



FINTECH

NOTES

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Dong He, Annamaria Kokenyne Ivanics, Xavier Lavayssière, Inutu Lukonga, Nadine Schwarz, Nobuyasu Sugimoto, and Jeanne Verrier

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May 2022

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Note 2022/005

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At a Glance

- Capital flows can bring substantial benefits for countries but also carry risks. Capital flow management measures (CFMs) can be part of the broader policy toolkit to help countries reap the benefits of capital flows while managing the associated risks.
 - Implementation of CFMs typically requires that financial intermediaries verify the nature of transactions and the identities of transacting parties, but it is facing the rising challenge of crypto assets.
 - Crypto assets have become a significant instrument for payments and speculative investments in some countries, driven by a host of macroeconomic, institutional, and demographic factors.
 - Crypto assets can be traded pseudonymously and held without identification of the residency of the asset holder. Many crypto service providers operate across borders, making supervision and enforcement by national authorities more difficult.
 - The challenges posed by the attributes of crypto assets are compounded by gaps in the legal and regulatory frameworks, as the legal status of crypto assets is often not clear and CFM laws and regulations may not cover crypto assets.
 - This paper aims to discuss how crypto assets could impact the effectiveness of CFMs from a structural and longer-term perspective and does not analyze how crypto assets may have been used to evade country-specific sanctions or CFMs.
 - To preserve CFMs' effectiveness in an environment of growing crypto-asset use, policymakers need a multifaceted strategy. Essential elements of such a strategy include:
 - Clarifying the legal status of crypto assets and ensuring that CFM laws and regulations cover them
 - Developing for persons and entities engaged in crypto activities and services a comprehensive, consistent, and coordinated regulatory framework and applying it effectively to CFMs
 - Establishing international collaborative arrangements for supervision of crypto assets
 - Addressing data gaps and leveraging technology (*regtech* and *suptech*) to create anomaly detection models and red-flag indicators that will allow for timely risk monitoring and CFM implementation
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I. Introduction

Capital flows can bring substantial benefits for countries but also carry risks. They help smooth consumption and finance investment, diversify risks, and contribute to a more efficient allocation of resources. They can also foster economic growth by transferring technology and managerial skills, stimulating financial sector development, and generating incentives for better governance and stronger macroeconomic policies. At the same time, large and volatile flows can pose macroeconomic and financial stability risks, which can be magnified by gaps in a country's financial and institutional infrastructure. To mitigate such risks while retaining policy autonomy, many IMF member countries, particularly emerging market and developing economies with less-developed financial markets, maintain some form of restrictions on capital flows.

Capital flow management measures (CFMs) can be part of a broader policy toolkit to help countries reap the benefits of capital flows while managing the associated risks. Although the appropriate combination of policies to handle capital flows depends on country circumstances and includes macroeconomic and financial policies—such as exchange rate flexibility, foreign exchange intervention, and monetary, fiscal, and macroprudential policies—CFMs may play a useful role in managing the risks associated with large and volatile cross-border capital flows in a way that protects macroeconomic and financial stability and does not produce significant negative outward spillovers. Indeed, the IMF's "Institutional View" on Liberalization and Management of Capital Flows envisages several circumstances in which CFMs may be appropriate, even though they would rarely be the sole warranted policy response.²

Implementation of CFMs is facing the rising challenge of crypto assets. Such implementation typically requires that financial intermediaries verify the nature of transactions and the identities of transacting parties; however, crypto assets can be held and traded on a peer-to-peer (P2P) basis without any intermediaries. Even when these assets are traded and held through intermediaries such as exchanges and wallets, those intermediaries may not be regulated or obligated to comply with CFMs. Moreover, no common and consistent taxonomy of crypto assets currently exists, which leads to inconsistencies in regulations and gaps in regulatory coverage. Many crypto service providers operate across borders, making supervision and enforcement by national authorities more difficult. Importantly, most crypto assets are traded pseudonymously and held without identification of the residency of the asset holder.

Crypto assets have grown considerably in market value; they are now a significant instrument for payments and speculative investments in some countries. Globally, the scale of crypto assets remains relatively small—at \$2–\$3 trillion, or about 1 percent of total market value of financial assets (Figure 1, panel 1); however, in some countries, large segments of the population now have exposures to crypto assets (Chainalysis 2021), and trading of US dollar-linked stablecoins vis-à-vis some emerging market and developing economy currencies has soared since 2020 (Aramonte, Huang, and Schrimpf 2022). Alongside this rapid growth in scale, the market structure has been changing. Stablecoins have gained market share, and the decentralized finance ("DeFi") market has grown into a multibillion-dollar industry (Figure 1, panels 2 and 3). Although retail investors have driven much of the crypto adoption, institutional investors and corporations contributed to the 2020–21 rally, particularly in the advanced economies in North America and Europe (J.P. Morgan 2022). At the same time, the crypto-assets ecosystem has broadened and increased in complexity (Box 1).

² The Institutional View (IV) establishes a consistent framework for policy advice and, where relevant, assessments of members' capital account policies. It provides guidelines for managing capital flows, identifying circumstances when CFMs may be appropriate. It also develops a roadmap for safe capital account liberalization without presuming full liberalization to be an appropriate goal for all countries at all times; and it highlights the importance of international cooperation on capital flow policies (IMF 2012, 2016, 2018, and 2022a).

A host of macroeconomic, institutional, and demographic factors has driven the adoption of crypto assets (Appendixes 1 and 2). The ease with which payments are made using cryptos, perceived anonymity of transactions, novelty and lure of crypto asset (particularly among the young), and desire to hedge against macrofinancial risks in economies with weaker fundamentals have incentivized populations to trade or invest in crypto assets. Geographically, the top 20 countries with the highest “intensity of crypto adoption” are composed of emerging market and developing economies from Asia, Latin America, and sub-Saharan Africa (Figure 1, panel 4).³ The United States is the only advanced economy in the group (Chainalysis 2021). Econometric analysis using a panel regression model confirms the relative importance of macroeconomic and demographic factors in driving crypto-asset adoption (Appendix 2; see also Feyen, Kawashima, and Mittal 2022). Empirical results show that volatile macroeconomic conditions (such as currency depreciation and high inflation) and a younger population age structure tend to boost crypto-asset adoption.

Continued growth and adoption of crypto assets could also induce new macrofinancial risks such as “cryptoization.” Crypto assets may be regarded by some as a new asset class with distinct return and risk characteristics, creating additional incentives for investors to allocate capital across borders. If the growth of crypto assets is sustained, they could increase the transmission of financial shocks across the world and amplify global financial cycles (IMF 2020a). Crypto assets, especially stablecoins, may replace local currency as a medium of exchange, a store of value, or even a unit of account, particularly in countries plagued with high inflation and exchange rate volatility; this phenomenon is referred to as “cryptoization” (IMF 2021). These macrofinancial risks may make it necessary to adapt the design of CFMs in the digital age.

This paper aims to analyze how crypto assets could impact CFMs from a structural and longer-term perspective and to identify possible policy responses and strategies. The analysis takes as given country authorities’ preferences about the degree to which they manage their exchange regime and capital account; it neither advocates for nor discourages the use of CFMs. Rather, it leaves to future research questions on the desirability and suitability of CFMs as a tool for managing macrofinancial risks in the digital age. The analysis aims to explore possible regulatory and technological solutions that can preserve countries’ ability to implement CFMs while facilitating a predictable regulatory environment conducive to productive financial innovations. Although this paper sheds light on some of the challenges that regulators may face in applying sanctions and CFMs from a structural and longer-term perspective, it does not analyze how crypto assets may have been used to evade country-specific sanctions or CFMs.⁴

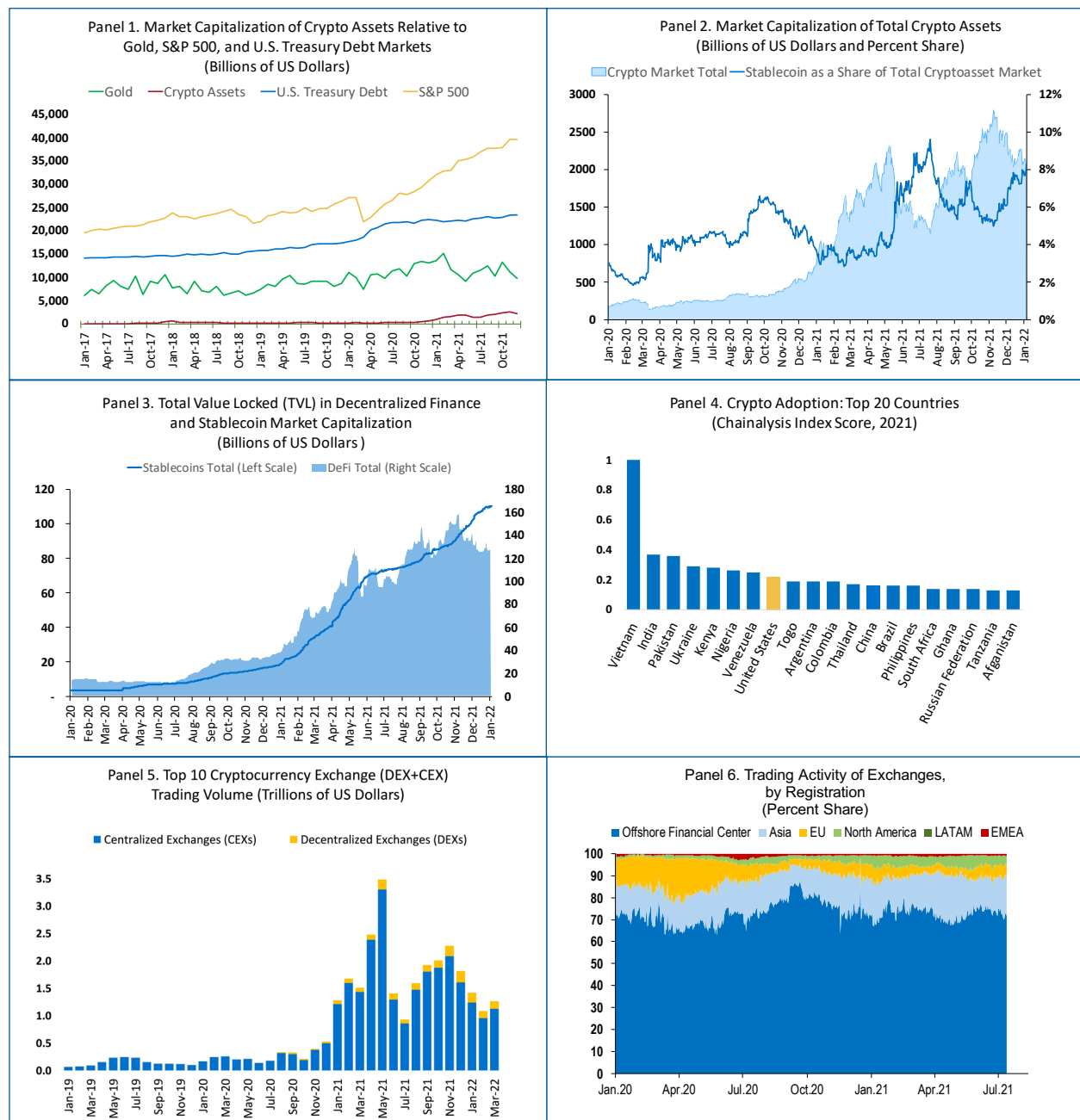
In the face of rising challenges from digitalization, central banks are exploring the pros and cons of issuing their own digital currencies. To maintain the attractiveness of central bank money as the official unit of account and the ultimate settlement asset in the digital age, central banks should continue to run effective monetary policy and strengthen monetary policy frameworks (IMF 2020a). At the same time, central banks are carefully considering the benefits of issuing central bank digital currencies (CBDCs). CBDCs could be designed to facilitate the implementation of CFMs while making cross-border payments more efficient; however, close collaboration between the issuing central bank and foreign central banks and other relevant authorities is crucial to realizing the potential efficiency gains of CBDCs while guarding against risks to the international monetary system. Those design choices and policy considerations will be discussed in a forthcoming companion paper tentatively titled “Capital Flow Management Measures in the Digital Age (II): Design Choices of CBDC.”

³ “Adoption” refers to the degree of use of crypto assets by users for transferring and storing value. The “intensity of adoption” metric measures which countries’ residents are carrying out the most crypto-asset transactions, both in terms of the number of individuals using crypto assets or carrying out more transactions per user.

⁴ Chapter 1 of the April 2022 *Global Financial Stability Report*, “Financial Stability Risks and Policy Implications of the War in Ukraine” (IMF 2022b), discusses developments in the crypto-asset markets immediately after the breakout of the war in Ukraine.

This paper is organized as follows: Section II gives a brief overview of CFMs, including their objectives, their characteristics, and recent trends. Section III demonstrates how the inherent features of crypto assets and gaps in their regulation could enable users to circumvent CFMs. Section IV proposes strategies to mitigate the challenges of crypto assets to CFMs. Section V summarizes the findings and conclusions of the study.

Figure 1. Trends in Crypto Assets



Sources: CoinGecko, Coin.dance, DeFi pulse, CryptoCompare, Federal Reserve Bank of Dallas, S&P Global Market Intelligence, the Block, Gold.org, Chainalysis (2021), and IMF staff calculations.

Note: Panel 2's bold blue line represents stablecoin as a share of the total crypto-asset market (right scale). In panel 4, blue represents emerging market and developing economies and orange represents advanced economies. Panel 5 features the trading volume of the top 10 centralized exchanges and top 10 decentralized exchanges. In panel 6, EMEA = Europe, Middle East, and Africa; EU = European Union; LATAM = Latin America.

BOX 1. The Crypto-Assets Ecosystem

Crypto assets are a type of privately issued digital asset that depends primarily on cryptography and distributed ledgers, such as blockchains, for record keeping and as part of their perceived value. Earlier types of crypto assets, such as Bitcoin, are issued in their own denomination, not a liability of any entity or backed by other assets. Stablecoins are newer types of crypto assets that are designed to maintain a stable value relative to a specific asset or a pool of assets (for example, national currencies, commodities, and other crypto assets) through holding reserves and, in some cases, via algorithms.

The crypto-asset market is supported by an infrastructure and associated entities that together make up a crypto-assets ecosystem. Entities include exchanges, wallet providers, miners, and stablecoin issuers and custodians. These entities perform key functions, including (1) operating the infrastructure; (2) storing private access keys for users; (3) issuing, creating, and destroying crypto assets; (4) validating transactions; (5) managing reserves; and (6) providing custody and trust services for reserve assets.

The functions can be performed by entities that operate on-chain or off-chain. On-chain refers to actions happening through the blockchain. In the case of public blockchains, those actions can be traced by anyone but are usually pseudonymous (that is, real identities of the transacting parties are not easily known). Off-chain refers to actions executed not through the blockchain itself but still handled by a network participant (for example, an exchange). These actions can be public, depending on the preferences of the network operator.

The entities can be centralized or decentralized. Centralized entities are typically legally incorporated and act as intermediaries by relying on private records (that is, off-chain). Decentralized entities depend primarily on code executed “on-chain” to provide their services. A key example is decentralized finance (“DeFi”) platforms. Such entities exist and operate often without legal incorporation. DeFi aims to replicate existing financial products and services, using smart contracts. Smart contracts are simply programs stored on a blockchain that run automatically when predetermined conditions are met.

Crypto exchanges play a vital role in this ecosystem. Most large crypto exchanges are centralized entities (Figure 1, panel 5). Many of them play the critical role of allowing users to access crypto assets, including stablecoins, through a large selection of sovereign currencies (serving as on- and off-ramps); others focus on intermediating trading of crypto assets. Buying and selling crypto assets directly between users, without a third party or intermediary, are called peer-to-peer, or P2P, transactions.

The ownership and use of crypto assets rely on the private keys that are stored in wallets. These wallets can be classified as hot (connected to the internet) or cold (kept offline) and hosted (or custodial) or unhosted (self-hosted or noncustodial). Unhosted wallets can make it difficult or impossible to determine who is in control of the crypto assets and the residency of the transacting parties.

Source: Adapted from IMF 2021.

II. An Overview of CFMs

CFMs are measures that are designed to limit capital flows. Examples can include administrative and price-based restrictions on capital flows—for instance, bans, limits, taxes, and reserve requirements. The definition of CFMs comprises two types of measures: (1) those affecting cross-border financial activity that discriminate based on residency and (2) those that do not discriminate by residency but are nonetheless designed to limit capital flows. The determination of whether a measure that does not discriminate based on residency constitutes a CFM requires a comprehensive evaluation of the totality of the country-specific circumstances surrounding its introduction (or its adjustment, in the case of an existing measure), regardless of the stated intent or motivation behind the adoption of the measure (Box 2).

In theory, there is no general recipe for CFMs' use and design, as the precise measures in each case will depend on country-specific characteristics and circumstances. However, the "Institutional View" proposes some general, desirable features of CFMs: they should be temporary and transparent and seek to avoid discrimination based on residency, and the least discriminatory measure that is effective should be preferred. CFMs on capital inflows should be targeted. In contrast, to be effective, CFMs on capital outflows may need to be comprehensive (as opposed to targeted) to prevent circumvention. Once introduced, the economic usefulness of maintaining CFMs should be evaluated against their costs on an ongoing basis. CFMs should be phased out when capital flow pressures or crisis circumstances abate and policy space to manage capital flows is rebuilt.

In practice, CFMs remain prevalent among IMF member countries, albeit on a reduced scale and scope. According to the Financial Account Restrictiveness Index (FARI),⁵ more than 90 percent of IMF member countries had some types of restrictions on capital flows in place at the end of 2019. Out of those member countries, almost half had only very limited restrictions, while 21 countries had extensive restrictions in place. Restriction intensity is higher in developing countries, followed by emerging market economies; advanced economies have largely liberalized their capital accounts (Figure 2).

Implementation of CFMs typically requires that financial intermediaries verify the nature of transactions and the identities of transacting parties. Countries typically start with a legal framework for foreign exchange transactions, such as a foreign exchange law, which regulates current account and capital account transactions, specifies who is responsible for enforcing the rules, establishes reporting requirements, and stipulates liability for violations of the law by individuals and legal entities. Regulated financial intermediaries—such as commercial banks, foreign exchange bureaus, brokers, and security dealers—and occasionally the central bank then ensure that only transactions permitted by regulations are authorized. The financial regulators verify—through reporting requirements, off-site monitoring, and on-site inspections—that applicable laws, regulations, and risk management requirements are observed by the regulated entities.

The verification process varies according to the nature of the CFM being enforced. The process could include checking the identities or residency status of the counterparties in a transaction; ascertaining the purpose of the transaction; proving that the foreign exchange was purchased for the stated purposes; enforcing limits set by the foreign exchange regulations; and verifying that authorization for the transaction was obtained from the relevant authority, such as a foreign exchange license or permit. The process may stipulate documentation needed to prove that the foreign exchange purchased and/or transferred is for the stated purpose and in the stated amount.

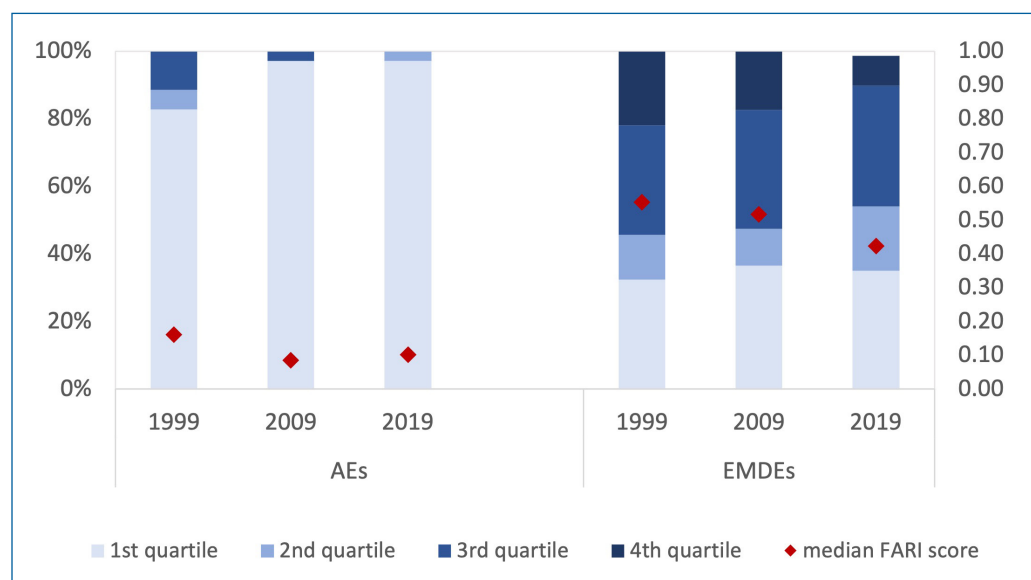
⁵ The FARI is constructed using data from the *IMF Annual Report on Exchange Arrangements and Exchange Restrictions* (Baba and others, forthcoming).

BOX 2. Types of CFMs and Their Objectives

- Residency-based CFMs comprise measures that set limits and restrictions on transactions between residents and nonresidents, such as asset (for example, residential property) sales to nonresidents, or on residents opening foreign bank accounts or making investments overseas.
- Administrative or direct restrictions usually involve either outright prohibitions or limits on, or an (often discretionary) approval procedure for cross-border transactions.
- Indirect or market-based restrictions (for example, reserve requirements, and taxes) discourage capital flows by making them more costly.
- CFMs that are applied at the aggregate level during inflow surges aim to limit the volume of capital inflows and avoid overwhelming the economy's capacity to productively absorb the flows in order to safeguard macroeconomic and financial stability.
- CFMs could also be applied on a sectoral basis. Surges in capital inflows to specific sectors, such as housing, can lead to financial vulnerabilities even if the aggregate volume of capital flows does not immediately cause stability concerns.
- CFMs on capital outflows introduced in crisis, near-crisis, or imminent crisis circumstances typically involve temporary measures aimed to preserve reserves and attenuate exchange rate pressures.
- In some cases, CFMs could also be applied for a longer period to offer breathing room while appropriate macroeconomic adjustments are undertaken.

Figure 2. Financial Account Restrictiveness Index (FARI), by Income Group and Year

Percentage of Countries in Each Quartile (Left Axis) and Median Score (Right Axis)



Sources: Baba and others (forthcoming), authors' calculations.

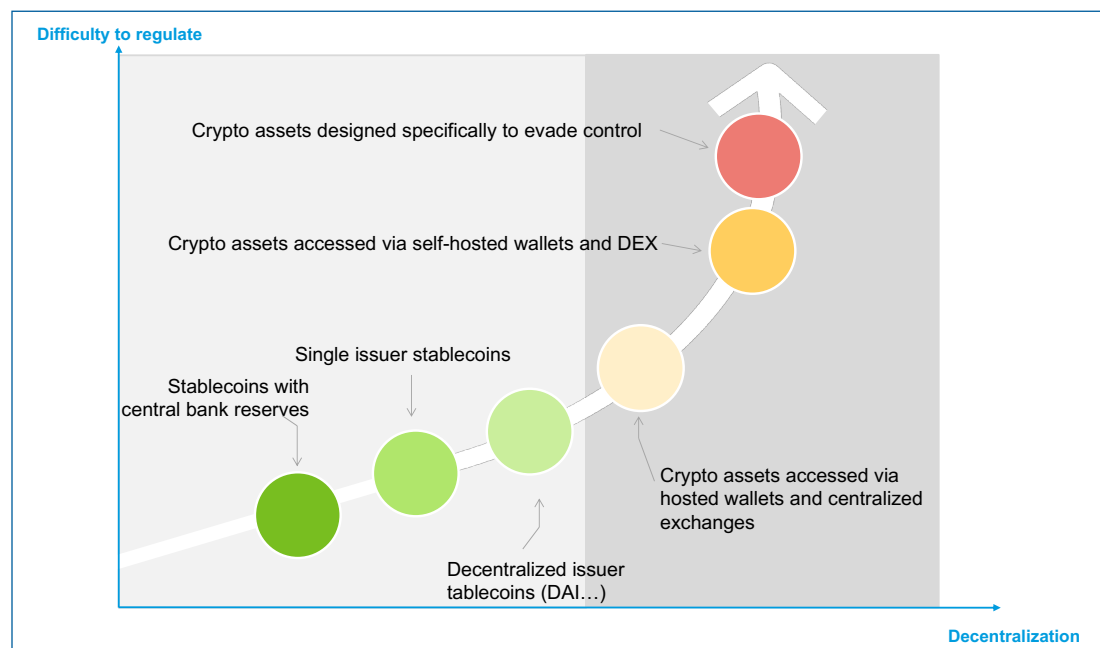
Note: Higher values represent more restrictions. AEs = advanced economies, EMDEs = emerging market and developing economies

III. How Crypto Assets Can Be Used to Circumvent CFMs

Crypto assets can challenge the implementation of CFMs in the following ways. First, their legal status is often ambiguous, and they frequently operate in a regulatory vacuum. As a result, they may not be covered by existing foreign exchange and CFM laws and regulations,⁶ and the regulatory authorities may not have clearly defined mandates and powers to control the use of crypto assets. Second, identities and residency of crypto asset holders or end users are not easily known. It could be difficult to prosecute or sanction them for violations of laws and regulations.⁷ And third, crypto-asset trades may not involve any intermediaries or service providers who can be held responsible to comply with foreign exchange and CFM laws and regulations and who can verify the identities of transacting parties and the nature of transactions.

The crypto ecosystem’s degree of decentralization significantly affects how difficult it will be for country authorities to enforce CFMs. Figure 3 shows how the more decentralized the ecosystem is, the more difficult it is to regulate. A multifaceted concept, decentralization relates to not only the governance structure for the creation and destruction of crypto assets but also the role of service providers such as exchanges and custodians. In addition, decentralization reflects the borderless nature of Distributed Ledger Technology (DLT) networks, which are not demarcated by national and geographical boundaries. Decentralization has implications for the amount of information such as the identity and metadata of transactions that can be generated and made available to participants in the network, to the public, or shared with authorities.

Figure 3. Decentralization and Ability to Regulate



Source: IMF staff.

⁶ “CFM laws and regulations” refer to any law or regulation that establishes a CFM.

⁷ For instance, if the CFM involves taxation, a tax authority can neither detect nor sanction tax evasion if it does not know who has entered a taxable transaction.

A. “What Kind of Creature Are They?”

Crypto assets operate in a legal vacuum in many countries, and there is no common or consistent taxonomy for crypto assets both within and across countries. Currently, some regulatory agencies classify crypto assets as securities, commodities, or monetary instruments for payments. In some cases, crypto assets with similar characteristics are treated differently across countries, and international standard setters have not developed a common taxonomy for crypto assets. This lack of a shared categorization leads to inconsistencies in regulations, incomplete regulatory coverage, and regulatory arbitrage.

Because the legal status of crypto assets is not clear and it is difficult to define their nature, existing laws and regulations on foreign exchange and CFMs may not adequately capture them. Under the International Financial Reporting Standards, crypto assets are classified as nonfinancial assets. IMF statistics currently also classify unbacked crypto assets as nonfinancial assets given their lack of counterparty liability.⁸ In some circumstances, this classification could put crypto assets outside the mandate of the authorities responsible for enforcing CFMs, if those mandates cover only financial assets. In addition, given that crypto assets are rarely regarded as legal tender globally,⁹ they are often not covered by the definition of foreign currency for the purposes of foreign exchange laws and regulations. Recently, however, a few countries (for example, South Africa) have initiated the process of amending their regulations to bring crypto assets and crypto asset services providers within the regulatory perimeter of foreign exchange legislation.

In the absence of clear legal status of crypto assets, it is difficult to develop effective regulatory frameworks for them or to apply CFM regulations. A few jurisdictions (such as EU, Japan, and Singapore) have issued or proposed bespoke regulations for crypto assets but, for most jurisdictions, regulatory responses have taken the form of public warnings of inherent risks, prohibiting banks and other regulated financial intermediaries from providing services for crypto assets,¹⁰ applying existing regulations to selected segments of the crypto-assets ecosystem such as exchanges, and outright bans. Importantly, most regulatory responses do not aim at capital flow management. Among the major emerging market and developing economies, Argentina and South Africa stand out for explicitly citing CFMs as an objective of crypto-asset regulation.¹¹

B. Who Are the Asset Holders and Where Are They Located?

Crypto assets can be designed along a spectrum of anonymity and privacy,¹² masking to various degrees the identities of transacting parties and the nature of transactions. Crypto assets like Bitcoin are pseudonymous: each user has one or several public addresses, but the user’s real identity is not known or disclosed. Theoretically, the public addresses could be traced back to the currency exchange account or other operations and, by proxy, an actual identity. But identifying whether different crypto-asset wallets

⁸ This classification might be revised in the future if, for example, crypto assets were to become widely accepted as a medium of exchange; see “Treatment of Crypto Assets in Macroeconomic Statistics,” IMF 2019. Because stablecoins backed by fiat currencies and CBDCs have corresponding liabilities, they are classified as financial assets.

⁹ The only known cases are El Salvador and the Central African Republic. In concluding the 2021 Article IV Consultation with El Salvador, Executive Directors of the IMF stressed that there are large risks associated with the use of Bitcoin on financial stability, financial integrity, and consumer protection, as well as the associated fiscal contingent liabilities. They urged the El Salvador authorities to narrow the scope of the Bitcoin law by removing Bitcoin’s legal tender status.

¹⁰ Regulators in several jurisdictions (such as Nigeria, South Africa, Kenya, Zimbabwe) have directed commercial banks to avoid processing transactions involving trade in crypto assets, thereby severing potential links with financial intermediaries.

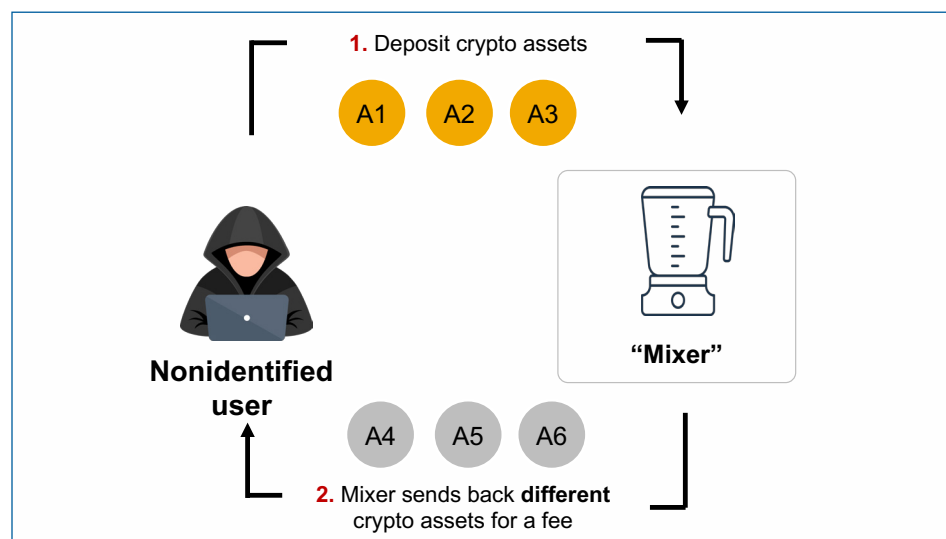
¹¹ In South Africa, the Exchange Control Regulation 10(1)(c) prohibits transactions where capital or the right to capital is, without permission from National Treasury, directly or indirectly exported from South Africa. This includes transactions where individuals purchase crypto assets in South Africa and use them to externalize “any right to capital.”

¹² Transactions are *anonymous* when the identity of the transacting parties or the users is not revealed or is unknowable. Transactions are *private* if transaction-relevant metadata (for example, the amount and the timing of the transaction) is not revealed.

belong to the same individual (or institution) is still a difficult task, and the process is complex and costly (ECB 2019; Houben and Snyers 2018; Schwarz and others 2021). Moreover, some crypto assets such as Zcash and Monero have been designed to offer enhanced anonymity and privacy by concealing the identity of transacting parties and other specifics such as the value of transactions.

New crypto-asset services and products are being continually developed to offer higher degrees of anonymity and more privacy to users. When crypto-asset services are web-based, common privacy techniques are used to conceal personal data such as the IP address.¹³ When interacting with the blockchain directly by launching a node or using unhosted wallets, advanced users can have better control of their data. A common strategy consists of unlinking a new address from the past transactions history by using mixers and complex layering (Figure 4). The use of mixers creates untraceable transactions by mixing the transactions of several participants and redistributing the funds to their original owners via new addresses.¹⁴ Moreover, technological advances and new services such as the Lightning Network provide additional privacy with little information appearing on-chain. In lightning networks, transactions are anonymized within a payment channel: only the total transfer of value, but not the individual transactions within it, is visible.

Figure 4. How Mixers Create Untraceable Transactions



Source: IMF staff.

Note: Funds from different owners are in addresses A1, A2, A3. Through the mixing transaction they are shuffled in different addresses. An external observer cannot link the new addresses to their prior owners

Available data on crypto assets is inadequate for countries to monitor transactions that might be relevant for CFMs. Countries that monitor crypto assets often rely on publicly available third-party aggregated data,¹⁵ but the data are not sufficiently granular for CFM purposes, which may require very detailed

¹³ Common privacy techniques include Virtual Private Network (VPN), Tor, and privacy settings of most modern browsers. Because VPNs communicate with the service via an intermediary server, they help hide the actual IP address. Tor is a P2P network where information is encrypted several times, revealing to each intermediary only the following layer until it reaches the recipient.

¹⁴ In 2020 Twitter accounts of celebrities and politicians were hacked and Bitcoin from members of the public were stolen. Hackers then allegedly laundered the funds through ChipMixer, a major Bitcoin mixing service, and Wasabi wallet, among others.

¹⁵ Aggregated information is available on public websites, which can provide, for instance, metrics for crypto-asset networks, estimates of market capitalization, prices and trading volumes on crypto exchanges, and the amount of funds raised when a crypto asset is offered to the public in "initial coin offerings."

data at the individual transaction level. The sources differ in the methodologies they use, completeness of coverage, and access to the underlying raw information. There is also no reliable way to estimate the stock or flow of crypto assets based on country residency of holder (IMF 2021). This difficulty is due, in part, to a lack of regulation of the service providers along the crypto-asset value chain; its unregulated activity in a borderless environment often hinders access to reliable information.

The lack of a physical location of crypto-asset ledgers makes determining the residency of the transacting parties and the applicable laws more difficult. Service providers, both exchanges and wallet providers, can span multiple geographies and may not be headquartered in clearly identified jurisdictions. They may not be obligated to determine the residency of parties to crypto transactions or the wallet holders, who can access wallets, exchanges, trading platforms, or marketplaces from anywhere in the world through the internet. Traditional regulatory and policy strategies may not, therefore, be adequately applied to oversee markets for crypto assets or market infrastructures that interact with crypto assets in transfer, trading, and settlement.

C. Can Intermediaries Be Held Responsible for Compliance?

Identifying entities in the crypto ecosystem that can be held responsible for regulatory compliance could be difficult. Crypto assets, such as Bitcoin, are created, distributed, traded, and stored using a decentralized system that, in principle, eliminates the need for an intermediary to process, validate, or authenticate transactions. Transactions on decentralized exchanges (DEXs) are processed using smart contracts that allow applications to function based on algorithms without the need for an intermediary. Usually when unhosted wallets are used, no third-party service provider or intermediary is holding assets on behalf of the clients. Although most transactions take place through hosted wallets and centralized exchanges, the use of unhosted wallets and decentralized apps and platforms has become more popular (Figure 1, panel 5). It is, in these cases, difficult to prescribe and enforce reporting and verification requirements.

Crypto exchanges and other service providers are not subject to consistent licensing regimes across the world, which may lead to regulatory arbitrage. Crypto exchanges and platforms are the gateway through which crypto assets can be transferred across borders. In many countries, these service providers are regulated only for compliance with anti-money laundering and combating the financing of terrorism (AML/CFT) requirements that focus on identifying illicit activities. In some countries, exchanges that trade crypto assets such as Bitcoin and Ether are either not regulated or are regulated as money transfer services that are subject only to AML/CFT requirements.¹⁶ The gaps in regulatory frameworks for crypto-asset service providers and differences in national approaches could lead to regulatory arbitrage. Importantly, many crypto service providers operate across borders and are often headquartered in jurisdictions with favorable regulatory, tax, and legal frameworks (Figure 1, panel 6; IMF 2021). Through the internet, those service providers could have customers anywhere in the world and do not necessarily need to be domiciled in the same jurisdiction as their customers, thereby compromising the ability of local authorities to enforce CFMs.

D. Using Crypto Assets to Circumvent CFMs: An Illustration of Mechanisms

Crypto assets and the associated ecosystem can be used to circumvent CFMs in various ways. Although the nature of CFMs varies considerably across countries, CFM objectives can be classified into two broad categories: (1) to restrict or limit the exchange of a local currency into foreign currencies, or the conversion

¹⁶ In the United States, Bitcoin is classified as a commodity and the Commodity Futures Trading Commission (CFTC) regulates Bitcoin-based derivatives, such as Bitcoin futures and swaps, as well as the platforms that trade such derivatives, but the CFTC has only very limited jurisdiction of the underlying cash market, including the buying and selling of Bitcoin where the activity is concentrated.

of foreign currencies into the local currency, and subsequent transfer of capital across borders and (2) to restrict or limit the terms and conditions of holding, trading, and transferring assets across borders. Crypto assets may enable these restrictions or limits to be bypassed, as illustrated in the following two examples. In addition, mining for energy-intensive blockchains like Bitcoin can allow countries to monetize energy resources. Bitcoin rewards and fees paid to miners could be a source of capital outflow.¹⁷

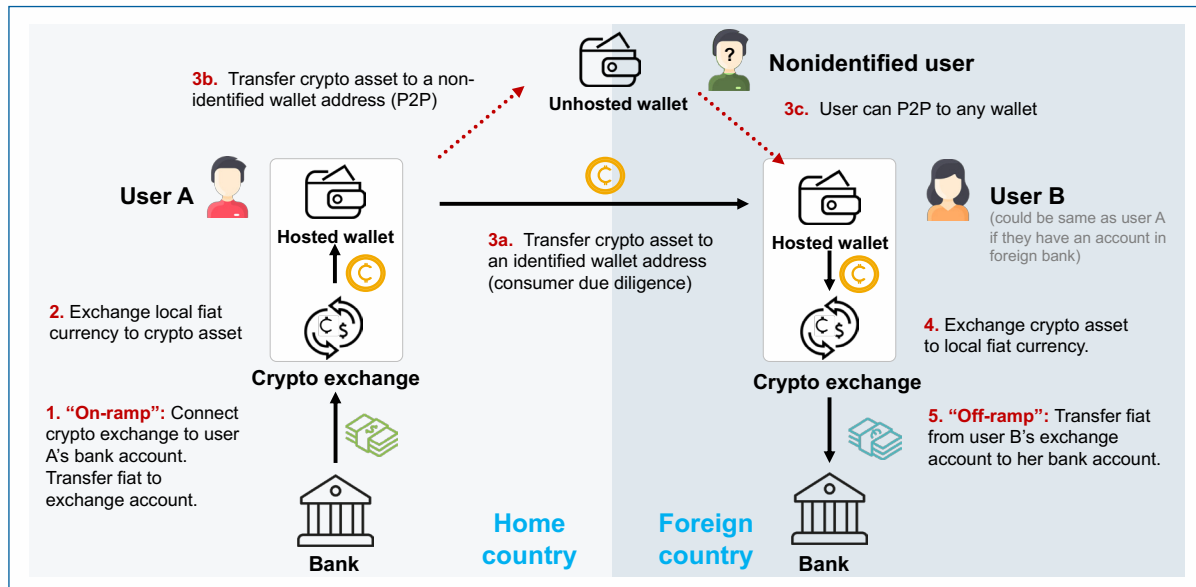
Crypto assets can be used as a vehicle to circumvent controls on capital outflows. Figure 5 shows a user who exchanges local fiat money into a crypto asset, such as Bitcoin, or a stablecoin denominated in a foreign reserve currency, via digital wallets and services provided by crypto exchanges or platforms (on- and off-ramp) through apps on mobile devices or other means such as automated teller machines. The crypto asset is then transferred across borders over a secure network and exchanged into foreign fiat money such as the US dollar, as desired, using either local or global exchanges or trading platforms (another on- and off-ramp). The proceeds can be either deposited to the user's foreign bank account or invested in other assets. The crypto exchanges may need to have a conventional bank account to receive or pay out local currency proceeds, but the central bank and the foreign exchange regulator do not necessarily have the power or sufficient information to block such account services. It is also possible for the crypto-asset exchanges to hold local currency proceeds through mobile money accounts or stablecoins instead of a conventional bank account, particularly for smaller transactions.

DeFi platforms can potentially be used to circumvent certain types of CFMs, such as those that limit or tax foreign exchange borrowing and lending. Crypto assets can be used to replicate exposure to certain assets without directly participating in the regulated markets. A user can use tokenized local assets as collateral to borrow through DeFi platforms a stablecoin pegged to a foreign fiat currency to replicate foreign exchange borrowing that otherwise may be constrained by CFMs.¹⁸ Authorities could find it difficult to detect and monitor these types of transactions or enforce compliance with CFM rules. DeFi charges substantially lower margins compared with those of traditional financial institutions, offering favorable prices to borrowers, which can be particularly attractive to those whose local currency interest rates are much higher than international interest rates. Although cost efficient, DeFi is subject to significant market and liquidity risks (IMF 2022c). When the collateral shortfall is large during periods of high market volatility, forced liquidations of collaterals can lead to volatile capital flows and exacerbate exchange rate pressures on the local currency.

¹⁷ The overall size of mining revenues suggests that the magnitude of such outflows is relatively contained. For example, the monthly average of all Bitcoin mining revenues in 2021 was around \$1.4 billion (IMF 2022b).

¹⁸ DeFi lending platform offers services where investors with crypto assets can borrow other cryptos including stablecoins. Although the most typical strategy is to borrow stablecoins against volatile collateral such as Ether and Wrapped-Bitcoin, collaterals used in DeFi borrowing could potentially be expanded to other tokenized assets. For example, MakerDAO, one of the largest DeFi platforms, has reportedly started offering mortgage loans against tokenized real estate assets: <https://www.coindesk.com/markets/2021/04/21/maker-price-passes-4k-for-first-time-as-makerdao-brings-real-estate-to-defi>.

Figure 5. Crypto Assets as Vehicles to Circumvent Capital Outflow Restrictions



Source: IMF staff.

IV. Strategies to Preserve the Effectiveness of CFMs

To preserve the effectiveness of CFMs in an environment of growing crypto-asset use, policymakers need a multifaceted strategy. Essential elements of such a strategy include developing a comprehensive, consistent, and coordinated regulatory approach to crypto assets¹⁹ and applying it effectively to CFMs; establishing international collaborative arrangements for implementation; addressing data gaps and leveraging technology (regtech and suptech) to allow for timely risk monitoring; and striking a good balance between ex ante and ex post enforcement.

A. Strengthening Legal and Regulatory Frameworks

Regulatory and supervisory frameworks for crypto assets will need strengthening in order to minimize regulatory arbitrage, which is a key channel for circumventing CFMs. Efforts include clarifying the legal framework and reviewing CFM regulations against challenges of crypto assets; developing a consistent taxonomy of crypto assets; tailoring regulatory requirements to the main use cases of crypto assets; setting up a licensing regime for crypto service providers; giving clear guidance to regulated financial institutions about their exposure to and engagement with crypto assets; and enhancing coordination and information sharing among relevant authorities (both domestic and abroad).

Clarity is needed on the legal status of various crypto assets, the perimeter of permissible activities, and mandates of the various regulatory bodies. It is important that the law clarify the legal status of crypto assets, which would determine the legal regime applicable to transactions with those assets. Such clarification may need to take into account—and reflect in the legal framework—crypto assets' unique features. Further, the law should clearly establish the rights and obligations of market participants engaging in transactions with crypto assets as well as the mandates of the various regulatory bodies to ensure that all relevant segments of the crypto ecosystem are captured by regulation. Inconsistent approaches may create regulatory and policy loopholes that could be exploited by the entities these regulations target.

A consistent taxonomy of crypto assets is critical for establishing coherent and consistent legal and regulatory frameworks, both at home and abroad. A uniform taxonomy will help promote a level playing field along the activity and risk spectrum so that similar products are regulated in a similar manner across countries—and that data collected are comparable for understanding market developments and monitoring risks. Consistency in the classification of crypto assets and regulations across jurisdictions would help reduce regulatory arbitrage opportunities.

Regulatory requirements and mandates should align with the use cases of crypto assets. Crypto assets differ in structure, trading arrangements, and use cases; thus, they do not fall neatly into existing regulatory frameworks. A variety of laws under the purview of different regulatory bodies may apply, so it is critical that regulating bodies' mandates be clearly stipulated to avoid overlaps or gaps in authority. To avoid regulatory arbitrage, a globally consistent and cross-sectoral approach to crypto-asset regulation is important. Such an approach should be risk based, supporting a level playing field along the activity and risk spectrum. For example, crypto services and products for investments should be overseen by the securities regulator; those for payments should be overseen by the central bank or another payments oversight authority. An effective coordination mechanism must be established to facilitate overseers of crypto assets—from central

¹⁹ The elements of such an approach are further discussed in Bains and Sugimoto (forthcoming).

banks to securities and banking regulators—to address the various risks arising from different and changing use cases of crypto assets.

Laws and regulations for foreign exchange and CFMs should be reviewed and amended, if necessary, to cover crypto assets—even if they are not classified as financial assets or foreign currency. In some countries, crypto assets fall outside the coverage of the existing foreign exchange and securities laws and, by extension, outside the related mandates of the central bank and other regulatory authorities. Similarly, crypto assets may not be classified as “foreign currency” and thus existing exchange and capital control regulations may not cover them. These loopholes should be closed. In addition, crypto-asset exchanges and wallet providers that offer fiat-to-crypto on- and off-ramp as well as transfer between parties should be brought into the regulatory umbrella and subject to the equivalent framework applicable to fiat currencies.

Consistent and effective implementation of the existing Financial Action Task Force (FATF) standards is key to mitigating financial integrity risks that might give rise to illicit capital flows. The FATF recommendations for AML/CFT applicable to virtual assets and virtual asset service providers (VASPs)²⁰ lay out the measures to be taken to minimize misuse of crypto assets by criminals; such misuse could give rise to illicit capital flows. These measures include, among others, requirements on VASPs related to customer due diligence (CDD), record keeping, transaction monitoring, and reporting of suspicious transactions. The parties who maintain control or sufficient influence in DeFi arrangements (such as the creators, owners, operators, or other persons) qualify as VASPs and should likewise be subject to AML/CFT regulation. The FATF standards do not apply to P2P transactions directly; however, the risks in the P2P context should nevertheless be monitored and mitigated.

Clear guidance and requirements should be given to regulated financial institutions about their exposure to crypto assets and engagement with crypto service providers. The appropriate banking, securities, insurance, and pension regulators should stipulate the capital and liquidity requirements and limits on exposure to different types of crypto assets and require investor suitability and risk assessments.²¹ If the regulated entities provide custody services, requirements should be clarified to address the risks arising from those functions.

Rules developed for existing financial service providers should proportionately apply to entities engaged in services of crypto assets. The licensing criteria and reporting requirements should be clearly articulated, the authorities responsible for licensing and oversight unambiguously designated, and the coordination mechanism among regulatory bodies well defined. Sanctions for noncompliance with the rules and enforcement mechanism should be clearly established. In terms of reporting requirements, crypto-asset exchanges that enable trades between crypto assets and fiat currencies can identify parties to a transaction when onboarding new customers, performing CDD checks, and making a transaction. Further consideration is needed on how to apply effective regulation to DeFi platforms and P2P transactions. Because DeFi platforms have groups of stakeholders that take and implement decisions, these groups—and the governance protocols on which their interactions are based—are the natural entry points for regulators (Aramonte, Huang, and Schrimpf 2021; IMF 2022c).

The borderless nature of the crypto-assets ecosystem limits the effectiveness of national approaches to regulation. For instance, crypto-asset service providers have incentives to register in “regulatory friendly” locations from which they provide platforms for crypto-asset transactions to a global market. Jurisdictions wishing to apply CFMs may not have sufficient information or powers to enforce restrictions and need to cooperate with crypto exchanges’ home regulators. International collaboration and information sharing

²⁰ “Virtual assets and *virtual asset service providers* (VASPs) are defined terms in FATF standard, and cover products and activities similar to those referred to as *crypto assets* and *crypto service providers* in this paper.

²¹ In some countries (for example., China, Kenya) crypto-asset service providers are perceived as “risky business” and denied access to bank accounts and other regular financial services.

are required to minimize regulatory arbitrage and ensure the continued effectiveness of CFMs. A comprehensive, consistent, and coordinated regulatory approach to crypto assets is a prerequisite for effective international collaboration, but it may not be sufficient.

Mechanisms may need to be developed for domestic authorities to authorize and regulate crypto service providers legally domiciled in foreign jurisdictions. Under the FATF recommendations, VASPs should be registered or licensed at least in the jurisdiction where they are created (as legal persons) or where the place of business is located (for natural persons) and supervised for AML/CFT purposes. The borderless nature of crypto assets means that customers in a given country can easily access services of a service provider not authorized by that country. Countries may, therefore, need to develop ways to authorize and regulate providers that offer services in their jurisdiction, even if the providers are legally domiciled elsewhere. Recent regulatory actions issued by Canada, Italy, Japan, Lithuania, Singapore, Thailand, and the UK against Binance suggest that it may be feasible to have some regulatory control over unauthorized service providers located overseas.²² Enforcement, however, may be challenging for regulators with capacity or technological constraints.

New international collaborative arrangements should be explored and established. Existing cooperation protocols among regulatory authorities in different jurisdictions—such as bilateral memoranda of understanding (MoUs), multilateral MoUs, and supervisory colleges for systemically important financial institutions—are well established but have been mainly designed for prudential and conduct purposes. In addition, although capital flows may occur between advanced economies, offshore financial centers, and emerging market and developing economies, most advanced economies and offshore financial centers have liberalized capital flows and CFMs are not typically within the mandates of financial regulators in those economies. Thus, the home regulators may not have the powers, tools, or interest in imposing CFMs. Existing regulatory cooperation protocols could be adapted for the purpose of implementing crypto-related CFMs.²³ Additional collaborative arrangements for CFM purposes, such as bilateral MoUs, may be necessary.

B. Leveraging Regtech and Suptech for CFM

Regtech and suptech can be deployed to enhance regulation and supervision of crypto assets.²⁴ Regtech solutions are used for a broad range of tasks, including identity management and transaction monitoring, such as gathering and analyzing customer and transaction data, and identifying noncompliant transactions based on automated triggers. Financial institutions have been increasingly using advanced analytics and artificial intelligence models in their operations. Although most of the current mature applications address forecasting or automating backoffice operations, they have been used for monitoring payments transactions

²² The UK Financial Conduct Authority (FCA) issued a public warning in June 2021 that “Binance Markets Limited is not currently permitted to undertake any regulated activities without the prior written consent of the FCA. No other entity in the Binance Group holds any form of UK authorisation, registration or licence to conduct regulated activity in the UK.”

²³ An example of regulatory cooperation relating to overseas online financial service provision is as follows: the State Administration of Foreign Exchange of China informed the Australian Securities and Investments Commission (ASIC) that “some online platforms are illegally engaged in forex margin trading activities.” Subsequently, in April 2019, ASIC issued a public notice that “Australian financial service (AFS) licensees that offer OTC [Over-the-Counter] derivatives to retail investors located in some overseas jurisdictions may be providing unlicensed or unauthorised services in those jurisdictions... AFS licensees are on notice that in addition to overseas consequences of potential breaches of overseas law, ASIC will consider whether breaching overseas law is consistent with obligations under Australian law to provide services ‘efficiently, honestly and fairly.’ ASIC will also consider whether AFS licensees are making misleading or deceptive statements about the scope or application or effect of an AFS license.”

²⁴ Regtech is the use of technology by financial institutions to enhance risk management and regulatory compliance. Suptech is the application of technological tools by supervisors and regulators to assess compliance by financial firms.

(FSB 2020).²⁵ Many of these capabilities can, therefore, be adapted and tailored to the specifics of CFM. For emerging market and developing economies, however, resource and skill gaps may pose a challenge to the effective adoption of regtech and supotech to support CFM implementation.

Data on the identity of wallet owners can enhance the effectiveness of regtech and supotech. Most blockchain networks facilitate pseudonymous transactions. This means that while the movement of funds and data is transparent in public blockchains, the real-world identities of the owners of assets and of transacting parties may not be known unless appropriate CDD has been carried out—in these instances, the service providers should have identified the owner of the assets and transacting parties. Pursuant to the “travel rule” under the FATF standard, part of the information on the originator and beneficiary parties to a transaction should “accompany” the assets transferred between two VASPs. Countries that are implementing appropriate AML/CFT measures, therefore, would have the basic infrastructure for collecting data and monitoring transactions. However, information collected and monitored pursuant to AML/CFT laws and regulations serves a different purpose—namely, to prevent and combat financial crime—and may not be allowed to be used or may be unsuitable for the implementation of CFMs without changes to the legal framework.

Blockchain analysis can be useful, but significant challenges will need to be overcome. Blockchain analysis involves using the transparency and immutability of the blockchain to link certain wallets, but its use is still at an early stage and limited to select areas—most notably, illicit transactions. Importantly, such analytics relies on effective geolocation and the use of on-chain transactions, both of which can be challenging where the use of geo-blockers (like VPNs), second-layer protocols (such as the Lightning Network), and off-chain transactions (such as movements within centralized exchanges) are used. DEX, privacy tokens, and unhosted wallets present unique additional challenges that warrant attention. Further, because DEXs are distributed open-source platforms that operate without intermediaries, software developers will need to program DEXs’ regulatory compliance into the source code. To manage the risks generated by protocol developers, measures could include public-private collaboration on code regulation through either ex ante provision of guidelines on operation and risk parameters or ex post measures of code reviews and audits (IMF 2022c).

Regulators can also create anomaly-detection indicators and models for CFM purposes that are similar to those used for AML/CFT purposes. FATF has developed anomaly-detection models and red-flag indicators to help detect illicit transactions and strengthen compliance with AML/CFT obligations. Red flags include, among others, practices like structuring transactions in small amounts below stipulated thresholds; simultaneously transferring crypto assets to multiple service providers (particularly those registered or operating in other jurisdictions); using multiple accounts without logical business explanation; creating separate accounts under different names; or using privacy coins or mixers and tumblers. The anomaly-detection models can be adapted to help monitor compliance with CFMs, such as detecting large volumes of cross-border P2P frequent transactions that exceed the total amount of allowed capital flows or tracking multiple senders and recipients.

A concerted effort is needed to develop data capabilities and to strengthen the availability, quality, and consistency of data. Data on crypto transactions is currently unreliable, incomplete, or fragmented. Data sharing by entities such as issuers, wallets, and exchanges is mostly voluntary and lacks uniformity (IMF 2021). For most jurisdictions, data reporting by crypto-asset service providers is required for AML/CFT purposes only. Authorities could consider augmenting data from their own monitoring tools with the use of blockchain analytics and the work of private-sector participants. Moreover, it is critically important that the authorities establish cross-border cooperation to share the relevant data between home and host jurisdictions.

²⁵ People’s Bank of China, for instance, has leveraged artificial intelligence, Big Data, and other technologies to develop a supervision information system for payment transactions. The use of regtech has also advanced in financial centers in Europe, including France, Germany, and Luxembourg (EBA 2021), and in other jurisdictions such as Australia, Canada, Hong Kong SAR, Japan, and Singapore (Schizas and others 2019).

V. Conclusions

Crypto assets have grown considerably in the past decade. Adoption of crypto assets across the globe has been driven by a host of technological, macroeconomic, institutional, and demographic factors. As such, the demand for crypto assets could be sustained. A cross-country review and econometric analysis using a panel regression model confirm the relative importance of macroeconomic and demographic factors in driving crypto-asset adoption. These results suggest that crypto assets have served as a perceived hedging instrument against exchange rate and inflation risks—particularly in countries with weaker economic fundamentals—and are more appealing to countries with younger populations.

Crypto assets could pose significant macro-financial risks, including for the implementation of CFMs. The emergence of crypto assets and their associated ecosystems as new instruments, new service providers, and new payment rails could challenge the authorities' ability to monitor capital flows and enforce CFMs through regulated intermediaries. The decentralized, borderless, and pseudonymous characteristics of crypto assets make them potentially attractive instruments to circumvent CFMs. Such specific characteristics are compounded by gaps in the legal and regulatory frameworks; these gaps result in key crypto-related activities and service providers lying outside the regulatory perimeter. Existing foreign exchange and CFM laws and regulations typically do not cover crypto assets, and coordination and information sharing arrangements among relevant authorities, both at home and abroad, are lacking.

To preserve the effectiveness of CFMs against crypto-related challenges, policymakers will need to consider a multifaceted strategy. Essential elements of such a strategy include devising a comprehensive, consistent, and coordinated regulatory approach to crypto assets and applying it effectively to CFMs; establishing international collaborative arrangements for implementation; addressing data gaps and leveraging technology (regtech and suptech) to create anomaly-detection models and red-flag indicators, to allow for timely risk monitoring; and striking a good balance between ex ante and ex post enforcement.

The policy strategy should give priority to developing a fit-for-purpose legal and regulatory framework for crypto assets. This effort will require clarifying the legal status of crypto assets and reviewing CFM regulations against challenges of crypto assets; developing a consistent taxonomy of crypto assets; bringing crypto-asset service providers under the regulatory umbrella; implementing AML/CFT standards; and developing mechanisms to regulate and supervise service providers legally domiciled outside jurisdictions where services are provided. Compliance by regulated financial intermediaries and service providers as gatekeepers between traditional financial systems and the crypto ecosystem is likely to be the most effective policy lever. Further consideration is needed on how to apply effective regulation to DeFi platforms and P2P transactions; the natural entry points for regulators would be the groups of stakeholders that take and implement decisions on DeFi platforms.

A concerted effort will be needed to improve the availability, quality, and consistency of data, to monitor risks and to leverage regtech and suptech for CFM implementation. Legal requirements and mechanisms for collecting and sharing data with the relevant national supervisory agencies need to be developed and legislated. Although blockchain analysis can be useful, help link certain wallets, and detect patterns of anomalies, significant challenges will need to be overcome in order to identify asset holders and their residency. Techniques modeled after the FATF anomaly-detection indicators could be explored for use in monitoring compliance with CFMs. Although AML/CFT compliance models may have different objectives from those of CFMs, the techniques can be adapted to help monitor compliance with CFMs, such as detecting large volume cross-border P2P frequent transactions or tracking multiple senders and recipients. More broadly, challenges from crypto assets may imply the need by the regulatory authorities to find in CFM enforcement the right balance between ex ante approval and ex post monitoring.

However, even with such a multifaceted strategy in place, the challenges crypto assets pose to CFMs will likely persist, especially in emerging market and developing economies where regulatory and technological capacity constraints are significant. Some crypto assets and related activities may go underground and attempt to stay under the radar of regulators, while new innovations may be adopted to circumvent regulatory actions. Nevertheless, a comprehensive legal and regulatory framework as well as its consistent implementation will likely be conducive to the emergence of law-abiding and regulatory-compliant innovations—while providing the basis and mechanisms to deal with a minority of bad-faith actors and criminals.

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VII. Appendixes

Appendix 1. Drivers of Crypto Asset Adoption in Selected Countries

This note highlights the drivers of crypto adoption by country and how they differ by level of development.

ADVANCED ECONOMIES	
US	Bitcoin mining, trading, and DeFi transactions in the US are among the highest in the world. Retail investors dominated the market, driven by speculative investment motives, but institutional investors searching for yield amid low interest rates contributed to recent price rallies. The launch of Bitcoin futures at various exchanges, including the Chicago Board Options Exchange and Chicago Mercantile exchange, and more recently the approval of the Bitcoin ETF, has reportedly led to more mainstream participation, and the well-developed financial infrastructure for trading cryptos facilitates trading.
UK	Crypto-asset adoption in the UK has largely been driven by institutional investors and “whales” moving into DeFi, although retail activity has also increased. Most transactions involved Ethereum and wrapped Ethereum, commonly used in DeFi protocols.
JAPAN	In Japan the aging population is cited to be a major factor in the relatively low level of crypto adoption. Regulatory uncertainty and the history of cyber incidents like the Coincheck hack in 2018 also played a role in dampening demand.
KOREA	In accordance with UN Security Council Resolutions, Korea maintains exchange restrictions for security reasons, which make it difficult for foreigners to use Korea-based crypto exchanges. As a result, Bitcoin commands a steep premium, the so-called kimchi premium, in Korea. Despite this premium, demand for Bitcoin in Korea reportedly remains strong.
EMERGING ECONOMIES	
ARGENTINA	In Argentina economic instability and foreign exchange restrictions are reportedly major drivers of crypto adoption. China’s ban of crypto mining has seen many miners moving to Argentina to leverage low energy prices. With the return of exchange controls, on the heels of high inflation and exchange rate depreciation, increased demand for Bitcoin caused the value of Bitcoin to sell at a premium.
CHINA	In China exchange controls continue to apply to most capital transactions. Between June and September 2021, all crypto-asset activities were banned and declared illegal. But until the recent ban, China was the largest source of crypto mining, and Chinese residents were active in trading crypto assets—reportedly for speculative investment purposes and potentially also to circumvent capital outflow CFMs.
RUSSIA	In Russia crypto assets have been popular, in part, due to a distrust of institutions and the combination of relatively large populations of skilled computer programmers with fewer economic and investment opportunities. Tax avoidance has also reportedly driven crypto-asset adoption. The recent introduction of international sanctions and wide-ranging capital controls could potentially reinforce this trend.
SOUTH AFRICA	South Africa maintains a set of exchange control regulations. Many residents have reportedly used crypto assets to transfer funds to foreign countries, although the exchange control regulations currently prohibit the use of crypto assets to externalize “any right to capital.” The repatriation of value to South Africa through crypto assets is also not permitted as part of an individual’s single discretionary allowance and/or foreign capital allowance. This is because the “flow” of crypto assets across borders/ jurisdictions is currently not recorded and cannot efficiently be monitored by regulators.
TURKEY	Bitcoin queries and adoption increased in Turkey amid significant bouts of volatility and exchange rate depreciation in late 2019, while CFMs have been used to a varying degree to contain capital flight.
NIGERIA	Nigeria maintains exchange restrictions resulting from administrative control on foreign exchange allocation—including for imports of necessities—as well as multiple currency practices (MCPs) and CFMs. Crypto assets reportedly have been used in cross-border payments and remittances to hedge against inflation and exchange rate depreciation. The increasing price of crypto assets lured investors and several local startups to act as local exchanges to facilitate crypto trades. The central bank prohibits commercial banks from dealing with companies involved in crypto assets, but firms have reportedly found a workaround using third-party accounts.
INDIA	In India the crypto-asset market is dominated by young investors with an appetite for risk and innovation. Availability of tech talent has also boosted faster adoption of new technologies. More stringent regulations on centralized exchanges boosted usage of innovative projects like DeFi protocols (Chainalysis 2021).

DEVELOPING ECONOMIES

AFGHANISTAN	The Taliban takeover of Afghanistan has reportedly fueled a surge in the use of crypto assets, propelling the country into the top 20 of the 154 countries ranked in the 2021 Global Crypto Adoption Index of Chainalysis.
IRAN	Iran is subject to US sanctions that include trade embargoes on the sale of its oil in international markets. Iran officially recognized crypto mining as an industry in recent years and amended regulations to allow Bitcoin and other crypto assets to be mined officially under government control and then supplied to the government for funding imports. The central bank reportedly will also allow licensed banks and moneychangers to pay for imports with crypto assets that have been mined by officially sanctioned miners.
VENEZUELA	Venezuela suffers from hyperinflation and is subject to US sanctions. The authorities introduced MCPs, exchange restrictions, and CFMs to dampen depreciation pressures, and Venezuelans turned to crypto assets to hedge. Venezuela leads other countries in the region in P2P activity possibly because crypto assets are widely used as an alternative payment, transfer, and hedging tool. Many companies accept payment in Bitcoin, and Venezuelan diaspora use crypto assets to send remittances back home.

Sources: Staff summary based on Chainalysis (2021); IMF's Taxonomy of Capital Flow Management Measures (IMF 2020b); and individual IMF Country Reports.

Appendix 2. Empirical Analysis of the Drivers of Crypto Adoption

This appendix presents an empirical analysis of the drivers of crypto-assets adoption across countries. It aims to estimate the effect of various macroeconomic, demographic, and institutional factors, including the role of capital account restrictions.

Model specification

The regression equation takes the form of:

$$y_{i,t} = \alpha_1 x_{i,t-1} + \beta_1 Z_{i,t-1} + \eta_i + \mu_t + \epsilon_{i,t}$$

in which y is a proxy for crypto adoption, x is a proxy for capital account restrictions, Z is a vector of macroeconomic and structural variables and η_i and μ_t represent country and year fixed effects

Sample, data sources, and limitations

Data gaps related to crypto assets are significant. In the absence of a widely accepted measure of crypto adoption, we chose to focus on Bitcoin, the dominant crypto asset with an 80 percent median market share over the period of study.²⁶ We use two variables as proxies for adoption: (1) trading volumes of Bitcoins in crypto exchanges and (2) Google search trends for the term Bitcoin.

The data consist of a large panel of advanced, emerging, and developing economies over the period 2013 to 2019. Trading volumes are collected from various sources and represent Bitcoin transactions in local currencies in 56 major global and local crypto exchanges operating in 47 countries (15 advanced economies and 32 emerging market and developing economies located in all regions).²⁷ The currency of the trade is matched to the country emitting the currency (for example, China for RMB, Turkey for TRY). Transactions in dollars and euros are dropped from the sample due to the international status of these currencies. The direction of trade is not observed, and higher volumes may not be tightly linked to adoption. In addition, a trading pair could be quoted simultaneously in several exchanges, leading to double counting.

²⁶ Source: Statista.

²⁷ We collect data from three websites (Bitcoinity, Coin.dance, and Bitcoincharts) to cover major exchanges in a large set of countries up to 2019. Some of the crypto exchanges are centralized (for example, Okcoin, Huobi) while some are decentralized (for example, Localbitcoins, Paxful). The dynamics of trading in these two types of exchanges is arguably very different. As a robustness test, we check that our main results hold in the two subsamples (results available upon request).

We complement our analysis with a measure of public interest for crypto assets derived from trends in Google searches in 145 countries. We focus on query volumes for the word Bitcoin for the sake of comparison with our first set of results and because Google searches for other crypto assets, such as Tether, are very limited in relative terms. Searches across countries are defined by Google relative to a user-defined benchmark (the United States, in our case) and scaled on a range from 0 to 100 based on the local number of total Google searches in a given month.²⁸

The explanatory variables include:

- A Financial Account Restrictiveness Index (FARI) compiled by Baba and others (forthcoming) with data from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).²⁹ This index is highly correlated with other popular indices, such as Chinn-Ito (2006) and Fernández and others (2016), but has the advantage that it is available for many countries, covers a broad scope of restrictions, and includes a breakdown by direction of flows. We focus on restrictions on outflows.
- Macroeconomic controls including inflation, exchange rate movements (appreciation/depreciation), and exchange rate volatility, all sourced or derived from the IMF International Financial Statistics.
- Structural indicators capturing the preparedness of the population to digitalization, such as the number of mobile cellular subscriptions per 100 people, the number of secure internet servers per 1 million people, and the share of the population above 65. In addition, we include personal remittances received (in percent of GDP). All structural indicators come from the World Bank Open Data.

Results

The regressions on trading volumes yield three main results (Table A2.1) First, the coefficient associated with the FARI on outflows is not significant. This finding could reflect the fact that trading volumes may not adequately capture the use of crypto assets or that CFMs as currently designed do not sufficiently affect crypto transactions. In some of the robustness checks involving other popular measures of capital account restrictiveness, such as the Chinn and Ito (2006) index, this variable turns significant and negative, suggesting that the more restrictive the capital account, the less crypto adoption. This finding could be due to the fact that in some countries capital account restrictions were probably effective in constraining access by local residents to the crypto-asset market. It is consistent with the existence of the so-called Kimchi premium in countries such as Korea, Nigeria, Thailand, and Venezuela. In these countries the Bitcoin trades at a higher price than in other markets. The existence of this premium suggests that capital account restrictions can constrain the availability of crypto assets and prevent arbitrage trades from equalizing prices across countries.

Second, the coefficients on macroeconomic conditions—currency depreciation, exchange rate volatility, and inflation—are important drivers of crypto-assets adoption, suggesting that crypto assets are used by investors as a hedging instrument. Currency depreciation in particular displays the highest significance levels and largest magnitudes.

Finally, the structure of the demographics comes back highly significant in all specifications and with large negative magnitudes. Countries with a higher share of the population over age 65 see less Bitcoin trading; however, indicators of ICT development, such as mobile cellular subscriptions and secure internet connections, do not turn out to be significant.³⁰ Interestingly, adoption seems to pass through remittances, potentially because crypto assets offer faster and cheaper cross-border payment solutions than do traditional channels.

²⁸ See [FAQ on Google Trends data](#) for more details on the methodology.

²⁹ All *de jure* indices of capital account restrictions derived from the AEAER are available only until 2019, which is the latest vintage of the report available to date.

³⁰ The results are not reported here for compactness but available upon request.

Table A2.1. Drivers of Crypto-Assets Adoption (Proxy: Trading Volumes)

Dependent variable: ln(trading volumes)	(1)	(2)	(3)	(4)	(5)	(6)
Capital account restrictions on outflows (FARI)	-0.8 (-0.81)	-0.92 (-1.03)	-0.86 (-0.92)		0.45 (0.32)	-0.76 (-0.81)
Capital account restrictions (Chinn-Ito)				-1.34** (-2.49)		
Exchange rate (USD/LC) (log)		-6.35** (-3.16)	-4.90* (-1.82)	-6.81** (-3.29)	-2.24 (-1.08)	-16.75*** (-9.88)
Foreign exchange volatility	-0.07 (-0.24)				2.47*** (3.65)	
Inflation	0.17* (1.89)	0.1 (1.24)	-0.16 (-0.48)	0.1 (1.30)	0.09 (1.20)	0.08 (0.76)
Share of population above 65	-16.46*** (-9.28)	-14.78*** (-7.91)	-15.12*** (-7.29)	-14.86*** (-7.77)	-23.29*** (-8.35)	-6.48*** (-5.94)
Remittances/GDP			1.88* (1.82)			
Constant	0.82 (1.06)	0.49 (0.65)	1.89* (1.74)	0.17 (0.24)	-8.45*** (-14.35)	-2.16*** (-3.92)
Adjusted R-squared	0.80	0.81	0.81	0.81	0.84	0.73
N	344	344	334	347	199	344
Countries	All	All	All	All	Emerging/ Developing	All
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No

t-statistics in parentheses

* p<0.10, **p<0.05, ***p<0.001

Sources: Bitcoinity, Coin.dance, Bitcoincharts, International Financial Statistics, World Bank data, Baba and others (forthcoming), Chinn and Ito (2006).

Note: The data set covers 47 countries between 2013 and 2019. The regressions are estimated with Ordinary Least Squares and robust standard errors. All explanatory variables are standardized. The values of the Chinn-Ito index have been flipped for comparison with the FARI. Therefore, higher values of the index are associated with more restrictions. The exchange rate (in log) is quoted in dollars per unit of local currency (increase = appreciation of the local currency). Exchange rate volatility is computed as the annualized standard deviation of monthly exchange rate log returns. Results are robust to the inclusion of an autoregressive term (regression estimated with dynamic panel data techniques).

The main determinants of Bitcoin trading are broadly similar in the subsample of emerging market and developing economies, but, interestingly, exchange rate volatility turns significant. Finally, removing time-fixed effects does not affect the main results, suggesting a limited role for global time-varying factors.

The regressions based on the alternative measure of adoption, derived from Google search trends, confirm these findings (Table A2.2). It is reassuring to see that, with a metric very different in nature and a substantially larger sample of countries, the main results hold. Specifically, the indicator of capital account restrictions is not significant in most specifications, and the age structure of the population is a key driver of adoption. Variables capturing macroeconomic conditions matter, but this time inflation plays a more prominent role than do exchange rate movements.

Table A2.2. Drivers of Crypto-Assets Adoption (Proxy: Google Search Trends)

Dependent variable: ln(Google searches)	(1)	(2)	(3)	(4)	(5)	(6)
Capital account restrictions on outflows (FARI)	0.02 (0.16)	-0.04 (-0.38)	-0.04 (-0.44)		0.02 (0.15)	-0.31* (-1.85)
Capital account restrictions (Chinn-Ito)				0.08 (1.04)		
Exchange rate (USD/LC) (log)		0.15 (0.40)	0.28 (0.69)	0.11 (0.30)	-0.17 (-0.40)	-7.32*** (-9.72)
Foreign exchange volatility	-0.03** (-2.46)				0.03 (0.11)	
Inflation	0.06** (2.09)	0.06* (1.95)	0.14** (2.70)	0.06* (1.93)	0.06* (1.85)	-0.02 (-0.43)
Share of population above 65	-2.14*** (-9.06)	-2.22*** (-10.02)	-2.25*** (-9.79)	-2.28*** (-10.33)	-1.75*** (-5.17)	3.41*** (13.54)
Remittances/GDP			-0.010 (-0.11)			
Constant	0.81*** (27.68)	1.26*** (46.79)	1.30*** (46.60)	1.30*** (44.42)	0.48*** (4.71)	1.19*** (17.75)
Adjusted R-squared	0.85	0.86	0.86	0.86	0.84	0.51
N	946	1081	1054	1067	771	1081
Countries	All	All	All	All	Emerging/ Developing	All
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No

t-statistics in parentheses

* p<0.10, **p<0.05, ***p<0.001

Sources: Google Trends data, International Financial Statistics, World Bank data, Baba and others (forthcoming), Chinn and Ito (2006)

Note: The data set covers 145 countries between 2013 and 2019. The regressions are estimated with Ordinary Least Squares and robust standard errors. All explanatory variables are standardized. The values of the Chinn-Ito index have been flipped for comparison with the FARI. Therefore, higher values of the index are associated with more restrictions. The exchange rate (in log) is quoted in dollars per unit of local currency (increase = appreciation of the local currency). Exchange rate volatility is computed as the annualized standard deviation of monthly exchange rate log returns. Results are robust to the inclusion of an autoregressive term (regression estimated with dynamic panel data techniques).
