on the people whose choices are shifted by an outside force—a law, a rule, or a change in circumstance. Policymakers, for example, use it to assess how the availability—by law—of government-paid health insurance at age 65 impacts health care use and to measure the earnings effect of staying in school longer because of compulsory education laws. In industry, Silicon Valley uses it to evaluate new features in tech platforms through randomized rollouts. By focusing on the people whose behavior is nudged by real-world events, LATE has helped move economics from theoretical models to practical, evidence-based policy.

Imbens credits the foundational work of statistician Donald Rubin—another Harvard colleague and friend—with helping shape the way he and Angrist thought about causality. He says the approach built on earlier studies, including Angrist's collaboration with the late Alan Krueger, a pioneering labor economist. Their 1991 paper estimates the causal effect of education on earnings using people's quarter of birth and US school-entry laws. That paper "was very influential" for advancing causal economics, Imbens emphasizes. Those early natural experiments laid the groundwork for the credibility revolution in economics in the 1990s, when researchers began questioning assumptions and insisting on plausible comparisons. They began asking, What would have happened if circumstances had been different? It was an empirical shift that Imbens helped define with new tools and sharper identification strategies.

Card, who shared the Nobel with Imbens and Angrist for his use of natural experiments in labor markets, notes that Imbens occupies a rare middle ground between theory and practice. "I'm more of a practitioner. He's more of a methodology guy. But he's among the methodology people who are most interested in what applied people are doing," Card says. Together, their work helps bridge the gap between what is happening in the world and how we can reliably understand why it's happening. Imbens says, "We wanted to make econometrics useful for empirical people in a way that we thought wasn't quite there yet."

But what Imbens brings to a team is far more than just intellectual firepower, says Rubin. "He's just innately friendly." He has a calm presence and collegiality that defuses tension and brings the focus back to the work, Rubin says. "He has a different sort of approach to life in many ways."

Curious beginnings

Imbens was born in 1963 in Geldrop, in the southern Netherlands. Though his parents were not academics themselves—and not university graduates when Imbens was young—they nurtured intellectual exploration. "They stimulated that in us," Imbens says. His father gave him and his two siblings math problems to solve for fun. "We enjoyed doing them," Imbens remembers. It sparked his curiosity and love of logical thinking, skills that would shape his approach to economics years later. "So both my siblings and I ended up going to university. In fact, my brother got a PhD in mathematics."

As a boy, Imbens was captivated by chess, a passion that reflected his love of strategy and analytical thought. He also inherited a streak of independence—and a touch of stubbornness—from his mother, Annie Imbens-Fransen, who later in life became a feminist theologian and an author. He remembers his mother's instinct for nonconformity. "We were living in housing that was owned by Philips," the multinational Dutch electronics firm where his father worked. "Once a year they [Philips] would paint the front doors this vile bright yellow," Imbens recalls. "My mother didn't like that. And so the day

"In a field that often rewards certainty, Imbens has made a career out of working in the messy middle—a place where data are imperfect and intellectual honesty matters most."

after they painted the doors yellow, we would paint them black. This was a row of townhouses. There was one house with a non-yellow door."

After high school, Imbens chose to attend Erasmus University Rotterdam, where one of his early influences, fellow Dutch economist and Nobel Prize–winner Jan Tinbergen, had established an econometrics program. He then went on to earn a master's in 1986 at the University of Hull in the UK, under the mentorship of Anthony Lancaster, who ultimately persuaded Imbens to follow him to Brown University, where Imbens received his PhD in 1991. "Getting into Brown for his PhD felt like winning the lottery for Guido," says Susan Athey, Imbens' wife and a fellow economics professor at Stanford University.

Lancaster introduced Imbens to Bayesian econometrics and provided the intellectual tools and, perhaps more important, the network of connections that helped launch Imbens' academic career in the United States.

After a stint at Harvard, Imbens held faculty positions at the University of California, Los Angeles, and Berkeley, and ultimately Stanford, where he now teaches. A landmark use of causal inference occurred when Imbens was at UCLA, in a study with Rubin and Harvard PhD student Bruce Sacerdote. They used lottery data to examine how sudden financial windfalls affect people's work and spending decisions. The results—showing that people don't necessarily quit their jobs after a windfall but that many do work a bit less—helped shift debates around basic income and pensions while also broadening the reach of causal inference beyond education and health.

Solving problems

Imbens is quick to acknowledge the role of serendipity in his own life. "I do feel very fortunate. I've just been incredibly lucky to be in the right place at the right time." Still, he believes strongly that cultivating meaningful relationships with many of the leading economists of his generation is as critical to his work as technical skill, and he places great importance on his role today of mentoring younger scholars. "I'm trying to influence the profession more generally in a direction that makes sense—where econometricians are working on problems that are important for empirical work," he says. "I try to instill that in my students: It's not always about the mathematics—it's about interesting problems."

In March 2025, Imbens was named faculty director of Stanford Data Science, an initiative that supports research and scholarship through data-driven discovery and data science education across the campus. He sees the role as a chance to encourage young researchers, deepen interdisciplinary ties, and bring data science into closer conversation with real-world policy.

Economic collaboration is never far from home. Imbens' wife, Athey, is a John Bates Clark Medal winner who is known for her pioneering work at the intersection of technology, economics, and machine learning. "Susan is a very broad economist... She's always a source of inspiration for the type of problems I work on," Imbens says. "We've really shared the load all the way through—and shared the fun," Athey says, noting that despite his heavy workload, Imbens leads a very grounded life, biking with colleagues on weekends, tending to his garden, having his students over for events, and when time allows, which is rare these days, preparing memorable meals.

But his most notable achievement is helping to reshape the way economists think about evidence, policy, and uncertainty. In doing so, he has brought clarity to questions that had once seemed unanswerable and opened the door for more credible social science. In a field that often rewards certainty, Imbens has made a career out of working in the messy middle—a place where data are imperfect and intellectual honesty matters most. That, too, is a form of elegance. When the Nobel Prize Museum asked each laureate to donate an item that was meaningful to their research, Imbens chose a container of laundry detergent—a quiet tribute to those early mornings spent folding shirts and trading ideas with Angrist. Few tokens could better capture the spirit of his work—rigorous, collaborative, and firmly grounded in the real world. F&D

GARY SEIDMAN *is a Seattle-based journalist who has written for the* Economist, *the* New York Times, *Reuters, CNN, and MSNBC.*

Café Economics

Taxing Matters

Stefanie Stantcheva explains how policymakers can raise taxes without scaring off innovators

The Internal Revenue Service building in Washington, DC, has its raison d'être etched in stone across its facade: "Taxes are what we pay for civilized society." That quote is from Oliver Wendell Holmes Jr., a Supreme Court justice in the early 1900s, but some prominent modern-day Americans, such as Steve Jobs, argue that it is innovation that truly allows societies to evolve: "Innovation distinguishes between a leader and a follower," Jobs said. So what happens when those two things work against each other...when taxes start to weigh on innovation?

Stefanie Stantcheva wants to know how tax policy can make or break the innovative spirit, a subject she studies at Harvard University's Social Economics Lab, which she founded. Her fascination with economics began when she was a young girl growing up in Bulgaria in the 1990s amid bouts of hyperinflation. She later moved to France and East Germany, where she found more economic puzzles to solve. Stantcheva was destined to become an economist and has been doing remarkable research ever since.

Economists need to go beyond conventional data to understand people's reasoning, perceptions, beliefs, and attitudes, Stantcheva tells F&D.

Her work on taxation and innovation won her the 2025 John Bates Clark Medal—known as the Baby Nobel—awarded for the most significant contributions to economic thought and knowledge by an economist under age 40.

Stantcheva's youthful approach has shed light on trends such as zero-sum thinking, which challenges conventional wisdom on growth and, she says, helps explain the reasoning behind the perception of economic policies among younger generations.

Stantcheva, the Nathaniel Ropes Professor of Political Economy at Harvard, discussed old and new thinking in economic policy with F&D contributor Rhoda Metcalfe.

F&D: You've been involved in many thought-provoking studies, but your work on taxation and innovation has received a lot of attention. What's the connection?

SS: There's an important connection. Innovators and inventors are economic agents, like everyone else, and they care about economic incentives and rewards. Our studies show the effect of taxation on inventors in the United States all the way back to the 1930s. We wanted to understand how taxes shaped the quantity of innovation, where it happened across different states, and its quality. We found that taxation has a negative effect

Illustration by Sonia Pulido

on innovation, both in terms of the quantity, as measured by the number of patents, and the location. States with higher personal—and especially higher corporate income taxes—lost out to lower-income-tax states in terms of innovation.

F&D: So if a state wants more innovation, more start-ups, all it has to do is lower taxes?

SS: It's more complicated, because taxation exists for a good reason. We need to raise revenue to finance important public spending. If a state has a lot of amenities—measured, for instance, by the number of inventors located there already, or by its research infrastructure—this dampens the effects of higher taxes. California, for example, has relatively high taxes. Yet innovators still want to move there because there is so much innovation there already and because of the many amenities, which are partly financed by high taxes. And this is also true in other major patenting countries, in western Europe and Canada, for instance. Superstar inventors are highly mobile and sensitive to taxes. Migration effects are powerful for highly qualified inventors.

The policy conclusion is that because taxes are needed for lots of reasons, it's important to dampen their negative economic effects. The way revenues are spent is critical. Revenues that foster research and innovation infrastructure, that make a location attractive, allow a state or a country to sustain higher taxes without losing all innovative capacity.

F&D: Taxation is a recurring theme in your research. What makes it so interesting?

SS: Who likes taxes, right? But they affect so many aspects of our lives. A well-designed tax system can encourage growth and equality and provide great infrastructure and public services. But a poorly designed tax system can have terrible cascading effects that hamper economic development. Taxation is such a powerful tool that it's important to study it and get it right.

F&D: One thing that sets your research apart is the way you use surveys, which are not new, but your approach is a little different. Can you explain?

SS: Surveys have been around for a very long time in economics, but there are things that remain completely invisible in data, no matter how good it is—things like people's reasoning, perceptions, beliefs, attitudes. This is why the surveys we do at the Social Economics Lab are so important. We try to understand how people think about economic issues and economic policies. We go deep into how people reason, why they reason the way they do, why they hold some views and not others. Our surveys also typically incorporate something experimental, which means some people will see one type of information while others will see another. We can see what happens from that additional information or that different angle on an issue. We're creating big data on something unusual: what's happening in people's minds. We can analyze it in a quantitative way. We can see patterns and understand cause and effect. We can draw many lessons from this.

F&D: Can you give an example?

SS: We tried to see how people in 20 countries feel about major climate policies. An interesting example is the trade-off between taxing pollution and banning it altogether. Should we tax polluting cars and still let people purchase them if they're willing to pay the price? Or should we ban polluting cars altogether? Economic theory suggests that a tax is more efficient than an outright ban. But people feel differently, and our surveys help us understand why. And it turns out people are driven by a strong equity concern. People find it unfair that the rich can simply pay to pollute while others cannot. They consider an outright ban to be fairer.

F&D: And your other study suggests more people are thinking in zero-sum terms. What's that about?

SS: Zero-sum thinking is the belief that if one individual or group gains, it must come at the expense of another. It's the belief in a limited amount of good. If you get a larger slice of the pie, I must get a smaller slice. It contrasts with positive-sum thinking—the belief that we can grow the pie and don't need to be in direct competition with each other. We set out to study how this mindset is spread across the US—across different groups, different generations, different places—and where it comes from and how it shapes policy views. Zero-sum thinking, it turns out, is much more prevalent among younger people in the US. That might seem surprising, but it's also true in other rich countries. The economic environment really matters. People who grew up in a time of lower growth and lower mobility, as is the case for younger generations in the US, are much more likely to be zero-sum.

The pattern is flipped in emerging market economies, where there is higher growth and higher mobility than before. Younger generations in these countries are less zero-sum than the older ones. But the economic environment also matters at the individual level. So if your own family has experienced upward mobility, then you are less likely to be zero-sum.

F&D: Do you see this further politicizing economic policy debates?

SS: What's interesting about zero-sum thinking is that, unlike so many other things today, it's not a partisan issue: It's evenly distributed across both sides of the political divide. It's not the case that one political group is more zero-sum than the other. It does, however, explain a lot of within-party variation in policy views. People who are more zero-sum, for instance, want more government intervention to protect the group that's suffering from the zero-sum situation. People who are more zero-sum support more redistribution, driven by the idea that the gains of the rich come at the expense of the poor. It's interesting to think about this in light of younger generations today being more zero-sum. What might this mean for policies in the future? **F&D**

This interview has been edited for length and clarity. Visit www.imf.org/podcasts to hear the full interview.

Book Reviews

Demystifying the New Deal

Carola Binder

US PRESIDENT Franklin D. Roosevelt's New Deal projects and regulations were so wide-ranging in their aims and scope that it's hard to reach a simple verdict on their effectiveness. George Selgin rightly avoids attempting to do so in *False Dawn*, his new book examining the administration's 1933–39 policies and the recovery from the Great Depression.

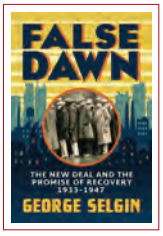
Selgin, a senior fellow at the Cato Institute's Center for Monetary and Financial Alternatives and economics professor emeritus at the University of Georgia, challenges the idea that the New Deal was a coherent plan that Roosevelt designed before taking office. Rather, key components were cobbled together after his inauguration, often without Roosevelt's initial support.

Selgin takes on these components one by one, from the 1933 bank holiday and the gold programs to the alphabet soup of agencies, including the Federal Deposit Insurance Corporation (FDIC), the Reconstruction Finance Corporation (RFC), the Agricultural Adjustment Administration (AAA), the National Recovery Administration (NRA), and the Home Owners' Loan Corporation (HOLC).

In these chapters, Selgin describes the conventional wisdom about some aspects of the New Deal, the challenges to the conventional wisdom, and the challenges to the challenges. He evaluates the literature and his own read of the historical record. By the end of each chapter, we know exactly where he stands, how firmly, and on what strength of evidence.

Selgin pinpoints where evidence is shaky or missing, making the book a treasure trove of research ideas for economic historians. For example, he also points to a need for improved empirical studies estimating the effects of policy uncertainty on investment—an especially important topic today, with some measures of economic policy uncertainty at record highs.

For a more general audience, the book's most important contribution is its debunking of what Selgin calls the "Keynesian myth," or "popular tendency to identify the New Deal with Keynesian economics," which has "had an unfortunate effect on discourses concerning the merits of each." Selgin cites Eric Rauchway's 2015 book *The Money Makers* as Keynesian myth-making, specifically its assertion that Roosevelt "conducted an active monetary and fiscal program of recovery...working along lines suggested by Keynes." Selgin shows that Roosevelt was *not* influenced by Keynes. He was firmly committed to fiscal conservatism until after 1937, and the Federal Reserve did not deliberately use monetary stimulus in response to the Depression.



FALSE DAWN: The New Deal and the Promise of Recovery, 1933–1947

George Selgin

University of Chicago Press

Chicago, IL, 2025, 384 pp., $35

"Selgin pinpoints where evidence is shaky or missing."

Perhaps even more important than the decidedly un-Keynesian monetary and fiscal policy was Roosevelt's disregard for Keynes's warnings about expectations. Keynes recognized that Roosevelt's antibusiness attitude and various New Deal policies, especially the National Industrial Recovery Act, were breeding fear and uncertainty and precluded the possibility of an investment-led recovery.

Business leaders shared Keynes's sense that the policy uncertainty generated by the New Deal was highly counterproductive. Selgin quotes Lammot du Pont II, president of the chemical company Dupont, who remarked in 1937 that "uncertainty rules the tax situation, the labor situation, the monetary situation and practically every legal condition under which industry must operate...The whole future is a gigantic question mark." Selgin explains that "it isn't simply bad outcomes that frighten investors; it's also not knowing what's in store." **F&D**

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Hope despite Hostility

Elizabeth Van Heuvelen

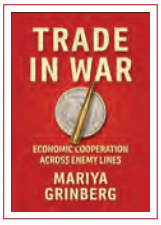
"Trade during wartime was once considered a nonstarter because it was seen as contributing to military capability."

IN *TRADE IN WAR*, Mariya Grinberg probes a fundamental question: Why do warring countries trade with each other? Grinberg, a political science professor at the Massachusetts Institute of Technology, posits both economic and security imperatives. In short, countries allow as much wartime trade as makes military sense and prohibit as much militarily dangerous trade as is economically viable. A series of case studies follow—spanning the Crimean War, both world wars, and the post–Cold War era—during which wartime trade "should have been least likely."

It may seem evident that warring countries can maintain some kind of commercial relationship, but Grinberg reminds us that this was not always true. A striking section of the book examines the introduction of "neutral rights" during the Crimean War, which caused a fundamental shift in thinking about trade during war: Nuanced trade policy can replace the extreme practice of severing all trade.

Trade during wartime was once considered a nonstarter because it was seen as contributing to military capability. Grinberg explains that after the onset of the Crimean War, and by complete happenstance, a large amount of produce already paid for by France got stuck in Russian ports because of late-melting ice in the Baltic Sea. These circumstances opened the way for France to persuade Britain and Russia to allow the shipment through despite the ongoing war. This led to a declaration on the rights of neutrals and eventual adoption of the Declaration of Paris, which codified such practices through subsequent conflicts, allowing trade to continue and, more important, shifting perceptions of the acceptability of trade during conflict.

Building on this historical foundation of neutral rights, Grinberg demonstrates how states developed more sophisticated frameworks for wartime trade decisions. She emphasizes the importance of the "conversion time" of trade products into military capability and the revenue generated by these trades. This helps determine wartime commercial decisions by weighing immediate military benefits against long-term economic costs. The case study of World War I shows how Britain and Germany frequently adjusted their commercial policies as the war progressed and their expectations about the conflict's duration and stakes changed. Britain's initial lax policy, based on the anticipation of a short war, tightened as the war dragged on. Germany, in contrast, went on to make more dire predictions about the stakes of the war and implemented an even more prohibitive policy, but ultimately allowed for more trade once it became clear the conflict would be protracted.



TRADE IN WAR: Economic Cooperation across Enemy Lines

Mariya Grinberg

Cornell University Press

Ithaca, NY, 2025, 259 pp., $48

The book ends with a look at more modern conflicts and whether states resolve the trade-off between economic and security imperatives in the same way without the pressures of war. Strategic calculations are complicated in today's global economy, she argues, particularly given global value chains and economic interdependence of major trading partners. Yet, according to Grinberg's understanding of wartime trade, this also suggests that decoupling in these circumstances is highly unlikely even amid heightened tension. This should come as no surprise given a key through line of the book: Economic cooperation can thrive even in the most hostile times. **F&D**

ELIZABETH VAN HEUVELEN *is a senior economist in the IMF's Strategy, Policy, and Review Department.*

History's Earliest Hustlers

Nicholas Owen

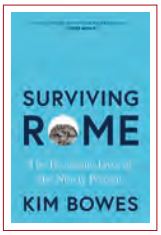
"THE HISTORY OF ROME," writes US archaeologist Kim Bowes, "is peopled by the rich." Cicero, Livy, and Tacitus chronicled the lives of consuls and emperors, but the classical world's most celebrated scholars weren't interested in ordinary working Romans. It's an omission Bowes seeks to remedy in her remarkable and meticulously researched new book, *Surviving Rome: The Economic Lives of the Ninety Percent*.

We meet a colorful cast of characters who survived—and sometimes even thrived—in what the author describes as the world's first "global" economy. The challenges faced by ancient Egypt's Soterichos family, who turned to cash crops to pay off debt, shed light on smallholder agriculture. We learn how Romans accessed credit in times of want from stories of the Pompeian pawnbroker and moneylender Faustilla. And the dealings of army supplier Philokles, who pimped out prostitutes to a garrison at Krokodilo in Egypt's Eastern Desert, form part of a discussion of income earned by working for the Roman state.

Bowes, a professor of classical studies at the University of Pennsylvania and former director of the American Academy in Rome, rejects the notion that all premodern societies were essentially the same—that it's possible to fill gaps in our knowledge of the ancient world by retrojecting based on peoples and places we know better. She draws instead on archaeological discoveries, bookkeeping records, and even human skeletons from far corners of the empire. The economy that emerges from these sources—many of which have surfaced or been subject to rigorous scientific analysis only in the past 20 years—is far more complex than hitherto supposed.

At the heart of this economy was a paradox: high consumption and rapidly expanding demand for cheap consumer goods—from greater varieties of food and drink to highly standardized pots, jugs, and jewelry—combined with low income and limited opportunities to earn a wage. Romans dealt with this income gap and supported themselves during months of scarcity through credit, pawning possessions, or borrowing against the next harvest or another source of future income.

Social mobility depended on accumulating small amounts of capital that could generate additional income—a plot of farmland, a yoke of oxen, a pottery kiln, or a loom for weaving. Yet most families struggled to amass savings to transform into capital.



SURVIVING ROME: The Economic Lives of the Ninety Percent

Kim Bowes

Princeton University Press

Princeton, NJ, 2025, 512 pp., $39.95

Neat analytical categories such as farmer, artisan, or wage laborer fall apart on contact with the messy reality of ordinary Romans who depended on a multitude of income sources to make ends meet. Distinctions between adult and child, rural and urban, creditor and debtor—even between free and enslaved—become blurred when it comes to ordinary lives.

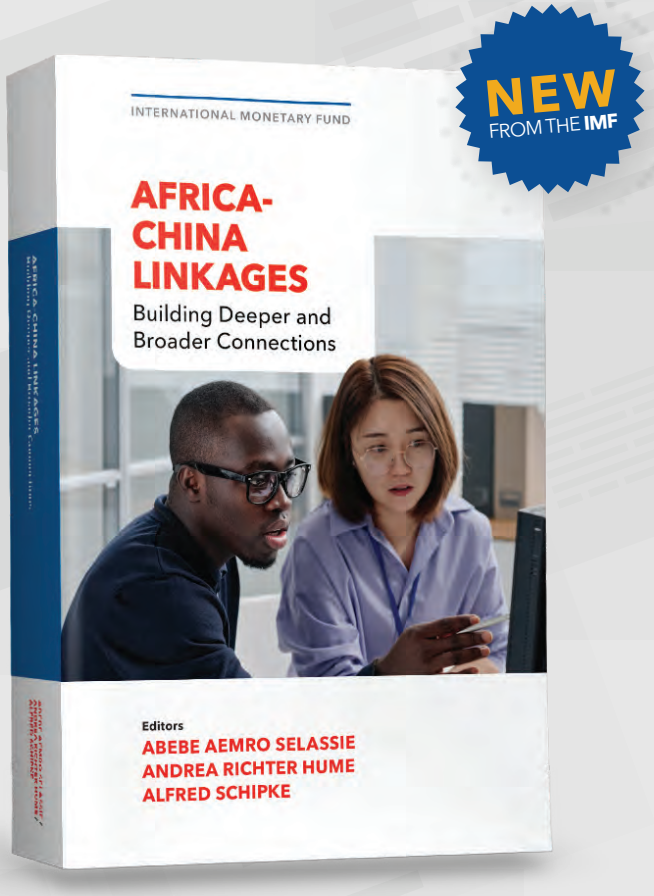
Bowes does not shy away from comparisons with the precarious economic existence of many people today. The relentless persistence of working Romans who "squeezed a living out of their circumstances" through graft, hustles, and money maneuvers is not so different from the efforts of a wide swath of 21st century American society, Bowes writes. Discussions of modern economic thinkers, from Adam Smith and Karl Marx to John Kenneth Galbraith and Thomas Piketty, add contemporary resonance.

Bowes's lively storytelling, accompanied by dozens of illustrations and photographs, will interest specialist and general readers alike. "It's amazing," Bowes writes, "how much we can know about the 90 percent just by listening to them." F&D

"Bowes does not shy away from comparisons with the precarious economic existence of many people today."

NICHOLAS OWEN *is on the staff of* Finance & Development.

FALL FEATURED TITLE



Africa has made remarkable strides across many development metrics, significantly improving life expectancy, literacy, health, and education.

With its population set to double to around 2 billion by 2050, Africa's economic trajectory will increasingly shape global dynamics. This book delves into the evolving Africa-China economic relationship by examining its many facets and the potential impact of China's current trends on Africa's future.

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Tradition and Technology

Jeff Kearns and Melinda Weir

Bermuda's new notes honor history with more durable, accessible, and sustainable design

Banknotes reflect Bermuda's landscapes, flora, and fauna.

BERMUDA'S FIRST COINS, minted around 1616, were "hogge money." They featured a galleon on one side and a hog on the other, a nod to free-roaming swine descended from those abandoned by Spanish and Portuguese mariners—and which, a century later, were a source of sustenance for shipwrecked English sailors. The poor-quality money, however, was abandoned after a few years when tobacco became the local currency.

Today, modern money in the British overseas territory continues to highlight the Atlantic archipelago's unique flora, fauna, and landscape. These themes, consistent across issuance since the Bermuda Monetary Authority (BMA) was created in 1969, make its notes and coins prized by collectors and praised for their design.

The BMA introduced its new $2 and $5 banknotes last year—the lowest denominations of the Bermuda dollar. The currency has been pegged to the US dollar since 1972, and both circulate interchangeably. The updates, which largely keep the original appearance, will be followed by changes for $10, $20, $50, and $100 bills.

Bermuda's pink $5 bill won the Banknote of the Year award from the International Bank Note Society, which cited its high-tech security measures and "colorful, eye-pleasing design." The industry group High Security Printing Latin America named the $2 and $5 best new 2025 notes.

The $5 notes show a blue marlin, Horseshoe Bay Beach, and Somerset Bridge—a short early 1600s span known as the world's smallest drawbridge. Its wood plank, less than a meter wide, can be raised to let the masts of sailboats pass through.

The $2 bill shows a Bermuda bluebird and two historical icons of the territory's role as a Royal Navy base for centuries: the Dockyard clock tower and the statue of Neptune. Both notes show the new head of state, King Charles III, in his first appearance on the currency.

The notes also share important design elements the monetary authority calls a significant step toward greater durability and security. They are Bermuda's first printed on polymer substrate, a thin plastic that's easier to keep clean than cotton and is expected to circulate more than twice as long. In addition, visually impaired users can identify the notes by their embossed dots: They form a triangle on the $2 note and a circle on the $5 bill.

Security details include a reflective tuna with a shadow outlined on the opposite side, another tuna visible when lit from behind, and a clear window showing clouds and underwater scenes. Waves, fish, and the sun flash gold when notes are tilted. Ultraviolet light reveals hidden elements. The futuristic technology builds on a long history. F&D

JEFF KEARNS *and* **MELINDA WEIR** *are on the staff of* Finance & Development.

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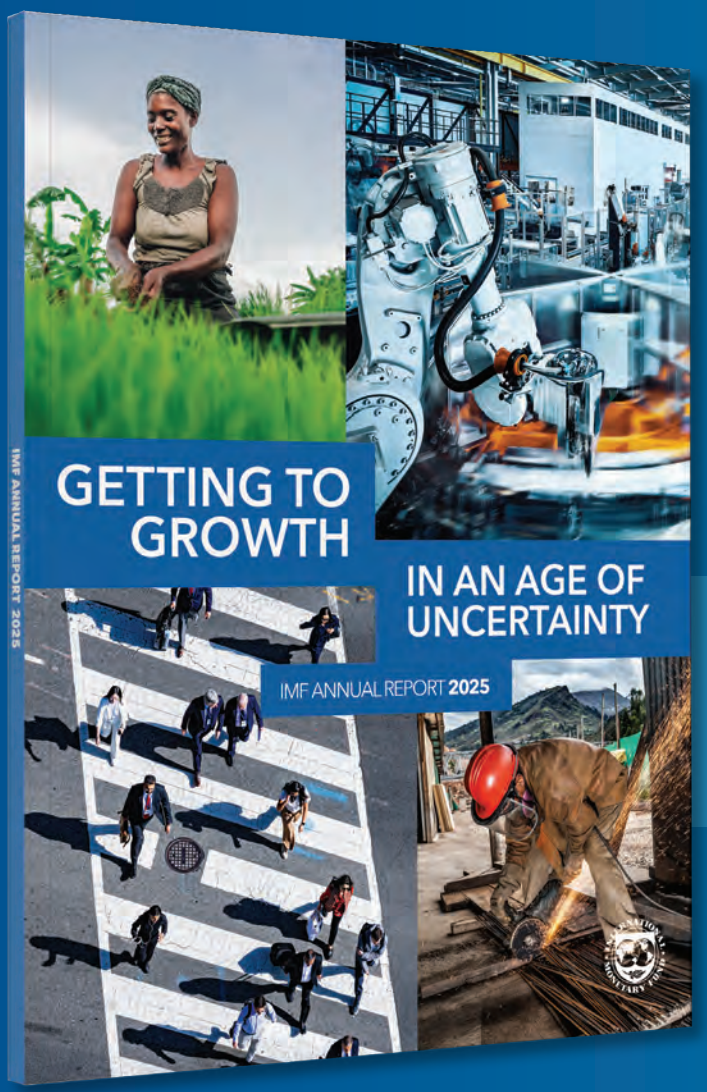
The historic clock tower, at the Royal Naval Dockyard, Bermuda.

NAVIGATING GLOBAL UNCERTAINTY THROUGH **REFORM AND UNITY**



The global economy faces rising uncertainty, especially for low-income countries. Bold domestic reforms, international cooperation, and IMF support are crucial for growth, stability, and resilience.

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