

CBDCs and the (calibrated) tiering of money: the financial stability arguments



José Ramón Martínez Resano | Banco de España

Keywords: central bank digital currency, digital money, payments, financial stability

JEL codes: E41, E42, E51, E52, E58, G21

Abstract

This paper summarizes a Bank of Spain occasional document¹ that explores the financial stability nexus operating in an ecosystem of money (banknotes and deposits) expanded with a CBDC. The transformations in the money ecosystem brought about by CBDCs are well known to create opportunities as well as new risks. The need of risk mitigants and the potential for risk amplification factors have split practitioners and academics around CBDCs. The endogenous mitigation of risks through improved bank competition often attributed to CBDCs by the former is argued to be uncertain and may be an insufficient plus from a systemic risk perspective. This paper reviews the traditional role of the tiering of money as a structural mitigant of risks and the need of adaptations to it to keep under check the risks from deposit substitution and disintermediation of bank deposits due to a CBDC. The introduction of an exogenous mitigant in the form a CBDC holding limit is already a recognized instrument to ensure the consistency of a money ecosystem expanded with a CBDC. In this context, the paper addresses the methodological and incentive issues raised by a “calibrated tiering of money” as an opposed to one where structural separation prevails. In a nutshell, the calibration of a holding limit on CBDCs leads to an effective separation between CBDC and bank deposits, although an open-ended one that could strain the engagement of banks around the expansion. This calls for a rule-based calibration methodology that mitigates time-inconsistency concerns but still is capable of addressing the evolving influence of frictions as an important driver of CBDC holding limits. The paper also emphasizes the need to factor in the potential for distortions in the working of the credit system when evaluating the financial stability nexus. In any case, the paper reiterates also for the Spanish case the tentative evidence accumulated for the Eurosystem that financial stability issues should not be a reason for concern for reasonable levels of CBDC take-up.

Disclaimer: This policy note is based on [Banco de España, Occasional Papers, No 2436](#). The opinions and analyses are the responsibility of the author and, therefore, they do not necessarily coincide with those of the Banco de España or the Eurosystem.

¹ See Martínez-Resano (2024)

CBDCs: a bird's view account of the innovation, its challenges and opportunities

The spark of explorations of retail CBDCs started with the appreciation of the risks caused by stablecoins to the traditional public-private architecture of money. The contemplation in economic history of the negative impact of free money on trade, monetary policy and financial stability (Dwyer,1996) urged to regulate the access of non-banks to the provision of money as a first step. But the restoration of regulatory fairness through the amendment of rules for financial infrastructure was deemed not be sufficient to deal with the long-lasting effects resulting from changes in the basic architecture. The need of a public digital alternative for retail money thus emerges primarily as the quest of a new anchor to complement banknotes and to strengthen the financial system in the digital age.

But the opportunities raised by a CBDC are not just of a defensive nature. The defense of the public common good justifies the exploration of CBDCs due to the strength of the network effects of having a digital money anchor. Unsurprisingly, the scope of these beneficial effects depends crucially on its design. Among the multiplicity of design features influencing the ambition of a CBDC, two particularly important ones of interest for this article are the comprehensiveness of the envisaged use cases (universality) and its potential to underpin the provision of new financial services (platform model).

The diversity of CBDC models is thus broad and their mix of benefits and challenges cannot be generalized. Niche and universal CBDCs exhibit a markedly different profile of benefits and challenges. Niche digital CBDCs can be broadly defined as those addressing contained failures in the provision of retail money and typically work as the analogue of partial fixes of retail payment mechanisms. In turn, universal CBDCs attempt a system-wide reform of the retail money network adapted to the public policy goals at stake.

The ambition of universal CBDCs shows correspondingly in the magnitude of the associated challenges and risks. In a nutshell, the net addition of value requires not only to entice the collaboration of private stakeholders to make CBDCs a success but, fundamentally, not to destroy basic equilibriums and public goods by the sizeable intervention that CBDCs can represent on the ecosystem of money. The ability to preserve monetary policy control and financial stability are two major tests that universal CBDCs must pass as a necessary condition. This paper deals just with the financial stability nexus surrounding CBDCs and attempts to make the case that it crucially rests on a stable redefinition of the classical layering of money. The redefined layering is argued to be “calibrated” as opposed to the structural features of the classical one.

CBDCs and their compatibility with financial stability: the need of a calibrated layering of money

Money is a social technology to store and mobilize economic value. A well-known crucial feature of the ecosystem of public (banknotes) and private money instruments (sight deposits) that implements such technology is the convertibility at par of the instruments being part of it. Indeed, the architecture of money and banking has advanced across time along an evolutionary process that relies on that consistency condition for the benefit of trade and credit. Nonetheless, the overall money and credit framework is well known to exhibit significant fragilities that have been subject of extensive mitigation through a broad palette of public policies (regulation, supervision, deposit insurance, liquidity back-up policies etc). Table 1 provides a stylized representation of the traditional ecosystem of money as a summary of the functional goals, the profile of risks and the risk mitigating features (institutional and technologic). CBDCs constitute an addition to the ecosystem impacting its existing equilibria and potentially leading to new financial stability risks. The following paragraphs are devoted to the description of the financial stability nexus in the operation of the traditional ecosystem of money and in the one expanded with a CBDC.

Table 1. The ecosystem of money attains its functionality and overcomes the risks to money singleness thanks to various mitigants of risks

	Free Banking	Banknotes	Bank Deposits	CBDC
Rationale	Fragmented trade Insufficient central powers	Two-tier money with parity Gravitation of powers Spatial gaps in money	Two-tier money with parity: Borrowed private money Private credit system	Digital shock to money ⑧: ↳back to free banking?
Risks/costs	Real costs of no parity Instability of banks No lender of last resort	Costly exchange technology Safe instrument to run	Deposit contract fragility ⑤ Growing bank powers ⑥ Private inertia to coordinate ⑦	Substitute of bank money ⑨ ↳Slow disintermediation? ⑩ Public and ↳private credit? ⑪ Fast disintermediation ⑫: leaking pipe in crisis Adoption risks: ⑬ coopetition and privacy Cyber
Mitigants	Creation of clearinghouses Emerging tiering : i.e. hierarchy	Two-tier money ① not competing central bank Balance of risks and costs: Safety valve in crisis ② Complement of bank money ③ : privacy and fiat -> trust remuneration->costly storage Robust to diversity of shocks ④	Two-tier money ①: Regulation and supervision Lender of last resort Presumption of support Correction of mobilization market failures	Limits on: holdings and remuneration ⑭ institutional New Two-tier money ⑮: Governance of coopetition Public coordination Control over convertibility Recycling and refinancing

SOURCE: Martinez-Resano (2024)

The table attempts to map the main concepts that have shaped the singleness and stability of money under various architectures (column view). The table has an implicit time dimension from left to right and attempts to place in context the features discussed in the text for CBDCs. The numbered circles attempt to highlight relevant issues in the text. ① is addressed across the whole document due to its role as structural mitigant that is challenged by CBDCs. ②, ③ and ④ are highlighted because they describe the sources or consequences of the internal balance achieved with banknotes. ⑤, ⑥, ⑦ highlight the main sources of fragility potentially shocked by CBDCs. ⑧ is covered in section 3.3. The substitution ⑨ and adoption risks ⑬ associated with CBDCs are covered in section 4.1 while the potential consequences in terms of slow disintermediation ⑩ and fast disintermediation ⑫ are extensively discussed in section 4.2. The role of endogenous mitigants like the alleged improvement of bank competition ⑥ thanks to CBDCs and the operation of effects through transformations in bank credit (both dealt in section 4.2) shape the uncertainty on the ultimate outcome. The main part of the paper corresponds to ⑭ and ⑮. The need to enforce a reformed two-tier money system leads to the need to impose remuneration limits that emulate the ones of physical banknotes and holding limits that emulate the costs of storing big amounts of physical banknotes. ⑭ is mainly covered in 4.2 but the governance component ⑮ is briefly addressed in 4.1.

The ecosystem of banknotes and bank deposits has long reconciled a multiplicity of use cases of money with limited adaptations to its working across time. The complementary mix of technologies and transaction costs underlying banknotes and deposits has set the ground to jointly provide compatible tools to exchange and to store economic value. Banknotes have provided a bridge to either transfer or to store economic value in certain conditions (anonymity and spatial dispersion) outside the reach of the commercial bank money system. In addition, the impossibility to pay interest on banknotes has been important to financially differentiate them from deposits. Finally, the confidence in the convertibility of deposits at par has bound together the overall spectrum of saving and payment use cases of money.

The balanced working of the classical ecosystem of money throughout decades can be said to be due to two main reasons: (1) the said technological complementarity between banknotes and deposits and (2) the increasing cohesiveness brought about by financial stability-oriented policies. On the first reason, it is relevant to notice that banknotes face an intrinsic limitation to be an instrument that competes with bank deposits without frictions. Thus, the transaction and holding costs associated with physical banknotes limit the conditions under which a run on deposits is attractive. In fact, physical banknotes have traditionally been viewed as a sort of “safety valve” for the money system in the sense that a drawdown of deposits to banknotes faces frictions that may automatically limit further outflows and ultimately offer some leeway to gain time to stabilize the system. Consistent with this behavioral pattern, the elastic supply of banknotes, i.e. the accommodation one-for-one in the demand of banknotes, has

traditionally counted as an important central bank policy to enforce trust in the singleness of money (Champ and Bruce, 1996).

On the second argument, a sense of the net benefits prevailing in commercial money production despite the recognized fragilities of the system, have led to broader regulatory, supervisory and bank support frameworks aimed at containing potential instability. Public intervention has thus systematically rebalanced the risk profile of private money and reinforced cohesion of the overall money system. Admittedly, limits to depositor protection and anonymity have operated somewhat in the opposite direction, although with a contained scope given overall preponderance of the aspirations to stability.

All in all, in the classical ecosystem of money financial stability has been underpinned by the joint effect of a naturally low level of competition between public and private money and by the incentives to support their cohesion. As a matter of fact, both mechanisms can be traced back to a structural design feature of the monetary system in two tiers with just banknotes piercing that separation.

Financial stability concerns have played historically a crucial role in shaping such structural separation principle. Lower levels of economic and political development have sustained in the past fragmented and undifferentiated monetary systems like the one prevailing during Free Banking period in the United States. But a stable separation between public and private money (tiering of money) can emerge when the financial policies carried by a sufficiently powerful government attempt pursue differentiated policy goals that include financial stability. (Goodhart, 1988) lays bare how the tiering of money between central bank reserves and commercial bank money emerged over time as a stable institutional outcome that eliminates the inconsistency that central banks could at some point compete with commercial banks. The supply of deposit-like instruments for savings by governmental institutions with policy powers was thus discarded and, instead, the only public money available to non-banks was banknotes.

The tiering-of-money also planted the seed for gradual development of regulation and supervision to control the risks associated to commercial banking activities. The emergence of central banks in the transition from free banking to modern monetary arrangements highlights their institutional evolution towards a regulatory role to ensure the consistency of the ecosystem of money.

Fast forward to the digital age, CBDCs could potentially alter the balance of the money ecosystem by piercing the layering of money beyond what is strictly safe. The relationship of complementarity between bank deposits and banknotes can be transformed into one of substitution in relation with CBDCs. The financial stability risks of allowing outright competition between fragile commercial bank money and an unrestrained form of CBDC would be high if operational, financial and safety attributes of CBDCs would strictly dominate over the ones of bank deposits. Under these conditions, the policy-based cohesion of the money and credit system might be compromised and need a thorough revision of what is acceptable and what is not. Thus, the evaluation of trade-offs and definition of priorities regarding CBDCs belong naturally to the planning and issuance thereof.

That process might be understood as a new redefined layering of money, one that restores the balance in the expanded ecosystem of money. This work program is still under exploration in multiple jurisdictions. But some of its contours and emergent features are already clear. CBDCs must be a constrained sort of money if the materialization of financial stability risks is to be avoided. The competition concern addressed by the tiering of money suggests that CBDCs should exhibit a limited ability to store economic value while being capable to deliver efficient transactional services. This widespread view puts both the incentives and the actual ability to hold CBDCs in the focus of restrictions. A remuneration similar to the one of banknotes and a cap on the size of CBDC holdings thus emerge as two basic features of the redefined layered architecture of money. The degree of privacy of CBDC holdings is also a crucial feature in shaping the degree the propensity to entail a tilt in the incentives to substitute bank deposits or banknotes.

The size of the cap on CBDC holdings effectively gauges the scale of both CBDC functionalities and competition-like financial stability risks. It influences decisively the width of the quantitative corridor of success, i.e. the distance between the maximum uptake compatible with financial stability and the minimum one needed to attain the goals ascribed to it as the public digital means of payment that expands the anchoring role of public money (Bindseil,2020).

From a different perspective, the size of the cap modulates the incentives for public-private collaboration in the new architecture of money. The traditional ecosystem of money based on banknotes and bank deposits has operated on the basis of an (evolving) engagement between central and commercial banks to satisfy the overall need of money by citizens. The overall complementary relationship between banknotes and bank deposits has facilitated a broadly cooperative alignment of incentives. This is less the case for CBDCs when the need is as intense if not more, because the singleness of money in the digital age requires seamless interoperability with bank deposits. Instead, the provision of a CBDC initially exhibits diverging incentives between the public sponsor and the commercial banks. Some of the most salient ones are the increased competition faced by banks, the potential for actual deposit drawdowns or the adaptation costs faced by banks to make CBDC a successful reality. The size of the cap should modulate the scale of these effects and, consequently, the cohesiveness of the newly layered architecture of money in the short-term.

From a longer-term perspective, the initial collision of incentives spurs a more careful consideration of the long-term gains from CBDCs and of the tools required to achieved them. The problem has been also witnessed in the classical layered money system. The risk that inefficient money mobilization systems could endanger the effective singleness of money has underpinned a fundamental role of central bank policies in a domain plagued by microeconomic failures. Their powers to enforce coordination and competition between private money issuers as well as their own capacity to provide efficient money mobilization frameworks has remained a mitigant of risks in both retail and wholesale payments. Financial stability considerations have for example justified a direct involvement of central banks in the provision of rails for wholesale payments.

The case for an episodically active involvement of public actors in the provision and/or configuration of retail payment systems has also a long tradition. The need of public initiatives in the field of private payment systems is also significant. (Padoa-Schioppa, 2004) elaborates on the indirect role of central banks at shaping payment systems by fostering soundness and competition. But the need is particularly strong when network externalities and coordination failures between commercial money issuers leads to inertia and slow modernization of existing systems. (Leibbrandt, 2004) documents how the provision of payment services in many jurisdictions experiences episodes of technological inertia that explain lock-in in inefficient solutions. A well-known case study of this problem is the long-time persistence of checks as the most used retail payment instrument in the US, well beyond the time when their use was efficient (Humphrey et al., 2000).

Calibration of CBDC holding limits: short-term and longer-term considerations

The calibration of the cap on CBDC holdings has been argued to be crucial in order to ensure the compatibility of CBDCs with financial stability values. Unsurprisingly, a right calibration should be also instrumental to achieve the specific payments-related policies pursued with their launch in the first place. And the potential for undesired perturbations to monetary policy formulation and implementation due to the level and/or dynamics of CBDC holdings raises an additional dimension in the calibration of the cap.

The pursue of payments-related goals with a CBDC requires that CBDC holdings attain a level above certain minimum for two different set of reasons. First, usability is a direct driver of a target for CBDC holdings above certain lower limit. A transactional use of CBDCs should cover a basket of payments sufficiently broad to make attractive the adoption of a CBDC. Otherwise, the lock-in effects of existing payment instruments and networks might disincentivize CBDC take-up. The attribution of a condition of legal tender to a CBDC would not entirely make unnecessary the recourse to other payment instruments if the maximum balance of CBDC holdings is too low.

Second, the money logic of CBDCs argues also in favour of a cap above a certain minimum. The fact that CBDCs need to be restricted in their ability to store economic value does not imply that a debit card-like implementation of it could deliver the aspirations of digital money. CBDCs need to be smoothly integrated with bank deposits to ensure the singleness of money. The smooth integration can be facilitated by waterfall mechanisms that link the mobilization of money through CBDCs to a reservoir of money in the form of sight deposits (Bindseil, 2020). But profiling CBDCs as an exclusively commercial bank money debiting/crediting tool could decisively detract the new instrument from some of

the powers resulting from a public money instrument. Namely, the conditions under which deposit drawdowns and payments would take place in that situation would result mainly from regulations, as opposed to a regime where the willingness of customers to hold balances outside banks operates as a disciplining mechanism. It is this willingness what ultimately can modify the competitive stance in payments and offer public authorities with muscle to spur reforms. Admittedly, this does not preclude the need of a regulatory arrangement to cement a cohesive attitude around CBDCs.

At a high level, a calibration that attempts to preserve monetary or financial stability values has to contemplate a sufficiently high magnitude of holdings at which unbearable frictions due to the issuance of CBDCs can materialize. Some academic literature has also underscored a role for CBDCs as instrument to spur bank competition (Andolfatto,2018), a view that in extreme interpretations could equate to a radical transformation of the money and credit system towards a narrow banking system (Mayer,2023). However, a sound calibration policy should be prudent in the handling of the uncertainty surrounding the impact on competition of a CBDC.

From a monetary policy perspective, calibration has to gauge the level at which the ability by central banks to adjust their balance sheet and control rates may be impaired by the impact of the CBDC on the central bank liquidity management framework. The need to recycle CBDC funds drawn down from banks also raises ancillary but important issues like central bank credit policies or collateral-related frictions that are also relevant from a financial stability perspective. But, more broadly, the main values at stake from the latter angle are the impact on soundness of banks and on the working of the credit system as a result of the balance sheet and liquidity frictions resulting from deposit drawdowns. Thus, leaving aside commercial bank engagement issues, a calibration needs to take into account the frictions and limits to accommodate deposits drawdowns due to the operation of prudential liquidity ratios, of the (limited) ability of markets to redistribute excess reserves as well as of conditions to access central bank refinancing facilities.

A tentative methodology to operationalize a calibration that contemplates those frictions has been proposed for the Eurosystem by Meller and Soons (2023) and refined by Lambert et. al (2024). Banks can fund outflows with excess reserves, with a range of inter-bank instruments and with central bank funding. The calibration of a sensible level for the cap on CBDC holdings relies then on the identification of the amount that can be soundly accommodated by each individual bank based on a corresponding balance sheet optimization that takes into account the cost of the mix of funding instruments available and the quantitative restrictions to use them. A preliminary version of the methodology indicates for various jurisdictions, including for Spain, that financial stability issues should not be a cause of concern for reasonable levels of digital euro take-up.

But the policy use of a CBDC calibration methodology raises still important application issues. From a strategic perspective, the redefined new layering of money is (by definition) is just a construct calibrated at a point of time. It lacks the atemporal validity of the structural separation that has traditionally sustained the strong commitment of central banks not to compete with commercial banks. A calibrated new layering of money thus raises the prospect of future revisions to the CBDC cap on holdings. The relevance of the size of excessive reserves for the scope of monetary policy and financial stability frictions provides a basic example of the conditional validity of calibrations. But the potential for a revision of goals regarding a CBDC introduces also a strategic driver of changes.

An important consequence of having open-ended limits on CBDCs (reflecting changes of significant variables across time) is the potential for moral hazard issues to arise. The perception of time-inconsistent decisions on the size of the cap on CBDC holdings might not quench (even unjustified) fears of inappropriate competition and policies down the road. The ensuing lack of engagement of banks might thus endanger the success of the CBDC in the first place. All in all, the calibration must follow the traditional prescription in such kind of situations of applying a rule to revise previous decisions.

But addressing those two needs, i.e. strategic adaptability of holding limits as well as precision at each point of time to control the potential of damages, within the same methodological framework calls for the adoption of a sophisticated new analytical machinery that integrates the tracking of cross-sectional drivers of financial stability risk with aggregate

gauges to inform on the slack for regime changes. The complexity of the challenges associated naturally intensifies the transparency requirements on such methodology.

When dealing with some of the frictions at stake, the reconciliation of adaptation, precision and transparency requires the adoption of prudent assumptions and scenarios. Whereas individual frictions can be modelled as optimization programs, interbank market failures are less susceptible to parametrization but not less important. The problem becomes particularly pressing when the shut down of interbank markets may occur along some systemic dimension. At the extreme, the closure of markets for the redistribution of liquidity for the overall set of banks (due to the onset of a systemic crisis) represents a scenario that needs to be considered given that the safety attributes of a CBDC would subject the system to considerable additional pressure. But intermediate scenarios where fractures make crystallize along some relevant dimensions like cross-border, business model type or credit rating may be also very relevant for the exam of emerging financial stability tensions. In the same vein, the operation of non-linear market adjustment effects also calls for the consideration of diverse sensitivity analysis within the framework, particularly as the scenarios at stake are more and more risky.

The behaviour of credit as deposit drawdowns are accommodated is a particularly relevant to include in the analysis given its potential role as amplification factor of risks. The exam of liquidity metrics and bank profitability may inform on the potential for disruptions of credit. But putting credit also at the core of the analytical framework matches the relevance of the overall credit flow reshuffling associated with a CBDC typically requiring new central bank investment policies.

Concluding remarks

A calibrated tiering of the money system intensifies the analytical needs that central banks have to deploy to keep under check the potential of distortions from a CBDC. The calibration methodology must reconcile strategic goals and risk control precision. The open-ended nature of CBDC holding limits as opposed to the structural separation characteristic of the traditional layering of money can be a long term driver of transformation but also a shorter term drawback. As to the realism of risk control, the significance of frictions and non-linear effects advises to also put credit at the focus of the analysis and to envisage a sufficiently rich set of sources of friction and of scenarios of systemic risk.

References

- Andolfatto, David. (2018). "Assessing the Impact of Central Bank Digital Currency on Private Banks". Working Paper, 25, FRB St Louis. <https://dx.doi.org/10.20955/wp.2018.026>
- Bindseil, Ulrich. (2020). "Tiered CBDC and the financial system". Working paper, 2351, European Central Bank. <https://dx.doi.org/10.2139/ssrn.3513422>
- Champ, Bruce, Bruce D Smith and Stephen D Williamson. (1996). "Currency elasticity and banking panics: Theory and evidence". Canadian Journal of Economics, 29(Nov.), pp. 828-864. <https://doi.org/10.2307/136217>
- Dwyer Jr, Gerald P. (1996). "Wildcat Banking, Banking Panics, and Free Banking in the United States". Economic Review, 81, FRB Atlanta. https://www.atlantafed.org/research/publications/economic-review/1996/no3-6/vol81nos3-6_wildcat-banking.aspx
- Goodhart, Charles. (1988). The evolution of central banks. MIT press. <https://mitpress.mit.edu/9780262570732/the-evolution-of-central-banks/>

Humphrey, David, Lawrence Pulley and Jukka Vesala. (2000). "The Check's in the Mail: Why the United States Lags in the Adoption of Cost-Saving Electronic Payments". *Journal of Financial Services Research*, 17(1), pp. 17-39. <https://doi.org/10.1023/A:1008163308353>

Lambert, Claudia, Barbara Meller, Cosimo Pancaro, Antonella Pellicani, Petya Radulova, Oscar Soons and Anton van der Kraaij. (2024). "Digital euro safeguards—protecting financial stability and liquidity in the banking sector". Occasional Paper, 345, European Central Bank. <https://dx.doi.org/10.2139/ssrn.4800259>

Meller, Barbara, and Oscar Soons. (2023). "Know your (holding) limits: CBDC, financial stability and central bank reliance". Occasional Paper, 326, European Central Bank. <https://dx.doi.org/10.2139/ssrn.4543369>

Martinez-Resano, José Ramon. (2024). " CBDCs, banknotes and bank deposits: the financial stability nexus". Working Paper, 2436, Bank of Spain. <https://repositorio.bde.es/handle/123456789/38457?locale=en>

Mayer, Thomas. (2023). The digital euro: An opportunity likely to be missed. In: Flossbach von Storch. <https://www.flossbachvonstorch-researchinstitute.com/en/studies/the-digital-euro-an-opportunity-likely-to-be-missed/>

Padoa-Schioppa, Tommaso. (2004). Shaping the payment system: a central bank's role. European Central Bank. Retrieved 05/13/2004. https://www.ecb.europa.eu/press/key/date/2004/html/sp040513_1.en.html

Whited, Toni M, Yufeng Wu and Kairong Xiao. (2022). "Will Central Bank Digital Currency Disintermediate Banks?", Working Paper, University of Michigan. <https://dx.doi.org/10.2139/ssrn.4112644>

Leibbrandt, Johan Gottfried. (2004). Payment systems and network effects [Thesis]. University of Maastricht. <https://cris.maastrichtuniversity.nl/files/612143/guid-dcaa651e-4d40-4aa0-8226-ae95f3b7b04c-ASSET1.0.pdf&ved=2ahUKEwilzN7QrpiJAxVqcvEDHaOckCUQFnoECBUQAQ&usq=AOvVaw0H0qwwHRL419iaHqxnJj-B>

About the author

José Ramón Martínez Resano is Adviser in the Financial Stability Department at Bank of Spain. In that position he covers financial stability issues raised by the dynamics of digitalization like cyber-risks, crypto assets or big techs. Previously, he was acting head of the debt issuance unit in the Spanish Treasury and of the financial risks unit at Bank of Spain. He has published pieces on a diverse range of topics like capital markets, central bank financial independence, sovereign debt markets regulation or derivative pricing.

SUERF Policy Notes and Briefs disseminate SUERF Members' economic research, policy-oriented analyses, and views. They analyze relevant developments, address challenges and propose solutions to current monetary, financial and macroeconomic themes. The style is analytical yet non-technical, facilitating interaction and the exchange of ideas between researchers, policy makers and financial practitioners.

SUERF Policy Notes and Briefs are accessible to the public free of charge at <https://www.suerf.org/publications/suerf-policy-notes-and-briefs/>.

The views expressed are those of the authors and not necessarily those of the institutions the authors are affiliated with.

© SUERF – The European Money and Finance Forum. Reproduction or translation for educational and non-commercial purposes is permitted provided that the source is acknowledged.

Editorial Board: Ernest Gnan, David T. Llewellyn, Donato Masciandaro, Natacha Valla

Designed by the Information Management and Services Division of the Oesterreichische Nationalbank (OeNB)

SUERF Secretariat

c/o OeNB, Otto-Wagner-Platz 3A-1090 Vienna, Austria

Phone: +43 1 40 420 7206

E-Mail: suerf@oenb.at

Website: <https://www.suerf.org/>