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Contents

Central bank digital currencies and financial stability 9

Jean-Pierre Landau

An initial analysis of energy transition risks using the Banco de España's FLESB stress-testing framework 21

Alejandro Ferrer, Javier García Villasur, Nadia Lavín, Irene Pablos Nuevo and Carlos Pérez Montes

Archegos and Greensill: collapse, reactions and common features 45

José Alonso Olmedo, Rebeca Anguren Martín, María Gamoneda Roca and Pablo Pérez Rodríguez

Measuring interconnectedness across institutions and sectors 63

Julio Gálvez

Strengthening the cyber resilience of the financial sector. Developments and trends 85

Silvia Senabre, Iván Soto and José Munera

Regulating for competition with BigTechs: banking-as-a-service and “beyond banking” 103

José Ramón Martínez Resano

Regulatory developments in bank solvency, recovery and resolvability 139

Ignacio Colomer, Sara González Losantos, María López Pérez and Luis Mohedano Gómez

Programme of the third Conference on Financial Stability of the Banco de España and CEMFI 169

Central bank digital currencies and financial stability

Jean-Pierre Landau

SCIENCES PO

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Most Central Banks in the world are currently considering - or at least studying - the launch of a Central Bank Digital Currency (CBDC). For instance, on 14 July 2021 the European Central Bank decided to launch a two-year investigation phase of a possible Digital Euro [European Central Bank (2021)]. Those announcements have raised many expectations and also some concerns. There is a fear that once the general public has easy access to the Central Bank balance sheet through electronic means (in addition to physical banknotes), competition will increase on the deposit taking activities of banks. This would compromise their funding, reduce their profitability and destabilise their business models. The perspective of frequent and ample bank runs would be very bad for financial stability.

These are legitimate concerns, especially in the euro area, where banks and bank credit take a major role in financial intermediation. However, there is another side to the issue. Central Bank money - and easy access to it - are crucial to financial stability. Contemporary monetary systems are based on a close complementarity between private and public money. CBDCs are necessary to preserve that equilibrium in a rapidly transforming digital economy.

1 Public money and financial stability

Private money is inherently unstable. In modern times, that instability was especially apparent during the period of free banking in the United States. It was marked by a succession of bank runs and panics. Modern Central Banks - first of all the Federal Reserve - were created with the primary purpose to remedy to that instability.

Private money is unstable because its value is uncertain. It is not anchored. For the same nominal face value, private banknotes may trade at different discounts across regions and periods of times. Their price is contingent on news and event, dependent on the perceived solvability and liquidity of the issuer. They are vulnerable to self-fulfilling expectations and multiple equilibria which trigger bank runs. In modern parlance, we would say that private money is information sensitive [Dang et al. (2015)]. That sensitivity is the potential source of permanent instability.

Central Banks issue a different kind of money. It is backed by their “unimpeachable solvency” [Woodford (2001)], the power of Governments to tax and, in most countries, is supported by legal tender. Public money is of superior quality. It provides the ultimate settlement asset between banks. It also defines the unit of account: a Euro is a liability of the Eurosystem with a nominal value of 1€.

With those attributes, public money is well equipped to serve as an anchor to the monetary and financial system. It provides a reference value. Analytically, there are two components to that anchor function: the currency must be uniform; and it must be attached to the unit of account.

Ensuring that the currency is “uniform” is a major mission for Central Banks. Uniformity means that, without any possible doubt, a euro is a euro whatever its form, its location and the entity which has issued it. If the currency is uniform, all monetary instruments with the same nominal value trade at par in all circumstances, which eliminates a major source of uncertainty in their valuation, as well as any information asymmetry that could impede trade.

After a century of successful central banking, we tend to take the uniformity of currency for granted. It is not. Europeans had a vivid reminder of this reality when, in Spring 2012, a “denomination risk” materialised between different parts of the euro area, temporarily introducing frictions in liquidity transfers and potentially compromising the equivalence between bank deposits in different countries. More broadly, uniformity can be compromised by physical distances (as in the Free Banking area in the US), differences in intrinsic values of monetary objects and, more recently, technological barriers.

The requirements for a uniform currency are very demanding. There needs to a process, an enforcement mechanism that ensures that all forms of money are considered as strictly equivalent at any moment in time. In practice, uniformity can be achieved if and when the different forms of money are always and everywhere convertible into each other, unconditionally and at par. In that case, the same money is truly circulating under a multiplicity of representations.

In principle, mutual and unconditional exchangeability is sufficient for uniformity. However, it raises, two questions. First, it necessitates an infinite supply of each forms of money, to accommodate potential shifts in their relative demands. Private issuers might not be able or willing to achieve that result. Second, while convertibility stabilises the relative prices of different monies, it would not by itself determine their value in terms of the unit of account. It does not exclude a dissociation between the medium of exchange and the unit of account, for instance through a partial or total dollarisation of the economy. There would still be the possibility of a general depreciation or appreciation of the whole set of private currencies (something that could be triggered for instance by a flight to safety).

Public money can solve the two problems at once. It defines the unit of account, it can be supplied elastically. It can be made exchangeable against all private currencies. It guarantees a uniform currency anchored on the unit of account. It serves as a bridge for converting one private money into another. It anchors their value. As noted more than 15 years ago by major central bankers, confidence in

commercial bank money lies in their ability to convert their sight liabilities into the money of another commercial bank and into Central Bank money, upon demand of their clients [Committee on Payment and Settlement Systems (2003)].

To fulfill those functions, public money must be present and freely available in all sectors and parts of the economy. It is no coincidence that in nearly all countries, the circulation of banknotes is under the close control of the Central Bank to ensure universal access (even if printing is often contracted to the private sector). More broadly, the two-tier banking system that prevails in contemporary economies guarantees the complementarity between Central Bank and private bank money. That equilibrium is now challenged and possibly destabilised by technological evolutions.

2 New challenges in a digital economy

Digitalisation brings multiple forces of destabilisation of public money and its role: the disappearance of cash; a new diversification in the forms of money; a fragmentation of payment systems; and, finally, a possible fragilisation of the unit of account.

2.1 The possible disappearance of cash

Cash is the only public money accessible to the general public. Its role in transactions has been constantly decreasing and displaced, in particular, by mobile contactless payments - a trend accentuated by COVID-19 pandemic. If cash were to disappear fully or be marginalised, it would eliminate universal access to public money. It would effectively suppress the convertibility of bank deposits, as there would be nothing left to convert them into.

2.2 Diversification in the forms of money

With the digital revolution, money becomes easy to create by (almost) anyone. A digital file can be transformed into a means of payment by attaching a value, a cryptographic protection that allows to securely confer ownership and a protocol to move safely on the internet. The era of “e-cash” foreshadowed in by Milton Friedman in 1999 has effectively arrived.¹ This “tokenisation” of money brings

1 “The internet is going to be one of the major forces for reducing the role of government. The one thing that’s missing but that will soon be developed is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A, the way in which I can take a \$20 bill and hand it over to you and there’s no record of where it came from and you may get that without knowing who I am. That kind of thing will develop on the Internet and that will make it even easier for people to use the internet” (remarks from a video-recorded interview accessible under this link: <https://youtu.be/6MnQJFEVY7s>).

enormous benefits for the efficiency of payments (especially cross borders) and financial inclusion. It also brings a proliferation of new amenities as money is bundled with a diversity of services attached to payments [Brunnermeier et al. (2019)].

The consequences for the uniformity of money, however, may be problematic. At the same time Digitalisation has revived private money creation. At the same time, it has boosted creativity by enabling the creation of a multiplicity of special purpose tokens. In the current, fashionable, parlance, money can be made “programmable”, with two possible meanings attached to this formulation. First, programming can be inserted into the use of money Payments can be managed by smart contracts, i.e. algorithmically triggered by events or conditions. A second acceptance is that programming directly affects the nature - and value - of the monetary unit itself. It might be tempting, for instance to make some welfare payments in a money with an expiration date, so as to ensure that they are spent, not hoarded, thus maximising their stimulus impact. Governments with autocratic or moralistic tendencies can limit the use of those welfare payments, prohibiting the purchase of alcohol or leisure goods, making them closer to food stamps. The technical possibilities are almost infinite. But what is the value of a money with an expiration date, or limited use? Will be traded as a discount? How can it be transferred? It is clear that one central characteristic of money has been lost: its liquidity, its unconditional exchangeability. Programmable money is, by design, information sensitive. Two obvious conclusions can be drawn. First, left to its own dynamics, digital private money will be increasingly diverse and non-uniform; and, second, digital public money should not be designed as programmable.

2.3 Fragmentation of the monetary system

Launched in 2019 by Facebook, the Libra project has acted as a wakeup call. Think of the potentialities of a new money, denominated in its own unit of account and instantly available across the world to more than 2bn users, irrespective of borders. Though rebutted by regulators, Libra illustrated the synergies that large platforms can develop between payments and other data-based activities such as social media and e-commerce. The economic logic of platforms pushes them to develop as closed ecosystems where consumers are “locked in” a specific environment through economic incentives and technical standards. Many existing or projected models of so called “stable coins” are built on this model. Like Facebook, they aim to issue digital money backed by a portfolio of financial or digital assets. Obviously, they raise financial stability concerns of their own as they de facto engage into large scale maturity transformation.

From a monetary perspective, such ecosystems have been dubbed “Digital Currency Areas” (DCAs) [Brunnermeier et al. (2019)] where economic agents are

held together not by a macroeconomic commonality but by digital interconnectedness. Such DCAs can develop cross border or inside a monetary authority jurisdiction. In China, the payment systems developed by Ant Financial and Tencent are very close to meet that definition, with each of them counting several hundred million consumers and no interconnection between the two networks.

In a fragmented monetary system, different types of currency would become imperfect substitutes, despite being denominated in the same unit of account. Because frictionless arbitrage would not be possible between different forms of money, each would carry a specific and idiosyncratic risk that would necessarily be reflected in the price at which they trade. As a result, “exchange rates” would arise between different types of domestic money. In effect, the monetary system would be transformed and behave more like the broader financial system where the creditworthiness of every single instrument is constantly re-assessed and priced. The likely result would be greater fragility, with the possibility of liquidity crises and periodic runs on some forms of currencies if doubts about their issuers emerge [Landau and Genais (2019)].

2.4 Monetary sovereignty

Monetary sovereignty is usually defined in international economics as the ability to conduct an independent monetary policy with associated trade-offs between capital account and exchange rate policies. However, there is a more fundamental component to monetary sovereignty: the prevalence of the domestic unit of account on a monetary territory, and the associated uniformity of currency. Only if it controls the unit of account used by economic agents in trade and financial contracts, can the Central Bank conceive and implement an independent monetary policy. It can then fix the overnight interest rate on its own liabilities and, by arbitrage, influence the whole set of monetary and financial conditions. The weakening of the Central Bank’s liabilities as a unit of account would reduce the monetary authority’s ability to conduct monetary policy. Central Banks have become aware of the possibility that new forms of “digital dollarisation” could threaten their autonomy and sovereignty. It is no coincidence that the most advanced projects of CBDCs are in emerging economies historically more exposed to the risk of dollarisation.

A CBDC would help monetary systems to face the numerous challenges posed by the digitalisation of money. It would grant the general public direct access to public money. It would enable full substitutability between payment instruments and keep their relative prices fixed. It would maintain maintaining the uniformity of money in a digital economy.

3 Policy choices regarding CBDCs

The design of CBDCs will involve many difficult choices and tradeoffs, including their functional scope, privacy regime and access to nonresidents. Only those features that have a direct impact on domestic financial stability, and more specifically the banking sector, will be discussed here. It will be assumed that the CBDC is issued as a “cash like” instrument, exchangeable on a peer to peer basis, with a zero interest rate guaranteed for at least for some amount of transaction balances.

In the current monetary arrangements, deposits by the general public are convertible into Central Bank money (the banknotes). But that convertibility does not occur permanently on a large scale. The reason is that it meets with physical obstacles: collecting, transporting and storing cash is costly and risky. In a paradoxical way, the equilibrium of the whole contemporary monetary system rests upon a purely physical friction. What digitalisation and CBDC bring is an easier way to shift money from one intermediary to another or from one issuer to another. Physical frictions would disappear. If the objective is to preserve the current equilibrium between private and public money, it is a legitimate question whether they should be replaced by different, policy made, economic and financial frictions.

3.1 Disintermediation risk

There are two dimensions to the disintermediation risk: (i) a “structural shift” could occur from private deposits to CBDC, fragilising the funding of banks; and (ii) runs may become easier and more frequent.

With immediate and easy access to Central Bank money, it is possible that the general public will permanently shift part of its transaction balances away from bank deposits and into CBDC. The potential amplitude of such a shift is unknown. It would have two cumulative effects: banks would lose funding; and they would have to compete more for deposits, increasing the cost of their resources. Depending on the magnitudes, there could be a significant reduction of banks profitability, and of their ability to distribute credit. Theatrically however, it is possible to conceive of a mix of policies that would exactly compensate for the structural shock [Brunnermeier and Niepelt (2019)].

Banks have always been subject to deposit flights and runs, including in modern times. Runs are the counterpart of the convertibility of deposits into public money. They can be described as a pathological form of convertibility. Digitalisation will make runs easier. Digital runs from a bank to another have already occurred. Whether runs by the public from banks to the Central Bank may become more frequent or more intense is unknown. The possibility should be taken into account when designing a CBDC.

3.2 CBDC design and financial stability

Design choices may be based on an apparently simple idea: limiting CBDC to its role as medium of exchange and preventing it to become a prominent and privileged store of value for the general public. Taking into account its attractiveness as a safe asset, it means introducing some limits to access. Limits can be set either through quantitative (ceiling) or price (tiering) mechanisms. In both cases, Central Banks would have to “legislate” an acceptable level of transaction balances. Both solutions are differently attractive.

A cap or ceiling on individual holdings of CBDC could be instituted. The mechanism is fully transparent, clear, and easily understood. Its quantitative impact can be directly assessed *ex ante*. It gives certainty and permissibility to banks and authorities alike. Obviously, it does not guarantee a fully elastic supply of CBDC and may have complex effects on the perceived safety of bank deposits in times of crisis. It also carries implicit choices on privacy as CBDC holdings of each individual (or corporates) would need to be clearly identified.

Tiering would be based on a different scheme, with different level of remunerations attached to different levels of holdings. For instance, transaction balances below a defined threshold would be at zero interest rate. Above and beyond that threshold, a negative interest rate could be instituted or would be applied. Conceptually, it would correspond to the safety premium that holders would be asked to pay for storing value in the Central bank’s balance sheet. Operationally, it would create a disincentive to excess holdings. There would be a clear and visible separation between CBDC’s roles as a medium of exchange and store of value. The negative interest rate could be flexibly adjusted in times of stress to price in the increased demand for safety. Any flight to safety could be accommodated, at least in part, by changes in prices rather than by significant quantitative shift in the holdings of different forms of money. Financial instability created by large asset reallocation would be avoided. Tiering, however, would bring its own challenges. First, the mere prospects of negative interest rates could reduce the acceptability of CBDC and compromise its primary objective of universal and ubiquitous presence in the economy. Second, the Central Bank would be seen as deciding upon two interest rates: the policy rate applied to its deposit and refinancing facilities, and the (negative) interest rates on excess holdings of CBDC. While perfectly consistent and rational, this scheme may create confusion and blur the communication on monetary policy.

Weighting the costs and benefits of different options will be the main tasks of Central Banks in the period ahead. They will have to navigate the tradeoffs between universal access and attractiveness, on the one hand, and limits to substitution with bank deposits, on the other. They may not want to make those choices in isolation.

4 The organisation and regulation of payments

As attested by the recent proliferation of speeches by prominent Central Bankers on the “future of money”, digitalisation has triggered a fundamental rethink of our approaches to money. However, it raises other essential aspects of public policy and will impact financial intermediation more broadly. While the issuance of CBDC will bring a necessary response to the challenges of digitalisation, it will not be sufficient.

First, the technological features of digital private money will matter. Interoperability between digital networks, in particular, is a key condition for the uniformity of currency. As it goes against the natural economic incentives and business models of platforms, it may have to be regulated in some form.

Second, both monetary and regulatory authorities will have to take a long term and consistent view on the architecture and design of financial intermediation, in particular the place of banks and their role in the financing of the economy. The main source of future disruptions for banks is not CBDC, but the competition in payments emanating from platforms and Big Techs.

The key issue, therefore, is the relationship and future interaction between two essential financial functions: payments and credit. From a theoretical perspective, two “corner” solutions may be envisaged. The two functions can be fully dissociated, with payment competition fully open, and financial intermediation less dependent on the deposit taking activity of banks. Or they can be bundled and linked by regulation, which would consolidate the current bank - based model. The implications for financial stability and the distribution of credit in the euro area are likely to be very different and much more important than the CBDC. In the European Union, many strands of regulation are directly concerned, on data, digital platforms, privacy, payments, and crypto assets. Consistency of approaches will be very important in the current period, when innovation is intense and continuous.

REFERENCES

- Brunnermeier, M. K., and D. Niepelt (2019). *On the Equivalence of Private and Public Money*, National Bureau of Economic Research, Working Paper No. 25877.
- Brunnermeier, M. K., H. James and J.-P. Landau (2019). *The Digitalization of Money*, National Bureau of Economic Research Working Paper No. 26300.
- Committee on Payment and Settlement Systems (2003). *The role of central bank money in payment systems*, Bank for International Settlements, August.
- Dang, T. V., G. Gorton and B. Holmström (2015). *The Information Sensitivity of a Security*, Columbia University, unpublished Working Paper.
- European Central Bank (2021). “Eurosystème launches digital euro project”, press release, 14 July.
- Landau, J.-P., and A. Genais (2019). *Digital Currencies. An exploration into technology and money*, Report to M. Bruno Le Maire, Minister of Economy (France).
- Woodford, M. (2001). *Monetary Policy in the Information Economy*, National Bureau of Economic Research Working Paper No. 8674.

An initial analysis of energy transition risks using the Banco de España's FLESB stress-testing framework

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Abstract

This article contains the Banco de España's initial analysis of the energy transition risks' impact on the banking sector, using its Forward Looking Exercise on Spanish Banks (FLESB) in-house stress-testing framework. Different macroeconomic scenarios, linked to higher prices and the extended coverage of the emissions trading system, with a three-year time horizon are considered. In this exercise, the probability of default of the business lending portfolios was modelled with a high level of granularity, by enterprise size and by sector, to capture these transition risks' uneven impact on them. The other risk factors and balance sheet and income statement items are also projected consistently with the macroeconomic scenarios in order to obtain estimates for the institutions' profitability and solvency. Overall, the scenarios have a moderate impact on the credit quality of business lending; however, those sectors with greater greenhouse gas emissions are significantly more affected. Nonetheless, the exposures to these more affected sectors account for a relatively limited percentage of the Spanish banking sector's total lending. As a result, the ultimate impact on profitability is also muted. While the analysis conducted is an initial and partial approach to measuring transition risk, by focusing on the short term, it helps reduce uncertainty over the costs of the energy transition process.

Keywords: climate-related risk, transition risk, stress tests, probability of default, profitability, solvency.

1 Introduction

The physical risks stemming from climate change, associated with environmental degradation and a higher frequency of extreme events (e.g. prolonged droughts, fires and flooding), are a new source of risk to the financial sector. In light of these risks, fiscal and environmental policies play a key role in reducing carbon dioxide emissions and driving the transition to a more sustainable economic model in which the physical risks of climate change are held down at low levels. However, these economic transition policies entail a series of costs for certain sectors, which could stifle economic activity in the near future and also pose risks to the financial sector. Both types of risk can materialise in tandem as the measures to mitigate them may be applied late or inadequately, when climate change has already at least partially occurred.

In this setting, regulatory and supervisory authorities have started to develop analyses and tools to model and assess the impacts of climate change on financial

stability. Sensitivity analyses and stress tests provide a sound methodological basis for a forward-looking analysis of climate-related risks, given these risks' uncertain nature. This is prompting the development and adaptation of these forward-looking methodologies to the specific characteristics of these risks.

The most significant climate-related risks to the financial sector are generally related to the credit exposures and market exposures to other sectors, including those which are exposed to extreme weather events or to the costs of transitioning to a more sustainable economy. It is therefore necessary to construct macro-financial stress scenarios that capture the heterogeneity of the physical and transition risks specific to each sector. It is also necessary to adapt the stress tests to analyse in more granular detail the sectoral exposures and their associated risks on the basis of these scenarios with uneven impacts across sectors.

In this regard, the Banco de España's first step has been to develop a framework for analysing the impact on the banking sector of risk scenarios associated with the initial phases of the implementation of transition policies in Spain. Specifically, the pre-existing top-down Forward Looking Exercise on Spanish Banks (FLESB)¹ framework has been adapted for this purpose.

The macro-financial scenarios used for this exercise were designed in-house by the Banco de España and are based on the higher price of emission allowances and on different extensions of the coverage of the Emissions Trading System (ETS) for an extensive breakdown of over 50 sectors. These changes to environmental legislation are reflected in different shocks over a three-year analysis horizon to the real gross value added (GVA) growth paths for that sectoral breakdown.

The Banco de España's Central Credit Register (CCR) was used to model different risk parameters relevant to the exercise. Very granular data are thus obtained on the credit exposures to non-financial corporations and sole proprietors, including information on their repayment situation and the debtor's sector of economic activity, among other characteristics. An additional advantage of this database is its long-running time series. It has been used in this application to form datasets since 2000.

The probability of default² (PD) of banks' business lending exposures is estimated using the CCR database separately for each sector and enterprise size (large firms, SMEs³ and sole proprietors). These PDs are stressed by taking into account the sectoral shocks to the transition scenarios' GVA growth, in addition to the attendant

1 The results of the FLESB are published regularly in the Banco de España's *Financial Stability Report*.

2 In this article PD means the probability a performing loan will be classified as non-performing within 12 months, i.e. the probability of it being migrated from Stage 1 to Stage 3 over that time frame.

3 The distinction between large firms and SMEs is consistent with the European Commission Recommendation concerning the definition of micro, small and medium-sized enterprises (see European Commission (2003)). Therefore, large firms are those with 250 or more employees and an annual turnover of over €50 million or whose balance sheet total exceeds €43 million.

deterioration of the financial position (profitability, leverage, etc.) of each sector of activity. The other parameters and sources of income and loss for the banks are also stressed using the FLESB framework on the basis of the impact of the transition scenarios on the aggregate macroeconomic forecast for the overall economy.

The results obtained point to a moderate deterioration in credit quality in PD terms that is, however, markedly uneven across economic sectors. Thus, under the most severe scenario, over a three-year horizon and in the face of the implementation of environmental policies combating emissions, the average PD in that period could increase by up to 0.8 percentage points (pp) compared with the baseline scenario in the most affected sector (manufacture of coke and refined petroleum products). The impact on profitability is also moderate and varies based on the relative share of operations in Spain (the jurisdiction where the introduction of the environmental policy is being studied) and its sectoral composition. Cumulative profitability as a percentage of risk-weighted assets (RWAs) could fall by between 0.19 pp and 0.41 pp over the horizon analysed. The results therefore suggest that the banking sector would be capable of absorbing the costs stemming from the commencement of climate transition policies; however, some banks' profitability would be hit harder. The banking sector's solvency would not be materially impaired as a result of the introduction of the environmental policy considered.

The rest of this article is structured as follows: Section 2 examines the goals and context of the exercise; Section 3 presents the short-term sectoral transition scenarios used; Section 4 details the methodological approach developed to adapt the PD to a climate-related risk exercise; Section 5 sets out the results obtained in terms of PD and profitability; and Section 6 summarises the main conclusions. The article includes an annex containing complementary methodological information.

2 Goals and context of the exercise

This article analyses the materialisation of risks stemming from the transition to a more sustainable economy over a three-year horizon, without examining the possible materialisation of physical risks or longer time frames. Measuring the macroeconomic impact of the physical risks is particularly complex since it requires the explicit modelling of the relationship between economic and environmental conditions,⁴ and since such impact materialises over long time horizons. The Banco de España's future research will develop the data sources and macroeconomic models necessary for examining this type of scenario. However, this initial examination of the transition costs, which is more feasible using the available techniques, currently enables the measurement and assessment of the costs of these early policies to fight climate

⁴ See [Box 3.2](#) of the Banco de España's Autumn 2021 *Financial Stability Report* for an analysis of the quantification of the effect of environmental disasters on real estate wealth at regional level.

change. If these costs are moderate, the transition policies are easier to implement, despite uncertainties enduring long term.

Other initiatives to quantify climate-related risk using forward-looking methodologies include those by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), such as the *Guide for Supervisors*,⁵ the *Guide to climate scenario analysis for central banks and supervisors*,⁶ the NGFS' risk scenarios and other supporting documentation⁷ published between May 2020 and July 2021. At European level, different working groups have addressed the methodological progress and specific features of these models, which have been reflected in the documents *Climate-related Risk and Financial Stability*⁸ and *Positively Green. Climate Change Risks and Financial Stability*.⁹

With regard to the first practical applications of forward-looking methodologies by national supervisors and regulators, of note is the work to quantify the impact of climate change on financial stability in France¹⁰ and the Netherlands.¹¹ These latest exercises also include the estimated impact for insurance companies and pension schemes. The Bank of England has disseminated the basis for its climate-risk exercise,¹² the results of which will be published in 2022. Baudino and Svoronos (2021) compare the methodologies used, the objectives covered and the results currently available. Many other national authorities are conducting climate stress tests on their banks or on the financial system as a whole (see European Central Bank and European Systemic Risk Board (2021)). The ECB has also developed its own top-down analysis framework (ECB economy-wide climate stress test)¹³ with a view to assessing the exposure of euro area banks to climate-related risks.

The ECB's exercise is different from the one presented in this article in terms of the sample of institutions, methodology, type of climate-related risks considered and time horizon. The ECB's work stands out due to the breadth of its cross-section at European level, as it covers approximately 4 million firms and 2,000 banks, and extends the analysis of the transition risks to also include the impact of physical risks over a 30-year period. The results of the ECB's work show that, if no measures are applied, the costs stemming from extreme weather events rise substantially, thereby increasing the firms' PD. However, the long-term benefits of implementing prompt measures that drive the transition to a green economy would offset those firms'

5 See Network for Greening the Financial System (2020a).

6 See Network for Greening the Financial System (2020b).

7 See Network for Greening the Financial System (2021 and 2020c).

8 See European Central Bank and European Systemic Risk Board (2021).

9 See European Systemic Risk Board (2020).

10 See Allen et al. (2020) and Autorité de Contrôle Prudentiel et de Résolution (2021).

11 See Vermeulen et al. (2018 and 2019).

12 See Bank of England (2021).

13 See European Central Bank (2020) and Alogoskoufis et al. (2021).

short-term costs. The preliminary analysis of the impact of physical risks on credit quality in Spain also points in the same direction.¹⁴

The methodological basis for quantifying climate-related risk and the first exercises conducted by the authorities are a benchmark for banks. In this regard, supervisors and authorities have also published guides and action plans encouraging banks to be proactive and to factor climate-related risks into their business strategies and risk-management processes.¹⁵

3 Scenarios

This exercise's scenarios were prepared in-house by the Banco de España using the *Sectoral Carbon Tax* (referred to as CATS) model, in accordance with the methodology published by Aguilar, González and Hurtado (2021). The model has a highly detailed sectoral structure and is designed to capture the impact of transition risks over time horizons of two to five years. It is a general equilibrium model that enables the simulation of the impact of shocks on the Spanish economy. Particular importance is attached to the sectoral asymmetries based on how intensively they use different types of energy. The model takes into account the interconnectedness summarised by the input-output table data for the Spanish economy and replicates its main characteristics in terms of productive system, energy intensity, emissions by type of technology, etc.¹⁶ The application of the model enables the projection of different GVA growth paths for 51 non-energy sectors and for two energy production sectors ("fuel" and "electricity"),¹⁷ based on their specific transition risks and other macroeconomic variables of interest for the stress-test exercise.

14 See [Box 3.1](#) of the Banco de España's Autumn 2021 *Financial Stability Report* for a simplified analysis of the long-term impact of physical risks on PD.

15 In December 2019 the European Banking Authority published its action plan on sustainable finance (see European Banking Authority (2019)). In November 2020 the ECB published its guide on climate-related and environmental risks for banks (see European Central Bank (2020)). In the same vein, in October 2020 the Banco de España published the supervisory expectations document on risks posed by climate change and environmental degradation (see Banco de España (2020)). Like in the ECB's guide, climate-related and environmental risks are recognised as sources of financial risk and guidelines are provided for less significant institutions regarding how they should incorporate and address climate-related and environmental risks, including the preparation of stress tests.

16 To obtain the elasticities of substitution between the different types of goods, a mixed calibration was used in which the elasticity of substitution between non-energy goods was set at 0.9 in accordance with the literature and the model in Devulder and Lisack (2020), and only the value of the elasticities of substitution between energy and non-energy goods, or between different energy goods, is calibrated.

17 The two energy sectors differ as regards the amount of emission allowances associated with each, and also in the way in which the simplified specifications of the model relate to the more complex real world structures. In the case of fuels, their production does not generate a large amount of emissions, but their use does; the agents who use the fuels have to acquire the associated emission allowances, while the fuel producer receives a price that does not include the amount corresponding to such rights. Electricity, in contrast, generates emissions when it is produced, but not necessarily when it is used. Thus, electricity users do not need to acquire emission allowances, but simply pay a price to electricity producers, who are responsible for obtaining the necessary emission allowances to be able to produce that electricity.

The starting point for the design of the scenarios for this exercise is a baseline scenario, which assumes growth close to the Spanish economy's structural growth, more akin to pre-COVID-19 growth, considering that these measures will be implemented in a normal economic environment. Taking this baseline scenario, the effects of different shocks are estimated on the basis of the implementation of measures aimed at transitioning to a low-carbon economy, resulting in the following scenarios:

- i) Higher emission price scenario: this scenario entails increasing the price of a tonne of CO₂ equivalent from €25 (2020 average) to €100 (the current regulatory limit, given that it is the amount to be paid in the event of insufficient emission allowances). This increase is comparable in relative terms to previous increases (the annual average rose from €6 to €25 per tonne between 2017 and 2019 and, after holding at €25 on average in 2020, has already risen in recent months to above €50). In three years this shock would prompt a total reduction in emissions similar to that of the orderly transition scenario prepared by the NGFS, which for the Spanish economy would be close to 10% over this time horizon.
- ii) Extension of ETS coverage to all business sectors scenario: this scenario entails all emissions becoming levied, irrespective of the sector producing them. It prompts a smaller reduction in emissions but a very different sectoral impact; the high-emissions sectors that are currently exempt from the emission allowances system would be harder hit.
- iii) Combined shock scenario: this scenario causes a far greater stress scenario, given that it is equivalent to first raising the price of emissions and then extending the coverage to all sectors, rather than just the sum of the two preceding scenarios. Moreover, this second step is performed at the new €100 per tonne price, rather than the original €25 per tonne price. Over the three-year time horizon, this scenario prompts a somewhat larger reduction in emissions than that under the Net Zero 2050 scenario of the NGFS.
- iv) Combined shock scenario, also envisaging the extension of ETS coverage to households: this is a combination of scenario iii) and the application of the ETS to households for their direct fuel consumption. It prompts a somewhat greater reduction in emissions than in scenario iii) (under which households were not levied) and above all a greater cost in terms of GDP, given that the shock triggers a greater income effect.

Other technical characteristics that were considered in the CATS model to design these scenarios will be detailed in a forthcoming occasional paper. These include the assumption that higher tax revenues resulting from any of the above-mentioned shocks are channelled back to households (which in the model are business owners)

Table 1

IMPACT OF THE SIMULATED SHOCKS ON ECONOMIC ACTIVITY

Differences in the cumulative rates of change (t+1, t+2, t+3) compared with the baseline scenario.

	GDP	Range of impact on non-energy sectoral GVA (a)	
		Lower bound	Upper bound
Higher emission prices	-0.6	-5.3	0.1
Extension of ETS coverage	-0.3	-2.1	0.1
Combination	-1.3	-8.4	0.3
Combination, including extension to households	-1.9	-9.1	0.3

SOURCE: Banco de España.

a The lower bound of the range of impact on the sectoral GVA in each scenario is the most negative difference between the cumulative rates of change in the three years of the exercise and the corresponding measures under the baseline scenario. The upper bound is the analogous most positive difference. The scenarios 1) higher emission allowances prices; 2) extended ETS coverage; 3) combination (of the two shocks); and 4) combination, including extension to households, match those in the text with the same numbering.

via lump-sum transfers.¹⁸ It is also necessary to examine with caution the scope of the transition scenarios considered, which do not cover all their possible types.¹⁹ This is because part of the adjustment and resource-reallocation costs are not included – specifically, capital, the treatment of households as homogeneous agents and the exclusion of the effects via global trade – with the focus being placed on the effects of domestic demand. Also, it is assumed that the rise in energy prices in the scenarios is insufficient to cause permanent increases in inflation that feed through to interest rates or translate into sharp financial market corrections or significant shocks to house prices. Therefore, the effects of the shocks reflected in the scenarios could be considered a lower bound.

Table 1 shows that the most severe shock, captured by the scenario combining the higher emission allowances prices and the extension of the ETS to firms and households, would result in a 1.9 pp smaller cumulative change in GDP over three years than under the baseline scenario. The other scenarios would result in differences in cumulative GDP of between -1.3 pp and -0.3 pp compared with the baseline scenario.

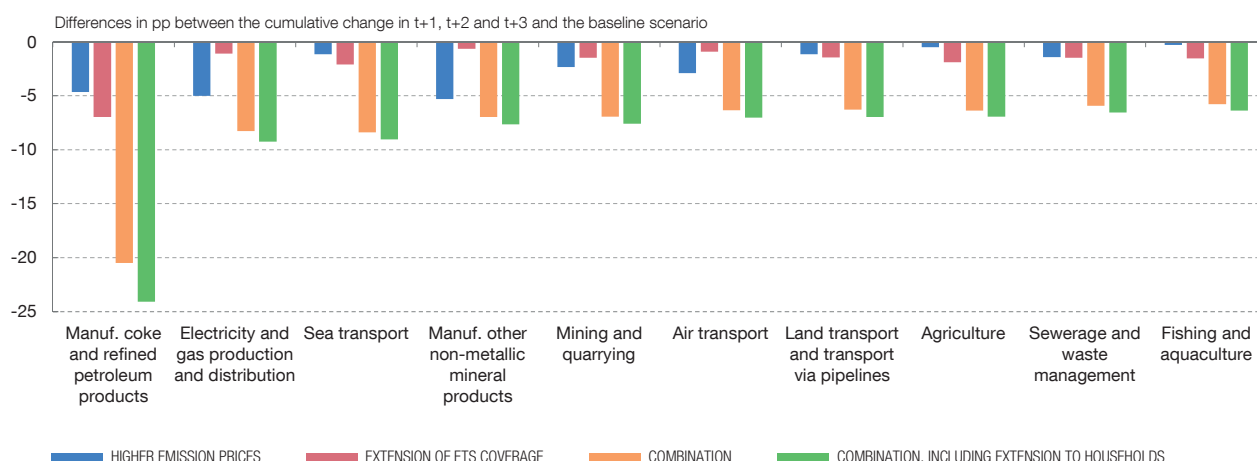
Further, the sectoral impact differs widely under all the scenarios, as demonstrated by the lower and upper bounds. Indeed, the GVA of some of the sectors considered by the model is stressed far more than aggregate GDP, especially under the scenarios with bigger shocks, as Chart 1 shows in greater detail.

¹⁸ If the higher tax revenues were channelled back via lower taxation on employment, the simulation would include an expansionary supply shock, which, as is quite common in the literature, can exceed the adverse effect of the tax on emissions. Given that the aim is to generate stress scenarios, the use of lump-sum transfers seems more appropriate.

¹⁹ See [Box 3.1](#) of the Banco de España's Autumn 2021 *Financial Stability Report*, which also expresses caveats as regards the scope of the transition scenarios considered.

Chart 1

CUMULATIVE DROPS IN GVA COMPARED WITH THE BASELINE SCENARIO (a)



SOURCE: Banco de España.

a From left to right the chart depicts the ten most affected sectors, ordered by the impact of the scenario combining higher emission allowances prices and the extension of the ETS to firms and households (most severe scenario).

4 Modelling of the probabilities of default by economic sector

4.1 General framework

The proposed framework models the PD of the exposures to businesses and considers a granular breakdown by bank, economic sector and business size. Business size is broken down into three categories: sole proprietors, SMEs and large firms.²⁰ In addition to the most aggregated macro variables (interest rate level, unemployment, growth of house prices, etc.), GVA growth disaggregated by sector and financial ratios obtained for groups of businesses by sector and by size were also considered.

It should be borne in mind that the other factors of bank risk and balance sheet and income statement items that are projected in the exercise, such as the value of the collateral provided, net interest income and RWAs, are also consistent with the proposed climate scenarios; however, PD is the channel through which the sectoral heterogeneity reflected therein is introduced. These other factors are projected on the basis of the aggregate macroeconomic variables consistent with the sectoral scenarios.

20 We examined the possibility of a more granular business-size breakdown; specifically, by distinguishing, within the SME group, between microenterprises (fewer than 10 employees), small enterprises (10-49 employees) and medium-sized enterprises (50-249 employees). This breakdown would be interesting, as the three groups have different characteristics, notably the quantitative importance of the microenterprise group and its specific limitations in access to credit, typically reflected by the use of mortgage guarantees. However, under the models used, obtaining, for the estimation, a sufficiently representative number of businesses with the additional breakdown by size would be impracticable in many sectors. Future research will consider how to expand the analysis of the corporate sector.

4.2 Specification

The PD is calculated at bank level for different economic sector and business size groups.²¹ Thus, pd_t^{bsg} denotes the PD in the period $t = 1, \dots, T$ of the businesses linked to the bank $b = 1, \dots, B$, in economic sector $s = 1, \dots, S$ and of size $g = 1, \dots, G$.

For the sectoral dimension, some additional aggregates are considered. These will be necessary if there is an insufficient number of observations to perform the estimation in certain sectors. It is assumed that each economic sector s belongs to one (and only one) group of similar sectors or “industry” $r = 1, \dots, R$, with $R < S$. pd_t^{brg} denotes the PD of that industry. Similarly, a is the aggregate of all the sectors, with the related PD equal to pd_t^{bag} .

The PD pd_t^{brg} is consistent with the average (weighted by number of debtors) of the PDs of the comprising sectors (for a given year, bank and size). Similarly, pd_t^{bag} is the weighted average of all the sectors and, in turn, of all the industries. To simplify the notation, the index i runs through all the sectoral components: the S sectors, the R industries and the total aggregate, such that $i = 1, \dots, I$, where $I = S + R + 1$. These elements are called “units”.

A logit link function is used in the PD modelling. Thus, pd^* is defined as:

$$pd^* = \ln(pd) - \ln(1 - pd) \quad [1]$$

With its inverse:

$$pd = \exp(pd^*) / (1 + \exp(pd^*)) \quad [2]$$

Three types of explanatory variables are considered:

- GVA growth in the period t , for the sector, industry or total aggregate, and for its first lag: $rvag_t^i$ and $rvag_{t-1}^i$. This variable is the same for all banks and business sizes.
- A vector of other M macro variables: $m_t = (m_t^1, \dots, m_t^M)$. This vector is the same for all banks, units and sizes. No lags are considered for this vector.
- A vector of J aggregate financial ratios by unit and size: $f_t^{ig} = (f_t^{1ig}, \dots, f_t^{Jig})$. This vector is the same for all banks and no vector lags are considered.

21 It is useful to highlight that, throughout this article, PD always refers to the aggregate PD of a certain group of exposures of businesses determined by the economic sector to which they belong, their size or the bank to which the exposure relates. Similarly, the financial ratios are always aggregate values of groups of businesses determined by their sector or size (in this case, not by the bank to which the exposure relates).

With these components, for the transformed PD the framework proposes a different panel model of B banks for each unit and size:

$$pd_t^{*big} = \alpha^{ig} + \rho^{ig} pd_{t-1}^{*big} + \beta^{0ig} rvag_t^i + \beta^{1ig} rvag_{t-1}^i + \theta^{ig} m_t + \delta^{ig} f_t^{ig} + e_t^{big} \quad [3]$$

Where α^{ig} , ρ^{ig} , β^{0ig} and β^{1ig} are scalars, while θ^{ig} and δ^{ig} are vectors. The variable e_t^{big} is an error component.²²

Paths of the explanatory variables in expression [3] are required to project pd_t^{*big} for periods longer than T. The paths for GVA growth and for the vector of the macro variables are part of the scenarios. However, the financial ratios are generated internally within the framework.

Accordingly, we opted for a panel model of the S sectors for each financial ratio $j = 1, \dots, J$, in each size $g = 1, \dots, G$, on the basis of the specification:

$$f_t^{jsg} = c^{jsg} + \varphi^{jg} f_{t-1}^{jsg} + \gamma^{jg} rvag_t^s + \vartheta^{jg} m_t + u_t^{jsg} \quad [4]$$

where c^{jsg} are sectoral fixed effects for each financial ratio and size, γ^{jg} is a scalar and φ^{jg} and ϑ^{jg} are vectors. u_t^{jsg} is an error component. These financial ratio dynamics, summarised in the parameters of the model in [4], are applied for simplicity to all levels of sectoral aggregation: individual sector, industry and aggregate of the economy.²³

The projections for the PDs pd_t^{big} over the projection horizon, $t = T + 1, \dots, H$, are then obtained using [3], with the financial ratios projected on the basis of [4].

Lastly, the projections for pd_t^{big} are adjusted to ensure consistency, for a given size, between the PD projections at the sectoral and the aggregate level, as analysed in the Annex.

4.3 Estimation

Specification [3] is identified separately for each unit (sector, industry, total aggregate) and size with a panel of B banks. I-G models are therefore identified. For a given activity and size, the identification process includes an exhaustive search that

22 This specification does not have bank fixed effects; it is a pooled regression. While the inclusion of fixed effects is advantageous for identification within the sample, it would impose some rigidity on the projections outside the sample in terms of the cross-unit differences that would be detrimental to the main, forward-looking purpose of the exercise. The period is relatively long (20 years) and the specifications implemented are tested to rule out the presence of autocorrelation, thus limiting the undesired effects of not including these fixed effects.

23 Fixed effects are considered for the financial ratio equations, but at sector level rather than at bank level, under the assumption that these invariant average fixed effects will be more stable over time at this higher level of aggregation. As different PD equations are estimated for each sector, in particular with a specific constant, equations [3] and [4] are consistent as regards the level of aggregation for which the fixed effects are considered.

ensures models with significant coefficients, signs consistent with economic theory (e.g. higher PD levels associated with a downturn in GVA growth), a lack of autocorrelation in the residuals and reasonable explanatory power within the sample. Implementing this process results, for each unit and size, in a final specification.

Should the exhaustive search not yield a set of eligible specifications for a unit and size, the model of its associated industry is imputed to it. If no set of eligible specifications for the industry is found, the aggregate model is imputed.²⁴

In turn, the identification of [4] is also performed separately, in this case by financial ratio and size, although no exhaustive search is performed. Instead, a manual selection is performed that favours to the extent possible a parsimonious specification with the same characteristics as in the automatic selection applied to [3].

The estimation of [4] is run via OLS. As the specification contains panel fixed effects (sectors) and an auto-regressive component, the estimated coefficients are biased. The typical alternative is the consideration of a GMM estimation method, such as the estimator in Arellano and Bond (1991) or other variants. However, this alternative estimation option requires an additional specification to be selected from within a broad set of instruments. Given the purpose of applying this estimation method on a recurring basis, the set of valid instruments may change over time, rendering the specification less stable. As a result, and since the expected bias induced by the OLS method decreases²⁵ as the value of T increases, this option is favoured over the GMM estimation. To verify that the bias is not significant vis-à-vis the current sample, the values of the coefficients were cross-checked against those that would be obtained via GMM.

The above-mentioned methodology is implemented with the available sources of information under certain practical considerations. First, a 12-month PD, measured annually, is used. The observation window for the data is 2000-2019, and the projection horizon is three years long.²⁶ The PD in each observation period for each bank, unit and size is calculated on the basis of the CCR.

In addition to GVA growth, the macro variables considered are 12-month EURIBOR, the unemployment rate, real GDP growth, stock market growth and house price growth. For specification [3] real GDP growth is disregarded, as the correlation between this variable and GVA growth (sectoral variable) may confuse the estimation of the cycle's effect on default risk.

24 This procedure is vulnerable to the situation where there is no eligible specification for the sectoral aggregate either. However, this did not arise in practice. In the imputation the constant is adjusted to ensure consistency in the variables' average.

25 See Nickell (1981).

26 As detailed in Section 3, the baseline scenario reflects a trend path and the others reflect shocks to that path. The years of the exercise's horizon, T+1, T+2 and T+3, are not linked to a specific T.

Three financial ratios, measured in two percentiles (i.e. calculated as a percentile of the sample of firms in each period and for each sector and size) are considered. The three financial ratios are: i) EBITDA plus financial revenue as a percentage of financial costs, proxying the flow of funds generated to service financial costs; ii) ROA; and iii) the ratio of equity to assets. The percentiles are the 50th (median) and the 25th (firms in an unfavourable position). The six financial ratios are calculated using information from the Central Balance Sheet Data Office (CBSO) of the Banco de España, eliminating from the sample those firms without financial debt. It is assumed that, despite not being identical,²⁷ the populations of the CCR and the CBSO are consistent and that the data from the CBSO are sufficiently representative to indicate the defaults by firms included in the CCR. In order for the inclusion of the financial ratios from the CBSO as explanatory variables to be useful, their average values do not need to be comparable with those of the CCR firms. Instead, a correlation in the financial cycle of the two groups, and that such correlation is not captured by the macroeconomic variables, shall suffice.

The sectoral dimension includes 61 sectors,²⁸ which approximately represent the two-digit NACE Rev.2 code breakdown, with greater detail in the activities more susceptible to being affected by the green transition. These 61 sectors are grouped into 21 industries.

Business size is broken down into three categories: sole proprietors, SMEs and large firms. Since the CBSO does not have information on sole proprietors, the financial ratios of the SMEs were used as a proxy for their financial position.²⁹

5 Findings

The findings yielded by the methodological framework described above are set out in this section. Firstly, Chart 2 shows the differences between each adverse scenario and the baseline in the average projections for ROA over the exercise's three-year time horizon for the corporate sectors most affected by the environmental policy changes under analysis.³⁰ As expected, the declines are more pronounced in the scenarios combining both effects (higher prices and extended ETS coverage, particularly when they affect households). In the case of SMEs, the greatest

27 The discrepancy is because the universe of firms reporting to the CBSO does not necessarily coincide with the universe of firms that have outstanding bank debt.

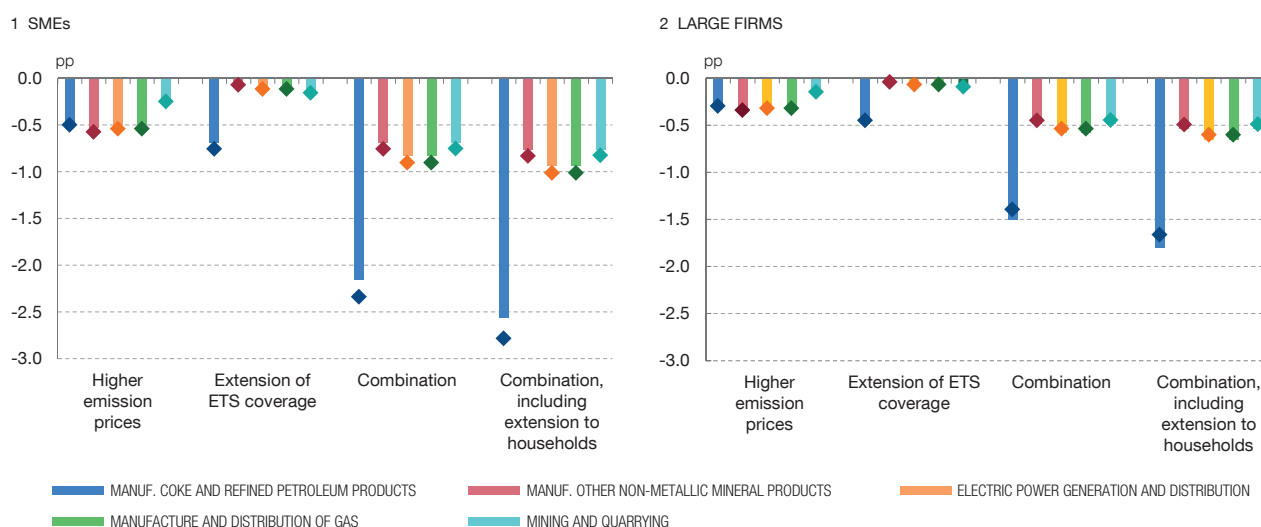
28 While the scenarios are designed for 53 sectors, the FLESB considers 61 sectors to present a more granular breakdown in portfolios with potentially different behaviours in terms of default risk or that are more susceptible to climate-related risks. To do so, the GVA growth paths available from the scenarios are applied to the more granular sectorisation used in the FLESB on the basis of their similar response to the cycle.

29 Should this assumption not be appropriate, the SMEs' financial ratios would generally appear as insignificant in the estimation exercise and would not be used for the final estimation based on the algorithm used.

30 The sectors most affected mean those with the highest PD increase on the baseline under the most adverse scenario. Similar findings for the leverage and interest coverage ratios are available from the authors upon request.

Chart 2

DIFFERENCE IN THE AVERAGE ESTIMATED ROA BETWEEN THE ADVERSE AND BASELINE SCENARIOS (a)



SOURCE: Banco de España.

a The bars represent the estimates for the 50th percentile (median firm), while the diamonds represent the estimates for the 25th percentile (firm facing financial difficulties).

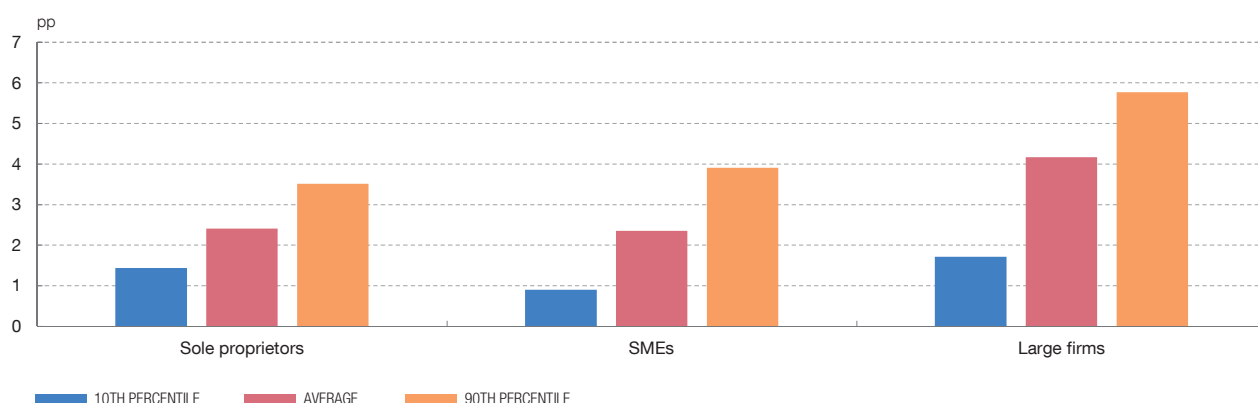
differences compared with the baseline scenario can be found in the manufacture of coke and refined petroleum products (fall of 2.56 pp under the most adverse scenario for the 50th percentile and of 2.78 pp for the 25th), the production and distribution of electricity and gas³¹ (0.93 pp for the 50th percentile and 1 pp for the 25th), the manufacture of other non-metallic mineral products (0.77 pp for the 50th percentile and 0.83 pp for the 25th) and, lastly, land transport and transport via pipelines (0.72 pp for the 50th percentile and 0.79 pp for the 25th). In the case of large firms, while the same sectors are affected, the impact is somewhat smaller.

To illustrate the sensitivity of PD to GVA growth on the basis of the estimated models, Chart 3 shows, for each of the three business sizes considered, the average and the 10th and 90th percentiles of the distribution of PD semi-elasticities with respect to GVA growth³² for the 61 sectors considered. The distributions of semi-elasticities for sole proprietors and SMEs are similar, with average values of 2.41 pp and 2.35 pp, respectively, while that of large firms leans towards somewhat higher values, with an average value of 4.16 pp. The model also includes other explanatory variables (both macroeconomic variables and financial ratios), which are correlated with GVA

31 Both sectors show the same fall since they are assigned similar GVA growth rates in the scenarios. Nonetheless, they are addressed separately for the purposes of the PD projection.

32 Having used a logistic regression, the semi-elasticity of PD to the variable x in point pd^* is given by $\beta(1 - pd^*)$, β being the coefficient of the variable x in the regression. For Chart 3, the average value of the series has been taken as pd^* , and the sum of the contemporaneous coefficients and the first lag as β , and the latter may be equal to 0 depending on the specification chosen.

Chart 3

PD SEMI-ELASTICITIES TO GVA GROWTH

SOURCE: Banco de España.

growth; therefore, the net sensitivity of PDs to the economic cycle must at all times be measured by analysing comprehensive scenarios.³³

Once the various sectoral PD models have been specified and estimated, these are then used to obtain projections over a three-year horizon in line with the baseline scenario and with the various scenarios involving different extensions of the emissions trading system. Chart 4 shows the deviations in average PD with respect to the baseline scenario over the projection horizon for the five sectors most affected³⁴ and for all of the sectors in each scenario.

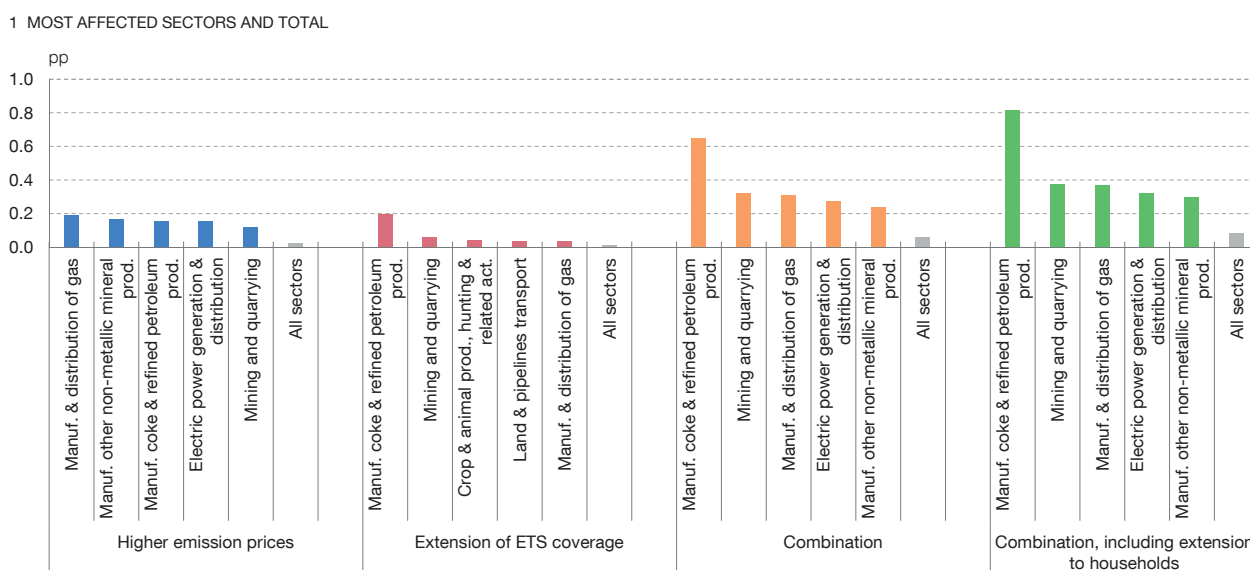
As can be seen in Chart 4, in all of the scenarios in which emission prices rise, the group of sectors with the largest increases in PD is made up of a set of activities with high CO₂ emissions: extractive industries, the manufacture of non-metallic minerals, electricity and gas production and distribution, and the manufacture of coke and refined petroleum products. Where only the extension of the ETS is factored in, certain sectors not previously covered by such system (such as agriculture or certain transportation activities) feature among those most affected. In the scenario in which only a rise in the price of emission allowances is considered, the impact on the PD of the various emissions-intensive sectors is more symmetric, whereas extending the ETS to more sets of sectors, triggering a larger contraction in aggregate demand, gives rise to an outcome with a greater adverse differential effect on petroleum refinery and coke manufacturing and, to a lesser degree, on mining and quarrying and gas production and distribution. In all of the scenarios in which emission prices

33 It is also worth noting that while these semi-elasticities are seemingly not particularly significant, GVA growth may be very high (even upwards of 10% in absolute terms) and the Logit function is not linear, any changes in PD in the event of changes in GVA growth are material from an economic standpoint.

34 The sectors most affected are those with the highest PD increase with respect to the baseline in the scenarios.

Chart 4

DIFFERENCE IN AVERAGE PDs BETWEEN EACH SCENARIO AND THE BASELINE SCENARIO (a)



SOURCE: Banco de España.

a PD of exposures to large firms, SMEs and sole proprietors. PDs are estimated for each bank, but the average weighted by the number of borrowers is presented.

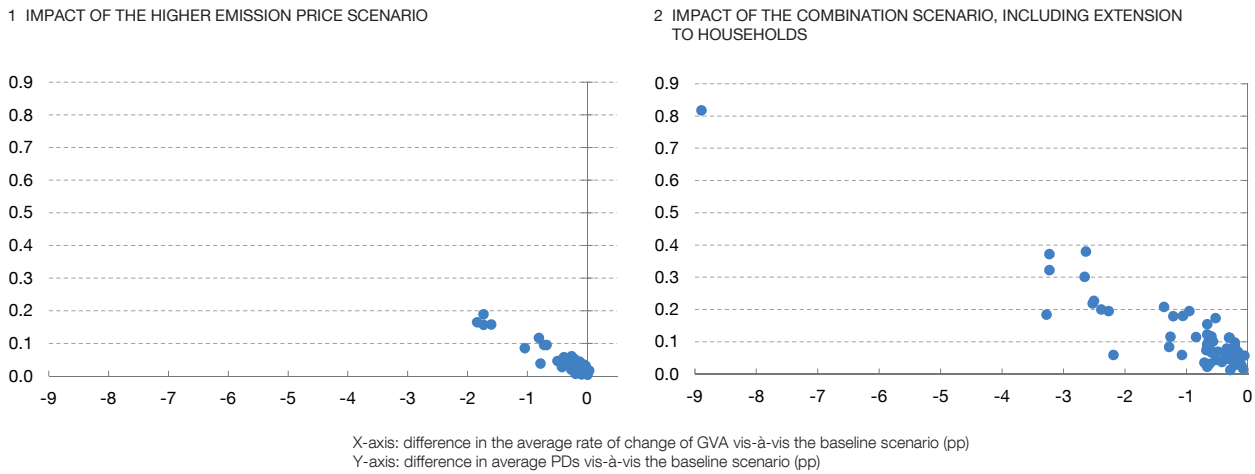
rise, the impact on the PD of these more affected sectors is several orders of magnitude greater than that on the sectors overall. In other words, the sector-specific impact of the various scenarios is highly asymmetric.

As expected, the sectors with larger increases in PD are those with steeper declines in GVA in the scenarios, measuring both aspects against the baseline scenario. Chart 5 shows the correlation between the baseline-adverse scenario differences in respect of PD and GVA growth for the scenario in which emission prices rise (see Chart 5.1), and the scenario combining all effects, including the extension of the ETS to all firms and households (see Chart 5.2). As can be seen in both scenarios, most sectors fall within a limited range of outcomes in terms of GVA and PD, whereas a small group of sectors (CO₂ or other greenhouse gas emissions-intensive sectors or those more sensitive to shocks to activity, such as the real estate sector) suffer greater distress. Particularly worth noting is the point located in the upper left-hand corner of Chart 5.2, which represents the coke manufacturing and oil refinery sector, and shows the greatest average difference in the decline in GVA (-8.9 pp) and in average PD for 2021-2023 (0.82 pp).

Once the PDs have been projected for each scenario and for corporate credit portfolios overall, having regard to their characteristics (sector and business size), the rest of the credit risk parameters required to estimate the expected credit losses on exposures to corporates are estimated: other transition probabilities for stages of credit quality, loss given default (LGD), etc. These other parameters do not depend on activity in the sector, but rather directly on the aggregate macroeconomic

Chart 5

DIFFERENCE IN AVERAGE PDs BETWEEN THE BASELINE AND ADVERSE SCENARIOS AND CHANGES IN GVA UNDER TRANSITION COST SCENARIOS (a)



SOURCE: Banco de España.

a Each dot on the chart represents a sector. PDs are estimated over the projection horizon for each bank, but the difference in each sector's weighted average is depicted. The weighting is done by number of borrowers.

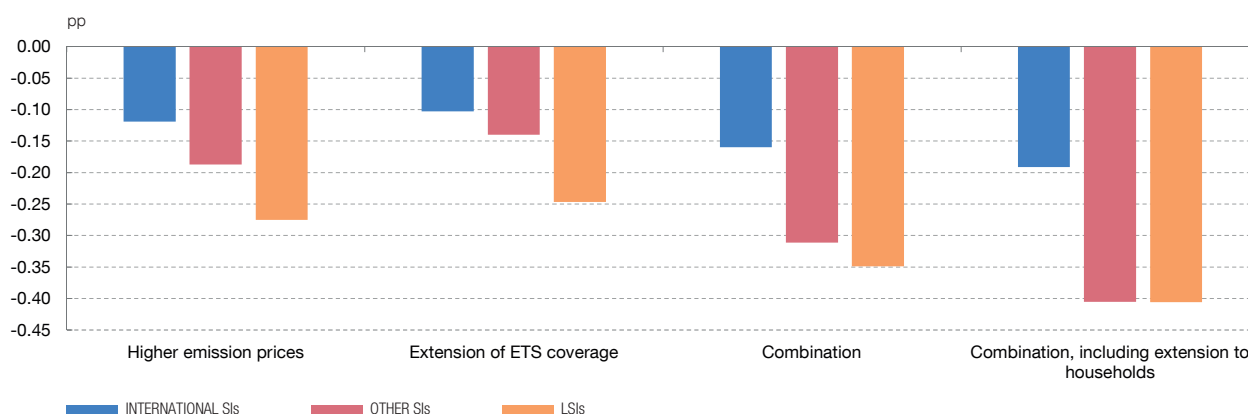
variables (including GDP growth, unemployment and house prices). The credit risk parameters of other (mortgage and consumer) credit portfolios are also estimated, together with other factors contributing to the stress-testing exercise (sovereign exposure risk, generation of net interest income and other income statement items, etc.), as per the standard FLESB procedures.

Thus, the framework enables the net impact of such scenarios on the profitability of Spanish banks to be estimated. Chart 6 shows the differences between the baseline and adverse scenarios in the ratio of accumulated after-tax profit to RWAs for three groups of Spanish institutions: institutions directly supervised by the ECB that have significant international activity (International SIs), the other institutions supervised directly by the ECB (Other SIs) and institutions supervised directly by the Banco de España (LSIs).

The higher emission price scenario has a greater impact than the extended ETS coverage scenario for all groups, in line with the larger increases in PD and the greater worsening of the aggregate macroeconomic forecast associated with the former. In both scenarios, the deterioration is more severe at LSIs and the institutions supervised by the ECB without significant international activity, since the environmental policy changes considered apply only in Spain, while cross-border diversification has a positive effect for the group of International SIs. As expected, the differences are greater (-0.16 pp, -0.31 pp and -0.35 pp for the International SIs, the Other SIs and the LSIs, respectively) in the scenario in which the price effects are

Chart 6

DIFFERENCE IN THE RATIO OF ACCUMULATED AFTER-TAX PROFIT TO RWAs BETWEEN EACH SCENARIO AND THE BASELINE SCENARIO (a) (b)



SOURCE: Banco de España.

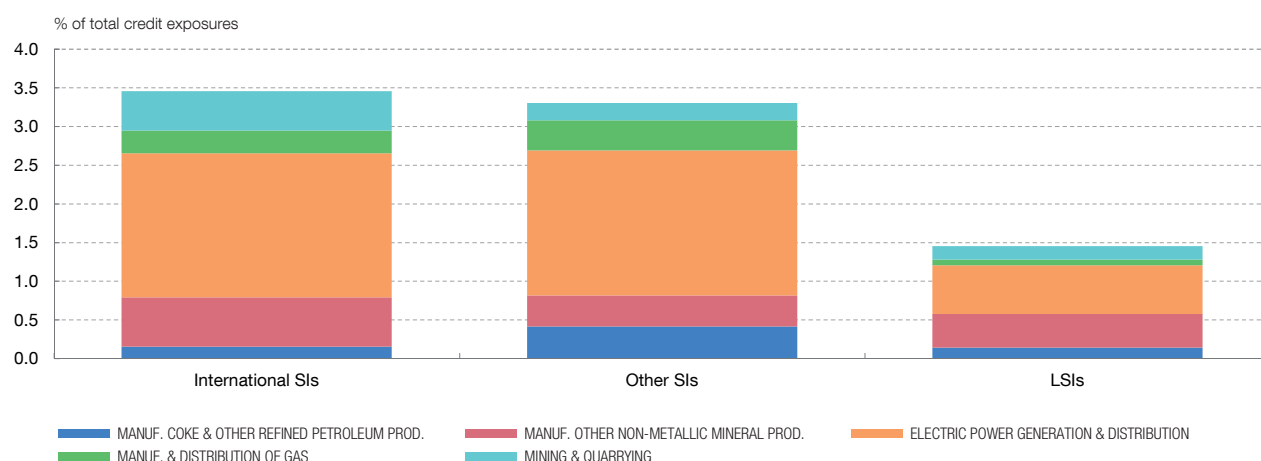
- a To calculate the ratio, the numerator (profit after tax) is accumulated over the three years of the exercise, while the denominator is the value of average RWAs in the same period.
- b The chart shows absolute percentage differences vis-à-vis the baseline scenario. However, since the profitability ratio for Other SIs is significantly lower than for the other groups, if the impact were calculated relative to the ratio under the baseline scenario $((\text{adverse ratio} - \text{baseline ratio})/\text{baseline ratio})$, the effect for the Other SI group would be higher than for the other groups. This is linked to the fact that they are not internationally diversified and, compared with LSIs, they are more exposed to the sectors most sensitive to the transition risks considered.

combined with the extension of the ETS to other sectors. Lastly, in the scenario in which ETS coverage is also extended to households, the declines with respect to the baseline scenario stand at -0.19 pp, -0.41 pp and -0.41 pp, respectively.

The impact of these scenarios is, in large part, contained thanks to the fact that the sectoral distribution of Spanish banks' credit exposures to emissions-intensive sectors is limited. Chart 7 shows the five sectors most vulnerable to transition risks (those with the largest baseline-adverse scenario increases in PD in the most severe scenario combining the different policies) as a percentage of the total credit exposures to corporates in Spain for the three groups of institutions analysed above. This percentage ranges from 3.5% for the International SIs to 1.5% for LSIs. Moreover, an analysis of the credit exposures of individual banks does not reveal any significant concentration of exposures to these sectors at any of these institutions.³⁵ Note that the ultimate impact of the exercise on the solvency of institutions does not depend solely on this sectoral distribution, but rather also on the share of total assets that lending activity accounts for, and the vulnerability of each bank to the shock to the aggregate macroeconomic conditions also entailed by the modification of these policies.

³⁵ For further information on the concentration of Spanish banks in sectors potentially affected by the transition to an emissions-free economy, see Delgado (2019).

Chart 7

SHARE OF SPANISH BANKS' CREDIT EXPOSURES TO SENSITIVE SECTORS (a)

SOURCE: Banco de España.

a Credit exposures in Spain are considered.

6 Conclusions

This article presents the first climate stress test conducted by the Banco de España on all Spanish deposit institutions. The analysis focuses on short-term transition risks arising from environmental policies aimed at reducing CO₂ emissions (higher emission allowance prices and extension of their requirement to more sectors) and their uneven impact on the different economic sectors. Both components have been included in the Banco de España's top-down FLESB stress-testing tool. To this end, macroeconomic scenarios reflecting these transition risks, developed with the Banco de España's CATS model, have been applied, and the FLESB credit risk methodology has been extended to enable PDs to be modelled with a high sectoral granularity, with sensitivity to GVA growth and to the financial position of firms in different economic sectors. These innovations are useful for credit risk modelling under general crisis scenarios, not just those linked to climate risks.

The exercise shows that the short-term impacts of the transition scenarios on the profitability and solvency of the Spanish banking sector are moderate, although the impact on PD and financial position is uneven across sectors. In particular, the sectors most linked to greenhouse gas emissions would be the most affected. However, these exposures represent a very limited fraction of total bank lending to business activity in Spain. Spanish banks would, therefore, be able to absorb the materialisation of the short-term transition risks envisaged in this exercise, which focus on shocks to the activity of the different economic sectors.

This exercise should be understood as a first milestone in climate risk quantification by the Banco de España. Future research will analyse the modelling of physical risks (desertification, floods, fires, etc.) in the macroeconomic environment and the banking sector, and additional risks from the transition to a green economy, such as those arising from replacing productive capital to adopt new technologies or the effects of the higher cost of emission allowances on prices.

Lastly, it should be noted that exercises of this kind are useful for informing monetary policy decisions. Although climate change and its economic and physical consequences go beyond the strict scope of the banking sector, and despite the fact that this first exercise examines only a limited subset of the total exposures, the analysis conducted helps to reduce uncertainty surrounding the effect of policies to combat climate change. Finding that certain transition risks will have a limited impact provides information, albeit still partial, for the cost-benefit assessment of adopting measures and allows future research to be steered towards other sources of transition and physical risks.

REFERENCES

- Aguilar, P., B. González and S. Hurtado (2021). “The design of macroeconomic scenarios for climate change stress tests”, *Financial Stability Review* No 40, Banco de España.
- Allen, T. et al. (2020). “Climate-related scenarios for financial stability assessment: An application to France”, *Working Paper* No 774, Banque de France.
- Alogoskoufis, S., D. Nepomuk, T. Emambakhsh, T. Hennig, M. Kaijser, C. Kouratzoglou, M.A. Muñoz, L. Parisi and C. Salleo (2021). “ECB economy-wide climate stress test. Methodology and results”, *Occasional Paper* No 281, September, European Central Bank.
- Arellano, M. and S. Bond (1991). “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations”, *Review of Economic Studies* 58, pp. 277–297.
- Autorité de Contrôle Prudentiel et de Résolution (2021). “A first assessment of financial risks stemming from climate change: The main results of the 2020 climate pilot exercise”, *Analyses et Synthèses*, No 122-2021.
- Banco de España (2021). *Financial Stability Report*, Autumn, 4 November.
- Banco de España (2020). *Banco de España supervisory expectations relating to the risks posed by climate change and environmental degradation*, 23 October.
- Bank of England (2021). *Key elements of the 2021 Biennial Exploratory Scenario: Financial risks from climate change*, 8 June.
- Baudino, P. and J.-P. Svoronos (2021). “Stress-testing banks for climate change – a comparison of practices”, *FSI Insights* No 34, 14 July, Bank for International Settlements.
- Delgado, M. (2019). “Energy transition and financial stability. Implications for the Spanish deposit-taking institutions”, *Financial Stability Review* No 37, Banco de España.
- Devulder, A. and N. Lisack (2020). “Carbon Tax in a Production Network: Propagation and Sectoral Incidence”, *Working Paper* No 760, Banque de France.
- European Banking Authority (2019). *EBA Action Plan on Sustainable Finance*, 6 December.
- European Central Bank (2020). *Guide on climate-related and environmental risks*, 27 November.
- European Central Bank and European Systemic Risk Board (2021). *Climate-related risk and financial stability*, 1 July.
- European Commission (2003). *Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises*.
- European Systemic Risk Board (2020). *Positively Green. Climate Change Risks and Financial Stability*, 14 June.
- Network for Greening the Financial System (2020a). *Guide for Supervisors. Integrating climate-related and environmental risks into prudential supervision*, Technical document, May.
- Network for Greening the Financial System (2020b). *Guide to climate scenario analysis for central banks and supervisors*, Technical document, June.
- Network for Greening the Financial System (2020c). *NGFS publishes a first set of climate scenarios for forward looking climate risks assessment alongside a user guide, and an inquiry into the potential impact of climate change on monetary policy*, Press release, 24 June.
- Network for Greening the Financial System (2021). *NGFS Climate Scenarios for central banks and supervisors*, June.
- Nickell, S. (1981). “Biases in Dynamic Models with Fixed Effects”, *Econometrica*, Vol. 49(6), pp. 1417–1426.
- Vermeulen, R., E. Schets, M. Lohuis, B. Kolbl, D.-J. Jansen and W. Heeringa (2018). “An energy transition risk stress test for the financial system of the Netherlands”, *Occasional Studies*, Vol. 16-7, De Nederlandsche Bank.
- Vermeulen, R., E. Schets, M. Lohuis, B. Kolbl, D.-J. Jansen and W. Heeringa (2019). “The Heat is on: a framework for measuring financial stress under disruptive energy transition scenarios”, *Working Paper* No 625, De Nederlandsche Bank.

The projections for pd_t^{bsg} are adjusted to ensure consistency, for a given size, between the PD projections at the sectoral and the aggregate level. This requires, for a given size and for each period of the projection horizon, the weighted average of the PDs of the S sectors in the B banks to be equal to the aggregate PD for that size. In other words, the following must be satisfied:

$$\sum_{s,b=1}^{S,B} m_T^{bsg} pd_t^{bsg} = pd_t^{ag} \quad [A.1]$$

for each period $t = T + 1, \dots, H$ and each size $g = 1, \dots, G$, where m_T^{bsg} is the number of debtors of bank b , in sector s , in size g , in the latest observation period T .¹

Since the proposed framework does not guarantee that condition [A.1] is met when projecting sectoral and aggregate PDs separately, this condition is imposed by means of a positive scalar for each size and time period of the projection horizon, k_t^g , which multiplies the PD projections for all banks and sectors obtained from the disaggregated model. It is therefore a linear scaling. Coefficient k_t^g is calibrated to satisfy equation [A.1].

The final projection, pd_t^{bsg} , $t = T + 1, \dots, H$, is thus calculated as:

$$pd_t^{bsg} = k_t^g pd_t^{bsg} \quad [A.2]$$

This adjustment allows the final projection for each bank to be interpreted as the aggregation of two effects: the systemic changes in PD by firm size and the dispersion of PD across economic sectors. Adjusting for the aggregate of banks rather than on a bank-by-bank basis ensures that the different sectoral composition of their portfolios is reflected in the estimate. If the adjustment were made bank by bank, the aggregate PD for the size would result from the aggregate model, and would therefore be insensitive to the bank's sectoral composition. Conversely, by adjusting at the aggregate level, if a bank, for example, has a higher concentration than the system aggregate in sectors with higher PD projections (because it is more sensitive to the climate scenario), then its aggregate PD by firm size will also tend to be greater than that of the system as a whole.

¹ The weighting by the number of debtors in each sector is kept constant over time because of the high computational cost of recalculating their number in each period and their relative stability within the projection horizon.

Archehos and Greensill: collapse, reactions and common features

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Abstract

The recent collapse of certain market operators has reopened the debate on the vulnerabilities of non-bank financial intermediation and their implications from the regulatory and supervisory standpoint. This article focuses on Archegos and Greensill whose collapse, although not systemic, highlights the importance of the interconnections between this type of institutions and the banking sector. It describes the circumstances that led to their collapse, the regulations applicable to them and the main reactions of the competent authorities to date. It then discusses some of the common features that can be identified as determinants and that could inform future debate on these cases from a regulatory and supervisory policy perspective.

Keywords: non-bank financial intermediation, total return swaps, derivatives, interconnections, regulation, financial stability.

1 Introduction

The profound impact of the 2007-2009 global financial crisis led to important changes to regulations applicable to the financial system, which have been developed and implemented over the last decade. A variety of readings and interpretations of the crisis were put forward, and a wide range of measures were adopted to mitigate its consequences and address its causes and underlying vulnerabilities.¹

These vulnerabilities include the widespread use, as from the 1990s, of mechanisms and instruments whose design limits the visibility of the actual level of leverage of certain funding structures.² In recent months, various episodes have put the potential risks of these mechanisms and instruments back on the table. Specifically, this article analyses the cases of Archegos Capital Management and Greensill Capital.

Both cases have highlighted problems linked to the opacity of certain financial mechanisms. Through a web of derivatives contracts with multiple bank counterparties, Archegos, a vehicle set up to manage a family's wealth, had reached high levels of exposure to certain US and Chinese telecom firms. Meanwhile, Greensill dealt in the discounting of invoices issued by the suppliers of ailing companies and financed the business by securitising those invoices.

1 Quarles (2019), Haldane (2017) and FSA (2009).

2 Rajan (2005).

Both business models were therefore characterised by high leverage. And the lack of transparency of this leverage increased its harmful effects when the underlying difficulties came to light: in the case of Archegos, because of the scant information required of this type of institutions and the absence of widespread requirements in the United States on transaction reporting to specialised repositories; and, in the case of Greensill, because of inappropriate application of the accounting standards, which enabled debtor companies to disguise their financial position.

Given their characteristics, the study of these episodes may contribute to assessing the degree of success of some of the reforms implemented in the wake of the global financial crisis. To a large extent, the G20's plan in response to the crisis sought to shed light on certain areas of the new financial intermediation model that had been taking shape in the previous years and addressed factors that have later proved to be essential in cases such as Archegos and Greensill.

Specifically, at its April 2009 meeting,³ the G20 called for greater regulation and supervisory oversight of hedge funds and similar vehicles, focusing on their leverage disclosures, assessment of their potential systemic risks and supervision of the risk management mechanisms put in place by the investment banks operating with such funds (including the setting of limits on their exposures and leverage levels). It also recommended the establishment of central counterparties to strengthen credit derivatives markets and help standardise their traded contracts. Problems related to these areas have resurfaced in the Archegos case.

The G20 meeting also addressed some of the problems relating to banks' excessive leeway for creating off-balance-sheet financial structures, for instance, by using structured or special-purpose vehicles (SPVs) to securitise pools of credit exposures that were taken off banks' balance sheets regardless of the degree of involvement and support of the originating bank. These aspects have re-emerged in the Greensill episode.

More generally, all these measures sought to address the problem of using securities portfolios to engineer highly leveraged arrangements, either by creating financing chains supported by those same securities, or through structures based on the use of complex derivatives instruments, designed to increase the synthetic exposure to the risks and rewards of certain types of assets.

Moreover, the legal and regulatory context favoured the transfer of exposures from banks' balance sheets to those of operators subject to lighter regulatory requirements. First, the securities issued as a result of this process were given a high credit rating, on which many of the regulatory requirements were based. This provided the holders of these securities with an additional source of liquidity, either through their sale

³ G20 (2009).

under a repurchase agreement (repo) or use as collateral in derivatives transactions. Second, certain legal systems (mainly common law systems) allow pledging (re-hypothecation) of securities acquired in repo transactions⁴ and grant creditors with claims relating to derivatives or repo transactions priority in insolvency proceedings.⁵

In the years following the April 2009 G20 meeting, the Financial Stability Board (FSB), along with the various international regulatory bodies, established mechanisms for discussing and coordinating measures to implement the recommendations and reforms agreed. With the aim of reducing the opacity of the new financing structures, the definition of control and the scope of consolidation were expanded⁶ and guidelines were established for the reintermediation of exposures.⁷ Regarding the excessive leverage prompted by the use of assets to support such structures, in 2013 the FSB published a policy framework for addressing shadow banking risks in securities lending and repos,⁸ dealing with issues such as re-hypothecation of collateral assets. Since 2016, all FSB members with hedge funds and similar operators have reported compliance with the G20 recommendations described above.⁹

Regarding reforms in derivatives markets, in 2020 the FSB reported significant progress in areas such as the reporting of transactions to trade repositories, central counterparty clearing, strengthening of the resilience of central counterparties, and margin requirements for non-centrally cleared derivatives.¹⁰

However, despite this considerable progress, episodes such as Archegos and Greensill have once again highlighted the risks and vulnerabilities associated with some of these activities. Section 2 describes each of these episodes against the backdrop of the key regulatory frameworks applicable to both. Section 3 presents the authorities' reactions and Section 4 identifies common determinants that could be part of a future analysis of these cases from a supervisory and regulatory perspective.

2 Description of the cases

The Archegos and Greensill cases have resulted in significant losses for some systemically important banks, but their business and applicable regulations differ, as do the drivers of those losses. Each of these two cases is therefore described separately below.

4 FSB (2017).

5 Duffie and Skeel (2012).

6 IFRS 10 (summarised in IAS Plus: <https://www.iasplus.com/en/standards/ifrs/ifrs10>).

7 BIS (2017).

8 FSB (2013).

9 FSB (2020b).

10 FSB (2020a).

2.1 Archegos

Archegos Capital Management was a US hedge fund structured as a family office¹¹ to manage Bill Hwang's wealth.¹² Family offices are exempt from some of the requirements applicable to other investment firms, for example in relation to the reporting of their exposures. Although the Dodd-Frank Act (DFA) introduced stricter regulations for investment advisers, to enable the US Securities and Exchange Commission (SEC) to oversee hedge funds, it left the treatment of family offices to the discretion of the SEC. In 2011, the SEC approved rules defining the criteria for exempting these vehicles from registration and certain investor protection rules.

Although the exact figures are unknown, Archegos held assets in the order of \$10 billion, with exposures of between \$50 billion and \$100 billion (even higher according to some reports). These exposures were largely concentrated in shares of ViacomCBS and Discovery (US telecommunications groups) and in various Chinese technology companies (e.g. Baidu).

The leverage required to reach this volume of exposure was achieved through the use of total return equity swaps, contracts whereby one of the parties takes a synthetic long position in the underlying asset, thus obtaining returns (dividends and price appreciation) in exchange for assuming its potential depreciation (see Figure 1). In exchange for the corresponding fee and margin calls, the counterparty to the transaction takes a synthetic short position in the underlying asset, which it usually hedges by acquiring the corresponding securities. This was the case of the investment banks acting as prime brokers¹³ for Archegos (Goldman Sachs, Morgan Stanley, Credit Suisse and Nomura),¹⁴ which therefore paid the return on the underlying asset in exchange for a fee (in some cases linked to an interest rate benchmark index). When the underlying asset appreciated, the prime brokers paid the increase in value to Archegos, whereas if it depreciated, the family office had to compensate the broker.

In the United States, the SEC is responsible for regulating all security-based swaps, including total return swaps, while the Commodity Futures Trading Commission (CFTC) is responsible for all other swaps. In line with the G20 agreement in the wake

11 These are management companies used by high net worth investors that offer all the services associated with wealth management, along with additional services for family members (such as tax and wealth planning services). They are often exempt from some of the requirements that apply to other investment firms (e.g. disclosure of their investments), as they have no clients outside the family.

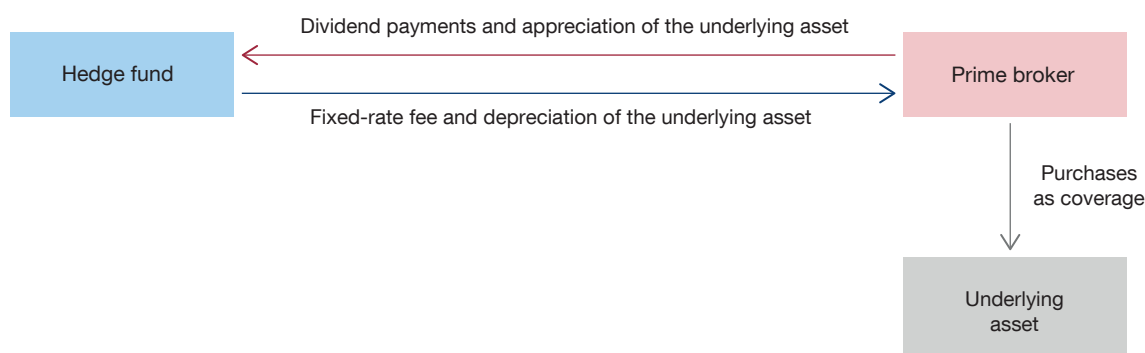
12 In 2012, Bill Hwang pleaded guilty in an insider trading case in the United States in which his investment fund, Tiger Asia Management, had profited from trading in Chinese bank securities, resulting in a \$44 million fine.

13 Hedge funds and other investment vehicles like Archegos use the prime brokerage services offered by investment banks and other financial institutions. These services include cash management or securities custody, but are mainly related to the provision of finance, either through securities lending or through structures such as the one described above, thus enhancing the leverage of their clients.

14 Other institutions have also been mentioned, such as Deutsche Bank, Wells Fargo and UBS.

Figure 1

TOTAL RETURN EQUITY SWAP OPERATIONS



SOURCE: Devised by authors.

of the global financial crisis, the DFA prompted derivatives market reforms, particularly for bilaterally traded (over-the-counter) derivatives. The reforms included reporting the terms and conditions of derivatives market transactions to trade repositories in order to improve market transparency. Only the CFTC has implemented such measures for the instruments under its remit. The information on Archegos' derivatives trades, which fall under the SEC's remit, is not yet available.¹⁵ Thus, neither the level of concentration of the family office's exposure to the securities of a small group of companies, nor the existence of highly leveraged positions with several prime brokers, was known.

Similarly, margin requirements were in place for firms with high notional values of non-centrally cleared derivatives, but not for smaller ones like Archegos. Although the deadlines have been postponed due to the pandemic, the SEC expects¹⁶ to implement these requirements for firms under its remit by end-2021.¹⁷

Against this background, in late March 2021 the value of some of the shares in which Archegos held open positions, such as ViacomCBS, fell sharply,¹⁸ which meant that

15 In May 2021, the SEC announced the launch of the first security-based swap data repository, which will come into force in November 2021. See SEC (2021a).

16 As with the registration of security-based swaps, the SEC's margin rules for these transactions will also come into force in November. See SEC (2020) and the [Key Dates for Registration of Security-Based Swap Dealers and Major Security-Based Swap Participants](#) section of its website.

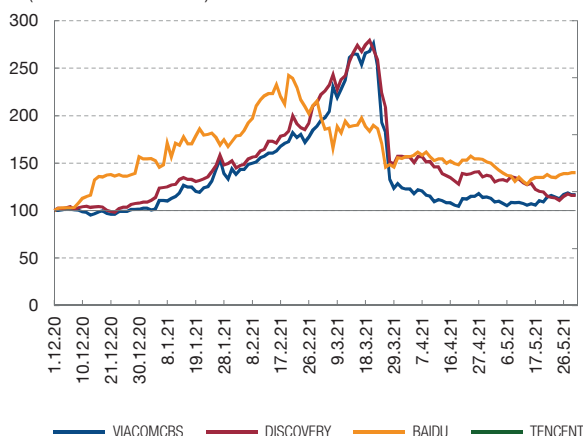
17 Regarding the regulatory framework applicable to situations such as Archegos', the Basel Framework addresses derivatives transactions through both their risk-based (counterparty or market risk) capital requirements and the leverage ratio.

18 These price falls were due to ViacomCBS' announcement that it would launch a \$3 billion public share offering, designed partially to boost its streaming services (weeks after launching its Paramount+ platform). Although some analysts (CNBC, 2021) considered this was the right strategy, many expressed doubts given the level of competition (Netflix, Disney+) in the sector. This price correction, prompted by the share offering, which diluted existing shareholders' ownership, interrupted the share price increase seen early in the year in response to this traditional telecommunications company's announcement that it intended to boost its streaming services.

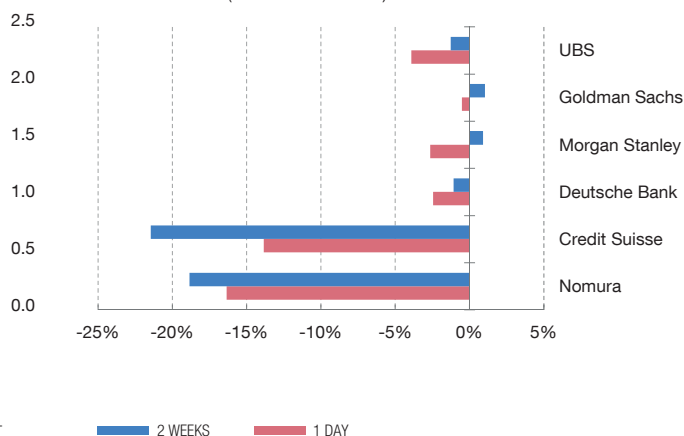
Chart 1

DAILY CLOSING PRICES

1 SHARES IN THE ARCHEGOS PORTFOLIO
(1 December 2020 = 100)



2 IMPACT ON THE SHARE PRICE OF THE BANKS THAT HAD ARCHEGOS
AS A CUSTOMER (since 26 March 2021)



SOURCES: Bloomberg and own calculations.

it was unable to meet the corresponding margin calls¹⁹ (see Chart 1). On Thursday 25 March, Bill Hwang called a meeting with the aforementioned investment banks to try to unwind the transactions in an orderly fashion. However, the next day, once the likely consequences of Archegos’ high level of leverage became apparent, some of these banks (initially, Goldman Sachs and Morgan Stanley) began to sell the shares that covered their short positions. This drove down the stock price further, inflicting larger losses on banks that were slower to sell (over \$4.5 billion in the case of Credit Suisse²⁰ and around \$2 billion in the case of Nomura). As a result, the stock price of both banks fell sharply (on Monday 29 March, Credit Suisse’s share price fell by more than 14% and Nomura’s by 16%).

2.2 Greensill

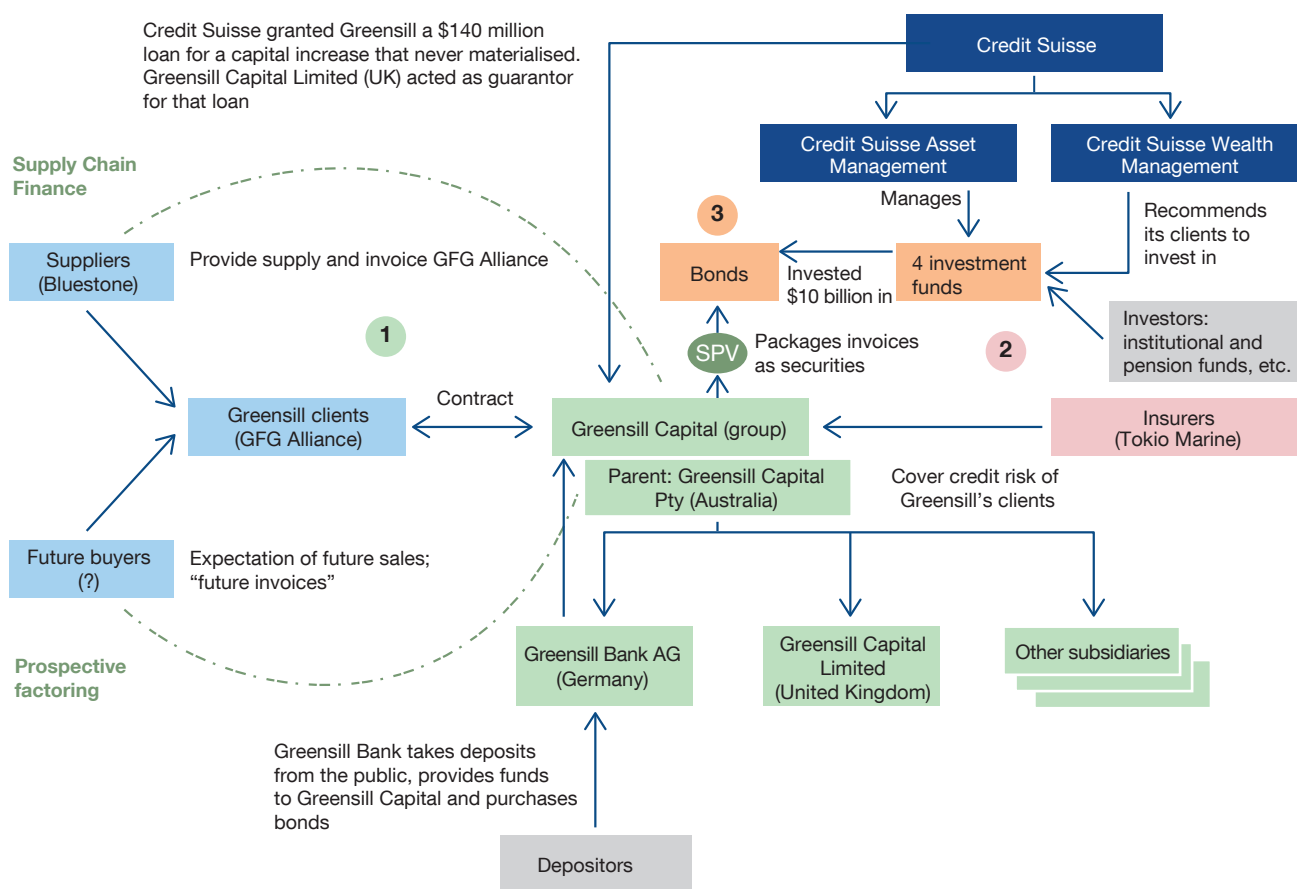
Greensill, an Anglo-Australian financial group with global presence, had been created as a fintech and operated a simple business model focused on factoring and supply-

19 Additional guarantee to be provided by investors in the margin account held with their broker due to losses in their trades which cause the value of the collateral to fall below a contractually established percentage (based on regulations and broker policy) of their total investments. If investors are unable to meet this call, the broker may be forced to sell the securities in the account outright.

20 In its 2021 Q1 report, Credit Suisse announced that its results included a CHF 4.4 billion provision for credit losses linked to the Archegos case. The document also stated that it had already unwound 98% of the positions related to this company and announced additional losses of CHF 600 million for 2021 Q2 as a result of market movements when closing these positions. In its 2021 Q2 report, Credit Suisse recognised additional losses of CHF 594 million associated with this case (losses of CHF 493 million as a result of market movements during the close-out of positions, a credit loss provision of CHF 70 million and operating expenses of CHF 31 million mainly reflecting severance-related costs and professional service fees).

Figure 2

STYLISED VERSION OF GREENSILL'S MODUS OPERANDI



SOURCE: Devised by authors.

chain financing or reverse factoring. With a corporate structure that included a subsidiary in the United Kingdom as its main operations centre and a bank headquartered in Germany, Greensill began by offering conventional financing services linked to the above-mentioned business model, specifically traditional factoring (purchase of a company’s accounts receivable) and reverse factoring (advancing payment to a customer’s suppliers based on approved invoices). Subsequently, in its search for higher profitability, Greensill expanded its business model to include prospective factoring, which consists in lending against prospective receivables, based on mere expectations of future business rather than actual transactions.

Greensill leveraged its business by packaging and securitising invoices. The securitised assets were distributed through Credit Suisse investment funds and their credit rating was enhanced through insurance policies subscribed with major insurers and which covered borrower default risk (see Figure 2).

Greensill’s subsidiary in the United Kingdom was registered with the Financial Conduct Authority (FCA) for the purpose of compliance with anti-money laundering regulations.

Its other activities did not fall under the remit of either the Bank of England's Prudential Regulation Authority or the FCA itself. Greensill Bank, the German subsidiary, was subject to control by BaFin, the German supervisory authority.

The collapse of Greensill was the result of a complex series of events closely linked to its business model, as described below:

1 Greensill's transactions with its clients (reverse and prospective factoring)

Greensill's collapse is connected with its supply-chain financing transactions and how they were reflected in the financial statements of the companies involved.

Through reverse factoring, Greensill and its peers in this market segment bridged working capital gaps at firms which, either because of the nature of their activity or of their poor financial condition, were unable to meet payments to suppliers out of their own trade flows. Supply-chain financing prevents working capital disruption and enables these firms to maintain the terms agreed with their suppliers, assuming greater leverage.

The main international accounting standard-setters – the International Accounting Standards Board (IASB) and the US Financial Accounting Standards Board (FASB) – have repeatedly insisted on the need to correctly report the consequences of these transactions, recalling the principles and requirements already in place²¹ and emphasising their significant impact and the liquidity risk caused by concentration of a large part of firms' obligations at a single financial institution. Instead of reflecting debt with the financial institution for the amount corresponding to the financed period, i.e. from the point at which the payment is made to the supplier until the end of the payment period agreed, the general practice was to treat the full amount as a trade debt, which meant it was not considered when calculating the firm's leverage.

Supply-chain financing can generate adverse selection problems, with possibly more severe consequences in the event of increased concentration. Indeed, this was the case of Greensill, which had extensive exposure (around \$5 billion) concentrated at one client, the metal giant GFG Alliance. In addition, Greensill financed GFG group firms through prospective factoring (i.e. on the basis of expectations of future transactions).

Eventually, the financial difficulties faced by GFG Alliance and other Greensill clients triggered a wave of defaults in 2020, which in some cases even led to insolvency.

21 IFRS (2020).

2 Expiry of Greensill’s insurance policies with Tokio Marine and other insurers

Insurance against customer default was a crucial element in Greensill’s business model. As a result of the difficulties described, in late February 2021 Tokio Marine and other Greensill insurers refused to renew policies for an amount of \$4.6 billion.

In light of this, on 3 March 2021 BaFin ordered a moratorium on Greensill Bank’s activities, owing to the imminent risk of a headlong flight into over-indebtedness.

3 Securitisation of invoices and its impact on Credit Suisse

Credit Suisse managed four investment funds which together had invested in \$10 billion worth of securities issued by Greensill and backed by invoices acquired through its factoring and reverse factoring operations. Given the difficulties described above and the consequent uncertainty surrounding the value of these securities, in March 2021 Credit Suisse decided to freeze the funds. This blocked Greensill’s activity, which was largely underpinned by these securitisations.²² It is estimated that Credit Suisse has so far reimbursed a total of \$6.6 billion to unit holders of the four funds.²³

All these factors combined – the adverse selection intrinsic to the business model, the excessive concentration vis-à-vis GFG Alliance, the cancellation of the insurance policies, the inability to mobilise funds through the banking subsidiary in Germany, and the freezing of funds from which it obtained much of its financing – prompted Greensill Capital to file for bankruptcy in the United Kingdom. Shortly afterwards, BaFin ordered that insolvency proceedings be opened against Greensill Bank in the German courts and the group’s Australian parent company (Greensill Capital Pty) also filed for bankruptcy.

3 Authorities’ response

Authorities have expressed their views on both cases. So far they have insisted that interactions between the non-bank and the banking sector were already being addressed, flagging the importance of understanding the causes of these episodes, how they unfolded and their consequences, in order to avoid their recurrence.

22 Credit Suisse’s relations with Greensill were not limited to marketing these funds. Lex Greensill, the company’s founder, was one of Credit Suisse Wealth Management’s leading customers. Moreover, Credit Suisse advised its customers to invest in these funds, and Credit Suisse Group AG had extended a \$140 million loan to Greensill for a capital increase that never materialised. Greensill Capital UK acted as guarantor for that loan.

23 As per the 2021 Q2 earnings release published in July (Credit Suisse, 2021a and 2021b).

3.1 Archegos

The Archegos episode prompted scrutiny by the US, European and Japanese authorities, initially to analyse whether or not all the institutions involved acted correctly and to assess the functioning of the regulatory and supervisory infrastructure in place.

The Federal Reserve's Financial Stability Report highlighted how this event, whose impact on markets and the financial system appears to be limited, serves as a reminder of the potential risk posed by non-bank financial institutions. This has been highlighted by regulators such as Jerome Powell, Chair of the Federal Reserve's Board of Governors, who attributed the problem to a risk management breakdown on the part of the prime brokers who understood the risks associated with Archegos' business but were incapable of detecting the extent of its leverage and risk concentration, as they were unaware that Archegos was entering into the same transactions simultaneously with various banks.²⁴

The lack of information on Archegos' operations has also been flagged. As a family office, Archegos was not required to provide data on its transactions to either the regulators or trade repositories. As early as 1 April 2020 CFTC Commissioner Dan Berkovitz cited the collapse of Archegos as a clear example of the havoc that large investment vehicles known as family offices can wreak on the financial markets.²⁵ In his statement, he criticised the easing of regulation and supervision applicable to these institutions, which manage billions of dollars. In turn, Lael Brainard of the Federal Reserve noted the limited visibility into hedge fund exposures, which may suggest a need for greater transparency requirements, including more granular and frequent disclosures.²⁶ Furthermore, SEC Chair Gary Gensler called for greater consideration of the potential impact that certain individual firms can have on the financial system, in order to reassess the exemption of family offices from margining and disclosure requirements.²⁷

Some voices have also pointed to the failure to implement some of the rules agreed for derivatives markets (such as reporting or margining requirements), which would have mitigated the impact of this episode. Other experts argue that margin requirements would not have prevented Archegos from leveraging or from distributing its exposures between several institutions.

However, others question the criticism of the existing transparency and regulations, arguing that risk management is the key factor to consider in transactions of this kind, and that these episodes should be used as examples for sophisticated investors

24 CBS (2021).

25 Berkovitz (2021).

26 Brainard (2021)

27 Gensler (2021).

of the need to review their risk management systems, organisational culture and incentives structure.²⁸

This was the approach adopted by FINMA, the Swiss supervisory authority, within the formal proceedings opened in April as a consequence of the significant losses incurred by Credit Suisse. In particular, the proceedings aim to investigate the risk management issues that surfaced at Credit Suisse. Like other authorities, such as the Department of Justice, SEC, CFTC and the Senate Banking Committee in the United States, or the FCA in the United Kingdom, FINMA requested documents and relevant information from Credit Suisse during the process. In addition, in late March 2021, FINMA imposed a temporary capital surcharge connected to the credit risk of Credit Suisse's investment banking business, which added some \$6.1 billion to its credit risk-weighted assets. The surcharge was later withdrawn in Q2.

At the international level, Carolyn Rogers, Secretary General of the Basel Committee on Banking Supervision (BCBS), said that although it is too early to consider a regulatory response, the BCBS will probably intensify the scrutiny of structured financial products and total return swaps.²⁹ The Basel Framework envisages the prudential treatment of derivatives transactions to which banks are exposed. It considers these transactions not only in terms of their margining requirements, but also from the perspective of their risk-based requirements (counterparty or market risk) and leverage ratio.

3.2 Greensill

In the case of Greensill, as indicated above, in March 2021 BaFin³⁰ banned Greensill Bank from making payments, owing to its high indebtedness and to secure its asset value. BaFin also ordered that it cease its business with customers and prohibited it from accepting payments not intended for repaying debts held with the bank. Just two weeks later, BaFin ordered that insolvency proceedings be opened against Greensill Bank.³¹ In turn, FINMA announced the opening of proceedings against Credit Suisse in April, taking several measures to reduce the bank's risk exposure, including organisational matters and cuts in or suspension of variable remuneration. As in the case of Archegos, FINMA also resolved to apply a capital surcharge of \$1.9 billion (equivalent to 62 basis points (bp) of its CET1 requirements and 19 bp of its leverage ratio).

In the United Kingdom, the House of Commons Treasury Committee carried out an investigation, outlining the elements to be considered to determine whether or not

28 Bloomberg (2021e).

29 Bloomberg (2021d).

30 BaFin (2021b).

31 BaFin (2021a).

institutions such as Greensill, which have so far avoided the regulatory perimeter, should be subject to regulation. In his statement to the Committee, Jon Cunliffe, Deputy Governor of the Bank of England, expressed his opposition to linking inclusion in the regulatory perimeter exclusively to an operator's potential systemic nature, arguing that there are other important factors to consider, such as consumer and investor protection.³² The above-mentioned investigation resulted in a report on lessons learned, which concluded that, in principle, the Greensill case alone would not justify a review of the regulatory perimeter to include supply-chain financing. However, it did constitute a warning on the need to enhance the scrutiny and supervision of non-bank financial institutions and, specifically, on the need to improve their transaction data. Moreover, the Bank of England has insisted on the need to improve the information available on non-bank financial intermediaries. In this vein, the possibility of authorising regulatory agencies to compile that information, with a view to preserving financial stability, has been discussed in the United Kingdom.

Regarding the accounting treatment of supply-chain financing, in June 2021 the IASB resolved to include an amendment of IAS 7 (which establishes the additional information to be provided in financial statements) in its work programme, with a view to incorporating requirements to enhance the transparency of supply-chain financing.³³ In the United States, the FASB has adopted a similar approach, and in September 2021 proposed a standard also aimed at increasing the information on financing structures of this kind.

4 Conclusions and features common to both episodes

In recent months, the Archegos and Greensill episodes (as well as others such as GameStop)³⁴ have reignited the debate on the vulnerabilities and risks associated with certain activities of the non-bank financial sector and their interconnections with the banking sector.

There has been extensive coverage of these episodes by experts and in the specialised press. Some studies have compared these operations with banking sector activity, referring to the need to apply the principle of “same risk, same activity, same regulation” provided the same economic functions are performed.³⁵ This is especially relevant in the current setting, where the low interest rate environment can encourage the use of certain structures to boost profitability. For this reason, and despite the wide range of activities included in the non-bank sphere, it is vital to

32 UK House of Commons Treasury Committee (2021).

33 <https://www.iasplus.com/en/standards/ifrs/ifrs10>.

34 For more information on the GameStop case, see SEC (2021b).

35 Basquill (2021).

ensure that risks are addressed consistently throughout the system, avoiding potential regulatory arbitrage.

The events described here demonstrate the importance of addressing risks to the financial system, irrespective of their origin. Although there are significant differences between the Archegos and Greensill episodes, there are also some common features:

- In both cases the non-bank agents involved were overleveraged. This ultimately prevented them from meeting their financial obligations, triggering the liquidity crisis and subsequent insolvency.
- Both cases underline the potentially systemic importance of the interconnections between the banking sector and other parts of the financial system (such as investment funds or credit intermediaries). Both at Archegos and Greensill, the banking sector played an important role as the ultimate financing channel. Although in the end losses did not reach systemic scale, the events are a reminder that the financial system can be exposed to the consequences of firm-specific shocks.
- The episodes highlight the importance of proper risk management.³⁶ Banks with weaker risk management practices were most severely affected and are thus in the spotlight of the analysis and main reactions.
- The information and data needed to assess the exposures and risks (including on derivatives transactions, financing chains or closed-end investment vehicles) have not always been available. Although a number of reforms undertaken over the last decade have addressed some of these gaps, part of the opacity remains (for instance, regarding certain parts of financing chains, or closed-end investment vehicles that are subject to less stringent reporting requirements).

None of these are new issues. Indeed, these events have underlined the importance of implementing some of the reforms agreed in the wake of the global financial crisis (for example, in the area of derivatives). In this respect, in its strategy to cast light on the shadow banking sector, the FSB defined five economic functions associated with potential sources of systemic risk. Both episodes analysed here featured activities associated with each of these economic functions: at Greensill, lending on the back of short-term funding structures, asset securitisation and the use of

³⁶ The risk culture and risk management deficiencies were highlighted in the independent external investigation on the Archegos case carried out by Paul, Weiss, Rifkind, Wharton & Garrison LLP at the request of Credit Suisse. For instance, according to the report, Credit Suisse had repeatedly breached its internal limits on potential exposure to Archegos since spring 2020, with no response in terms of risk mitigation measures, despite discussions on ways to modify the margin calculation model. See Credit Suisse (2021c).

insurance to enhance the credit quality of the securities issued; and at Archegos, an investment vehicle leveraged through intermediaries to operate in the financial markets.

For this reason, both these cases highlight the importance of the international projects that were already under way for the non-bank sector. In this respect, bodies such as the FSB have placed special emphasis on the work on non-bank financial intermediation, endeavouring to address vulnerabilities identified during the market turmoil of March 2020. This includes developing an approach to assess the potential systemic risk generated by this area of the financial system and to design the corresponding measures. Work such as that being undertaken by the FSB on risk monitoring in the non-bank sector, analysis of interconnections within the financial system and assessment of risks linked to institutions such as investment funds is vital from a supervisory and regulatory standpoint to minimise the risk that cases of this kind may recur in the future.

REFERENCES

- BaFin (2021a). "BaFin determines that compensation is payable to Greensill Bank AG's depositors", press release of 16 March.
- BaFin (2021b). "BaFin orders moratorium on Greensill Bank AG", press release of 3 March.
- Bank of England (2021). *Assessing the resilience of market-based finance*, 13 July.
- Bank for International Settlements (BIS) (2017). "Final Guidelines on Identification and Management of Step-in Risk Issued by the Basel Committee", press release of 25 October.
- Basquill, J. (2021). "Greensill and GFG: Uncovering a Scandal", *Global Trade Review*, 12 August.
- Berkovitz, D. M. (2021). "CFTC Oversight of Family Offices Must be Strengthened", Statement of Commissioner Dan M. Berkovitz on CFTC Oversight of Family Offices, 1 April.
- Bloomberg (2021a). "Credit Suisse Missed Many Warnings before Greensill's Collapse", 6 March.
- Bloomberg (2021b). "Bill Hwang Was a \$20 Billion Whale, Then Lost It All in Two Days", 12 April.
- Bloomberg (2021c). "Imaginary Invoices Are Hard to Collect", 6 April.
- Bloomberg (2021d). "Archegos Blowup prompts regulatory questions at Basel Committee", 16 April.
- Bloomberg (2021e). "Family Offices Don't Need New Regulations", 24 June.
- Brainard, L. (2021). "Statement by Governor Lael Brainard", *Financial Stability Report*, 6 May.
- CBS (2021). "Fed Chair Jerome Powell on Archegos collapse, money market funds, and the potential of a U.S. digital dollar", 11 April.
- CNBC (2021). "ViacomCBS stock closes down 23% as Wall Street expresses doubt about streaming execution", 24 March.
- Credit Suisse (2021a). *Financial Report 1Q21*.
- Credit Suisse (2021b). *Financial Report 2Q21*.
- Credit Suisse (2021c). "Paul Weiss Report on Archegos Capital Management", Credit Suisse Group Special Committee of the Board of Directors, 29 July.
- Credit Suisse (2021d). "Credit Suisse response to the Paul Weiss Report", 29 July.
- Duffie, D. and D. Skeel (2012). *A Dialogue on the Costs and Benefits of Automatic Stays for Derivatives and Repurchase Agreements*, University of Pennsylvania Carey Law School.
- Federal Reserve Board (2021). *Financial Stability Report*, May.
- Financial Accounting Standards Board (FASB) (2021). *Disclosure of Supplier Finance Program Obligations*.
- Financial Services Authority (FSA) (2009). *The Turner Review. A regulatory response to the global banking crisis*, March.
- Financial Stability Board (FSB) (2021). *Non-Bank Financial Intermediation*.
- Financial Stability Board (2020a). *OTC Derivatives Market Reforms: 2020 Note on Implementation Progress*, 25 November.
- Financial Stability Board (2020b). *Implementation of G20/FSB financial reforms in other areas. Summary of key findings based on the 2019 FSB Implementation Monitoring Network (IMN) survey*, 8 June.
- Financial Stability Board (2017). *Re-hypothecation and collateral re-use: Potential financial stability issues, market evolution and regulatory approaches*, 25 January.
- Financial Stability Board (2013). *Policy Framework for Addressing Shadow Banking Risks in Securities Lending and Repos*, 29 August.
- G20 (2009). *Global Plan Annex: Declaration on Strengthening the Financial System*, Statement issued by the G20 Leaders at the London Summit, 2 April.
- Gensler, G. (2021). "Testimony of the SEC Chair before the House Committee on Financial Services", 6 May.

Global Banking Regulation Review (2021). "If it walks like a bank...", 14 July.

Haldane, A. (2017). "Rethinking Financial Stability", Speech at the Rethinking Macroeconomic Policy IV Conference organised by the Peterson Institute for International Economics, 12 October.

International Financial Reporting Standards (IFRS) (2020). *Supply Chain Financing Arrangements-Reverse Factoring*.

Kinder, T. and L. Lewis (2021). "How Bill Hwang got back into banks' good books — then blew them up", Financial Times, 29 March.

Llewellyn, D. T. (2009). "Financial innovation and a new economics of banking: lessons from the financial crisis", Chapter 1, Financial Innovation in Retail and Corporate Banking, Edward Elgar Publishing.

Nomura (2021). Consolidated Results of Operations: Fourth quarter, year ended March 2021; and first quarter, year ending March 2022.

Platt, E., L. Lewis, O. Aliaj and S. Morris (2021). "Banks face regulators' scrutiny on handling of Archegos fire sale", Financial Times, 30 March.

Quarles, R. (2019). "The Financial Stability Board at 10 Years—Looking Back and Looking Ahead", Speech at the European Banking Federation's European Banking Summit, 3 October.

Rajan, R. G. (2005). *Has financial development made the world riskier?*, Working Paper No 11728, National Bureau of Economic Research.

Rennison, J., E. Platt, C. Smith and P. Stafford (2021). "US put off derivatives rules for a decade before Archegos blew up", Financial Times, 12 April.

Reuters (2021). "Credit Suisse Repays another \$400 Mln to Greensill-linked Fund Investors", 6 August.

Santomero, A. (2007). "Loan portfolio management: good news or bad news for financial stability", European Banking Report Board, Rome, Italian Bankers Association.

Scope Ratings (2020). *Greensill Bank AG Issuer Rating Report Overview*, 16 October.

Securities and Exchange Commission (SEC) (2021a). "SEC Approves Registration of First Security-Based Swap Data Repository; Sets the First Compliance Date for Regulation SBSR", press release of 7 May.

Securities and Exchange Commission (2021b). "Staff Report on Equity and Options Market Structure Conditions in Early 2021", 14 October.

Securities and Exchange Commission (2020). "SEC Announces the Creation of the Security-Based Swaps Joint Venture, Led by Division of Examinations and Division of Trading and Markets", press release of 18 December.

UK House of Commons Treasury Committee (2021). *Lessons from Greensill Capital. Sixth Report of Session 2021–22. Report, together with formal minutes relating to the report*.

Wiggins, J. (2021). "Greensill Capital parent was possibly insolvent on March 2", Financial Review, 22 July.

Measuring interconnectedness across institutions and sectors

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Abstract

This article analyzes the transmission of risk across euro area sovereign debt markets, euro area equity markets, and financial and non-financial sectors in Spain. To this end, the study draws on the connectedness methodology proposed by Diebold and Yilmaz (2009), which focuses on forecast error variance decompositions from vector autoregressive models. The results indicate that the spillover indices using this methodology identify periods during the euro area sovereign debt crisis and the current COVID-19 pandemic when spillovers were generated across financial markets and sectors.

Keywords: spillovers, risk transmission, contagion, financial markets, connectedness.

1 Introduction

The COVID-19 pandemic has revived interest in understanding how contagion spreads in financial markets, which received much attention during the Great Financial Crisis and the euro area sovereign debt crisis. One central concept to understanding contagion, and more broadly, financial stability, is the concept of interconnectedness, or the strength of ties between different market players. It figures prominently in key aspects of market risk (e.g., return and portfolio interconnectedness), counterparty risk (e.g., bilateral and multilateral contracts), and systemic risk (e.g., system-wide interconnectedness). As an example of how central interconnectedness is, it has been argued that the pandemic has strengthened the “nexus” between sovereigns, banks and the non-financial sector,¹ thereby intensifying the transmission of risk across these sectors. This implies that if vulnerabilities arise in one sector, then spillovers to other sectors may become more likely, with potentially devastating effects.

The purpose of this article is to shed light on the transmission of risk across the main euro area sovereign debt and equity markets, focusing on the contribution of Spanish financial markets to the transmission of shocks to other markets and vice versa. The study then turns to the impact across the non-financial and financial sectors in Spain. To do so, market prices are used at a weekly frequency to estimate the direction and intensity of spillovers in each area. In particular, the analysis systematically uses the connectedness methodology first introduced in Diebold

¹ See Schnabel (2021).

and Yilmaz (2009),² which is based on forecast error variance decompositions calculated from vector autoregressive models. This technique generates a measure of system-wide interconnectedness called spillover index, and associated concepts such as directional interconnectedness and net interconnectedness. The main advantage of the technique, as opposed to other approaches of measuring the contribution to systemic risk of specific institutions [e.g., Adrian and Brunnermeier (2016) and Brownlees and Engle (2017)], is that it permits a unified approach for empirically measuring interconnectedness at a variety of levels, from pairwise interconnectedness to system-wide interconnectedness. Moreover, the measures have a clear connection to network concepts.

The results indicate that the spillover indices are able to track events in the GFC, the euro area sovereign debt crisis, and the COVID-19 pandemic quite well. In particular, with respect to the euro area sovereign debt market, it is found that the spillover index is able to track the decoupling of peripheral and core sovereign bond markets during the 2010-2014 period. Another finding is that both equity market return spillovers and equity market volatility spillovers sharply increased at the onset of the COVID-19 pandemic. It is also shown that Spanish equity markets mainly receive contagion from core equity markets, while they transmit contagion to peripheral equity markets.³

The analysis looks at cross-sectoral stock market spillovers within Spain, with a focus on the channels of contagion during the COVID-19 pandemic. It is found that contagion spread from the non-financial sector to both the financial sector and the Spanish sovereign debt market from the outset of the COVID-19 pandemic onwards. These results can possibly be traced to the increase in vulnerabilities and risks within the non-financial sector and the increase in government exposures to the non-financial sector as a result of the over-all fiscal policy response to the crisis.

The rest of the paper is organized as follows. Section 2 provides a brief literature review of existing approaches to measure systemic risk. Section 3 describes the Diebold and Yilmaz connectedness methodology, and its empirical implementation. Section 4 shows the empirical analysis. Finally, Section 5 concludes.

2 Diebold and Yilmaz (2009) seminal paper spawned a wide literature that refines the measurement and estimation of connectedness to take into account relevant financial institutions via large-scale vector autoregressive models (VARs) with functions that distinguish the key financial institutions [e.g., Demiret et al. (2018) and Gross and Siklos (2020)], more explicit identification schemes based on heteroscedasticity [e.g., De Santis and Zimic (2018)] or structural VAR approaches [e.g., Boeckelmann and Stalla-Bourdillon (2021)].

3 This article adopts the same nomenclature as in previous literature and refers to Greece, Ireland, Italy, Portugal and Spain as “peripheral countries” and the rest as “core countries”.

2 Systemic risk measures: a brief primer

The global financial crisis resulted in changes in approaches to monitoring financial stability. Prior to this crisis, financial regulation and stability measures were micro-prudential in nature, and focused on individual risk measures, such as Value-at-Risk (VaR). The new view, however, stresses the importance of interrelationships between financial institutions. Due to this, new measures were developed to capture systemic risk, spillovers from one financial institution to another (and vice-versa), and other phenomena.

There are four broad categories of systemic risk measures: i) tail measures; ii) network-based models of the financial system; iii) contingent claims analysis, and iv) dynamic stochastic macroeconomic models. The more popular measures are tail-based measures, and network-based measures of the financial system, which are the focus of this article. Tail-risk based measures [see e.g., ΔCoVAR of Adrian and Brunnermeier (2016), Marginal Expected Shortfall of Acharya et al. (2017), and the SRISK index of Brownlees and Engle (2017)] focus on co-dependence in the tails of returns of financial institutions. In particular, these measures are closely linked to Value-at-Risk type approaches; the main difference, though, is that these approaches are able to distinguish the impact of firm-specific disturbances from disturbances to the entire financial sector. Value-at-Risk, however, is institution-specific, and does not take into account the interrelationships of different firms.

Network-based models, meanwhile, focus on the propagation of contagion, the interconnectedness between different firms/sectors, and spillovers from one sector to another. Ideally, to pursue this type of analysis, one would want to observe network data. That is, one would like to observe actual financial exposures of firms to one another. This is not often the case, though. In this regard, several procedures have been developed to measure connectedness across financial institutions in the absence of such information; most of these measures are based on financial market prices. Billio et al. (2012), for example, propose to measure interconnectedness through a method that is based on pairwise Granger causality. A disadvantage of this approach, however, is that the method might be unstable over time, and that it is essentially bivariate in nature. An alternative approach pursued in this article is the interconnectedness approach proposed by Diebold and Yilmaz (hereafter referred to as DY) in a series of papers [see e.g., Diebold and Yilmaz (2009) and Demirer et al. (2018)], which is essentially based on vector autoregressive models (VAR).

The advantage of this approach over Billio et al. (2012) is that it permits to study contagion and spillovers across several firms or sectors. Moreover, it also permits the analysis of contagion from firm-level to a system-wide level. A drawback,

however, as opposed to Billio et al. (2012), is the need for identifying assumptions, as the methodology is essentially based on variance decomposition analysis.⁴

3 Measuring interconnectedness using the Diebold-Yilmaz approach

The starting point for measuring interconnectedness of financial institutions using the DY approach is the estimation of vector autoregressive models, which capture the relationship between several variables as they change over time. In particular, DY build their connectedness index from the variance decomposition matrix associated with an N-variable vector autoregressive model. The variance decomposition matrix indicates the contribution of each financial institution to shocks to other financial institutions in the system being modelled. DY augment the variance decomposition matrix obtained from the estimation of the VAR model with rows and columns that indicate total contributions of all other institutions to a particular financial institution. Hence, this permits the calculation of different measures that can be computed, which are presented from the following schematic of the connectedness in Table 1. The procedure is more formally explained in the Annex.

The main upper left block of the interconnectedness table contains the variance decomposition matrix,⁵ which we will denote by $D^H = [d_{ij}^H]$, where i is the row variable, j is the column variable, and H is the time horizon from which we computed the matrix. The connectedness table augments the variance decomposition matrix with an additional row that contains row sums, an additional column that contains column sums, and an additional cell in the bottom-right containing an average for all cases, for each $i \neq j$.

From the connectedness perspective, the measures of relevance are the off-diagonal elements of the matrix D^H , as they provide measures of pairwise directional connectedness. The pairwise directional connectedness from j to i is defined as:

$$C_{i \leftarrow j}^H = d_{ij}^H$$

Sometimes, one might be interested in net pairwise directional connectedness, which is simply the following difference:

$$C_{i \leftrightarrow j}^H = C_{j \leftarrow i}^H - C_{i \leftarrow j}^H$$

4 As explained in the Annex, the spillover index is computed from the forecast error variance decompositions coming from the estimation of a vector autoregressive model. As reduced-form shocks are rarely orthogonal in nature, one would need to proceed with some scheme to identify the uncorrelated “structural” shocks from the correlated orthogonal shocks.

5 One can obtain the variance decomposition matrix by rewriting the VAR system that is specified earlier to a moving average representation, compute H step ahead forecasts, and the corresponding forecast errors and obtain its covariance matrix.

Table 1

INTERCONNECTEDNESS TABLE

	x_1	x_2	...	x_N	From others
x_1	d_{11}^H	d_{12}^H	...	d_{1N}^H	$\sum_{j=1}^N d_{1j}^H$ $j \neq 1$
x_2	d_{21}^H	d_{22}^H	...	d_{2N}^H	$\sum_{j=1}^N d_{2j}^H$ $j \neq 2$
...
x_N	d_{N1}^H	d_{N2}^H	...	d_{NN}^H	$\sum_{j=1}^N d_{Nj}^H$ $j \neq N$
To others	$\sum_{i=1}^N d_{i1}^H$ $i \neq 1$	$\sum_{i=1}^N d_{i2}^H$ $i \neq 2$...	$\sum_{i=N}^N d_{iN}^H$ $i \neq N$	$\frac{1}{N} \sum_{i,j=1}^N d_{ij}^H$ $j \neq j$

SOURCE: Own elaboration.

From the pairwise connectedness measures, one can define aggregate measures of interconnectedness. For example, the row sum of the off-diagonal elements provides the amount of the H step forecast error variance of variable i coming from shocks arising from other variables can be expressed as the following quantity:

$$C_{i \leftarrow \cdot}^H = \sum_{\substack{j=1 \\ j \neq i}}^N d_{ij}^H$$

Meanwhile, the total directional connectedness to others from j can be described as the following quantity, which is the column sum of the off-diagonal elements:

$$C_{\cdot \leftarrow j}^H = \sum_{\substack{i=1 \\ i \neq j}}^N d_{ij}^H$$

Finally, one can compute a grand total of all of the off-diagonal elements of the elements in the variance decomposition matrix. This measure is what DY call the *total directional connectedness*:

$$C^H = \sum_{\substack{i,j=1 \\ j \neq i}}^N d_{ij}^H$$

The total directional connectedness measure can then be thought of as a measure of total system-wide connectedness.

3.1 Model implementation

The aim is to study spillovers across European sovereign bond yields, stock market indices, and Spanish financial and non-financial sectors using market data at a weekly frequency. The rationale behind this choice (as opposed to using e.g. daily frequency) is to avoid the possibility of stale prices.⁶ In particular, the analysis draws on Wednesday-to-Wednesday returns, as these are less susceptible to day-of-the-week effects.⁷

To implement the DY methodology, one needs to specify the predictive horizon H and the dynamics of the variables, as represented by the number of lags p . In addition, time-varying interconnectedness allows to move away from the completely static procedure implicitly assumed thus far. Allowing for time-varying interconnectedness is especially important as the dynamics of the variables one is interested in may vary with the business or the financial cycle, or it may evolve slowly e.g. with the structure of the financial system.

A predictive horizon of $H = 1$ week is chosen, similar to Diebold and Yilmaz (2009) and Boeckelmann and Stalla-Bourdillon (2021). To compute the optimal number of lags p , the analysis needs to rely on standard information criteria, such as the Akaike information criterion and the Bayesian information criterion. The information criteria reveal that for each of the areas, the most adequate model is one that has $p = 1$. Finally, to allow for time-varying interconnectedness, the analysis relies on a rolling window estimation, with a one-sided rolling window of 103 weeks (approximately two years). In the robustness exercises, attention is given to how the spillover index changes when the predictive horizon or the rolling window are changed.

4 Empirical analysis

This section shows the empirical application of the connectedness methodology. First, the data used for the empirical analysis is described, followed by the dynamic analysis of interconnectedness.

4.1 Data

Interconnectedness is studied under three different settings: sovereign bond markets and equity markets of major European countries, respectively, and non-financial and

⁶ Prices are stale when current prices do not reflect actual market information.

⁷ With Friday-to-Friday returns the results are quite similar.

financial sectors in Spain. To pursue this analysis, information from Datastream is used. The type of information in each setting is outlined below.

- Sovereign bond markets: Weekly information is obtained on 10-year sovereign bond yields from Austria, Belgium, France, Germany, and the Netherlands (core), Greece, Ireland, Italy, Portugal and Spain (periphery). The main variables for this estimation are weekly changes in sovereign bond yields, and the corresponding volatilities, calculated via one-month rolling windows of standard deviations of yield changes.
- Equity markets: Weekly information is obtained on the main equity indices on the countries mentioned above. This estimation uses weekly log changes in equity price indexes, and the corresponding volatilities, which were calculated via one-month rolling windows of the standard deviations of equity returns.⁸
- Sectoral indices: Weekly information is obtained on sectoral indices based on the different constituent firms in the Madrid Stock Exchange. The sectors included in the stock exchange are: petroleum, construction, consumer goods, leisure and tourism, retail, transportation and distribution, banks, insurance, telecommunications, and real estate. In the subsequent empirical analysis, sectoral indices are aggregated into financial and non-financial sectors via a weighted average, with the market capitalizations as the weights. In a subsequent analysis, the non-financial sectors are further divided into vulnerable and non-vulnerable sectors, following the classification in Blanco et al. (2021).⁹ The corresponding volatilities, which are rolling windows of one month, are also calculated.

The data used for the empirical analysis spans January 2001 to July 2021 for sovereign bond yields and equity indices, and from January 2008 to July 2021 for sectoral indices (due to data availability).

4.2 Results

The results of each of the empirical analyses are described below.

⁸ Similar results are obtained when computing the spillover index via the corresponding squares of the returns.

⁹ Blanco et al. (2021) divide the sectors into three groups: severely vulnerable, moderately vulnerable, and non-vulnerable. Because the analysis pursued here only allows to observe broader sectors as opposed to the more detailed sector classifications in Blanco et al. (2021), only two groups are considered, wherein severely and moderately vulnerable sectors are combined into one group. Vulnerable sectors are power, basic materials, industry and construction, consumer goods, leisure and transportation. Non-vulnerable sectors are retail trade, telecommunications and real estate.

4.2.1 Sovereign debt markets

The blue line of Chart 1.1 plots the total connectedness of sovereign bond yields over a two-year rolling window. The chart shows two main patterns. First, it indicates that prior to the debt crisis, sovereign bonds were highly interconnected. In particular, one finding is that close to 90 % of forecast error variance comes from spillovers to different sovereign bonds. However, as the sovereign debt crisis unfolded, the spillover index decreased to less than 50 % in 2014. The drop in spillovers can be associated to the decoupling of sovereign bonds of the peripheral countries and the core countries, a fact that can be observed from the moving average correlations of sovereign bond yields plotted in Chart 1.2, which turned to be negative at around the same period. Connectedness of the sovereign bonds increased afterwards, which can be attributed to bailout packages and other policies targeted at ensuring financial stability of the euro area. The proportion of forecast error variance decompositions were relatively stable at 70 % up until 2019. Finally, there was a sharp increase in 2020, which coincided with the COVID-19 pandemic and subsequent measures to contain it. As documented in Corradin, Grimm and Schwaab (2021), at the onset of the COVID-19 pandemic, there was an increase in sovereign bond yields in countries like Italy and Spain, which prompted the announcement of the PEPP on 18 March 2020, which is precisely the week where we observe the spike in the spillover index. The announcement of this program led to a lowering of sovereign bond yields in all euro area countries.

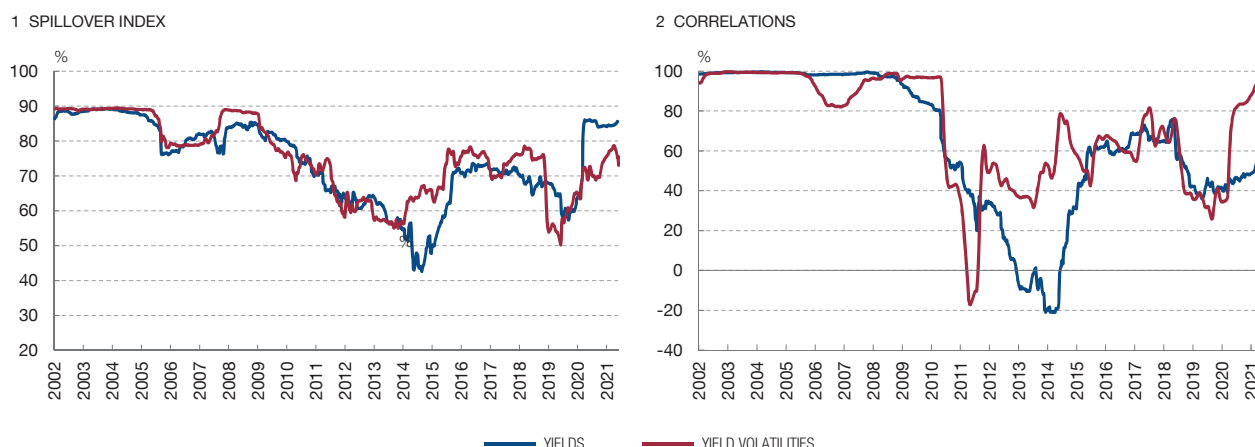
The red line of Chart 1.1, meanwhile, plots the total connectedness of sovereign bond yield volatilities. As can be observed, the patterns of bond yield volatilities are similar to that of bond yield changes. The correlation dynamics also follow a similar pattern, as can be observed in Chart 1.2.

To understand whether the fluctuations in connectedness are general or specific for certain groups of countries, the spillover index for core countries (blue line of Chart 2) and the spillover index for peripheral countries (red line of Chart 2) are computed. The chart for core countries shows that there is almost no variation in the spillover index, which hovers slightly above 80 % throughout the sample period. Meanwhile, the chart for peripheral countries indicates the wide variation observed in the total spillover index for all countries. This result suggests that the movements in the spillover index are driven by peripheral countries and not by core ones.

The results of the study of how Spain contributes to the variation in sovereign bond yields are in Chart 3, which shows the net connectedness of Spain to the core and peripheral countries, respectively. A positive measure of net connectedness implies that Spain is a net receiver of shocks, while a negative measure implies that Spain is a net transmitter of shocks. As can be observed, with respect to core countries, the Spanish sovereign market in general influenced sovereign bond yields in core

Chart 1

SPILLOVER INDICES IN EURO AREA SOVEREIGN DEBT MARKETS

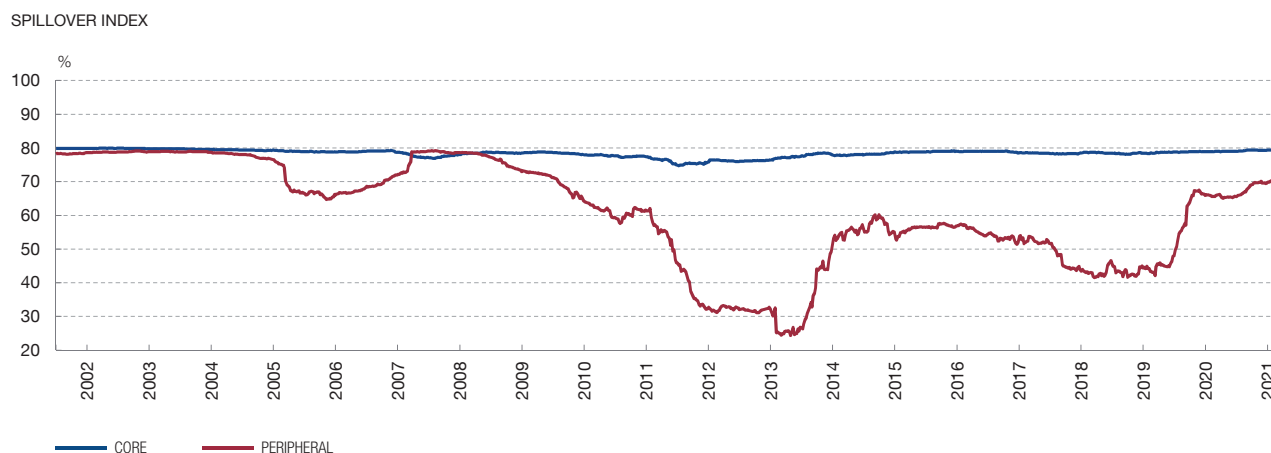


SOURCES: Datastream and own elaboration.

NOTE: The charts above show the total spillover index for changes in sovereign bond yields (see Chart 1.1), and sovereign bond yield volatilities (see Chart 1.2). The spillover indices are defined as the sum of all variance decomposition "contributions to others". The values of the index are from 0 to 100, and can be thought of as percentages. The charts are estimated from a VAR(1) model with a two-year rolling window, and a predictive horizon of one week.

Chart 2

SPILLOVER INDICES OF SOVEREIGN BOND YIELDS IN CORE AND PERIPHERAL COUNTRIES



SOURCES: Datastream and own elaboration.

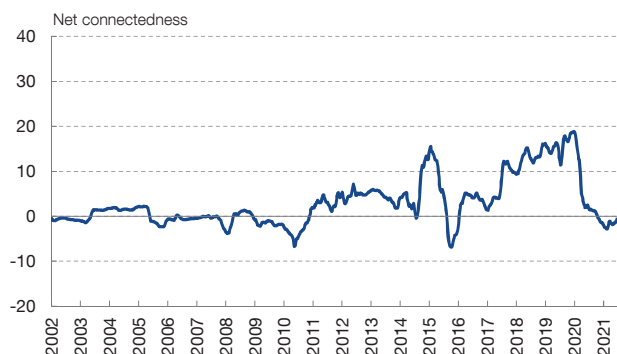
NOTE: The chart above shows the total spillover index of changes in sovereign bond yields of core countries (blue), and peripheral countries (red). The spillover indices are defined as the sum of all variance decomposition "contributions to others". The values of the index are from 0 to 100, and can be thought of as percentages. The chart is estimated from a VAR(1) model with a two-year rolling window, with a predictive horizon of one week.

countries during the 2006-2010 period, and in 2011-2014 (although there were brief spikes wherein Spain was a net receiver of contagion). From 2015 onwards, however, the Spanish sovereign market was influenced more by movements in the core countries. This can be related to the end of the sovereign debt crisis, when the Spanish economy started its economic recovery, and improved its competitiveness

Chart 3

NET CONTRIBUTION OF SPANISH SOVEREIGN BOND YIELDS TO CORE AND PERIPHERAL COUNTRIES

1 SPAIN VIS-À-VIS CORE COUNTRIES



2 SPAIN VIS-À-VIS PERIPHERAL COUNTRIES



SOURCES: Datastream and own elaboration.

NOTE: The charts above show the net connectedness of Spain with respect to core countries (see Chart 3.1), and peripheral countries (see Chart 3.2). The charts are estimated from a VAR(1) model with a two-year rolling window. The charts are estimated from a VAR(1) model with a two-year rolling window and a one week prediction horizon. A positive value of the measure indicates that Spain is a net absorber of contagion, while a negative value of the measure indicates that Spain is a net transmitter of contagion.

vis-à-vis other countries in the euro area. Meanwhile, with respect to peripheral countries, it is found that prior to 2011, Spain influenced peripheral sovereign bond yields. The Spanish sovereign market then became a net receiver of contagion coinciding with the sovereign debt market crisis.

The index increased significantly until July 2012, right around the period of the “whatever it takes” speech by the then ECB President Mario Draghi. This suggests that during the sovereign debt crisis Spanish sovereign yields were highly influenced by developments in the other peripheral countries. There was then a decrease until 2018, wherein Spain is found to become a net transmitter of shocks, although the absolute value of the index was relatively low.

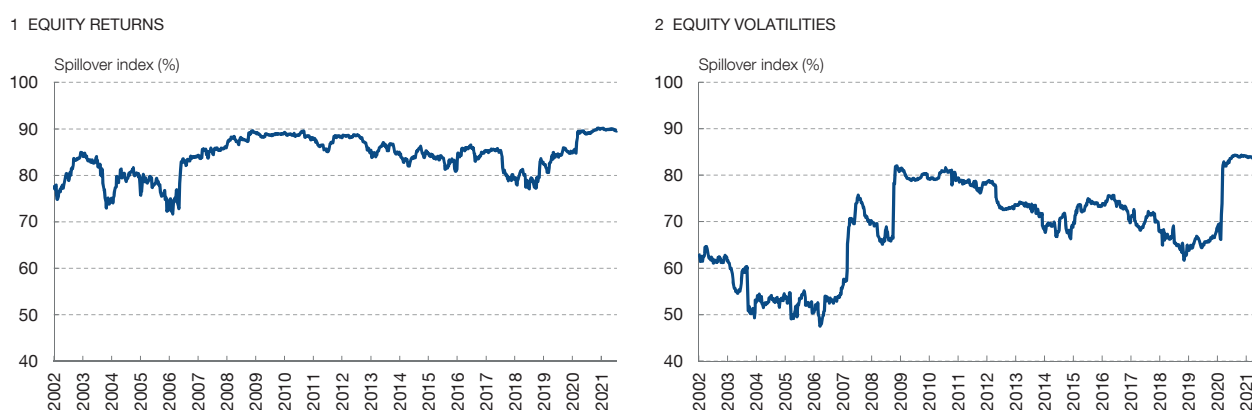
4.2.2 Equity markets

Turning to the study the connectedness of equity markets in the major euro area economies, Chart 4 shows the spillover indices computed for equity index returns (see Chart 4.1) and equity index return volatilities¹⁰ (see Chart 4.2). The charts indicate relatively small movements in equity return spillovers, which fluctuate between 70 % and 90 % of forecast error variance decompositions. These high levels indicate that there is a high degree of system-wide interconnectedness across euro area equity markets. By contrast, with respect to equity index return volatilities, wider movements

¹⁰ To compute volatilities, 4-week (1 month) rolling window standard deviations are calculated.

Chart 4

SPILLOVER INDICES OF EURO AREA EQUITY INDEX RETURNS AND EQUITY RETURN VOLATILITIES



SOURCES: Datastream and own elaboration.

NOTE: The charts above show the total spillover index for equity markets (see Chart 4.1) and for equity volatilities (see Chart 4.2) across major European countries. The spillover indices are defined as the sum of all variance decomposition "contributions to others". The values of the index are from 0 to 100, and can be thought of as percentages. The charts are estimated from a VAR(1) model with a two-year rolling window and a one week prediction horizon.

in the spillover index are observed. In particular, the volatility spillover series show increases at three distinct points:

1. Prior to the onset of the global financial crisis in 2007.
2. Prior to the onset of the European sovereign debt crisis in 2010.
3. The stock market crash as a result of the lockdown measures at the onset of the 2020 COVID-19 pandemic.

The fact that there is much movement in volatility spillovers but not in return spillovers is consistent with the results in Diebold and Yilmaz (2009), who find similar results, but for global asset markets. As noted by Diebold and Yilmaz (2009), this result for equity markets can be largely associated with a high level of financial integration across several economies, hence the relatively stable plot for equity returns.¹¹ Meanwhile, the movements in volatilities are due to responses to economic and political events.

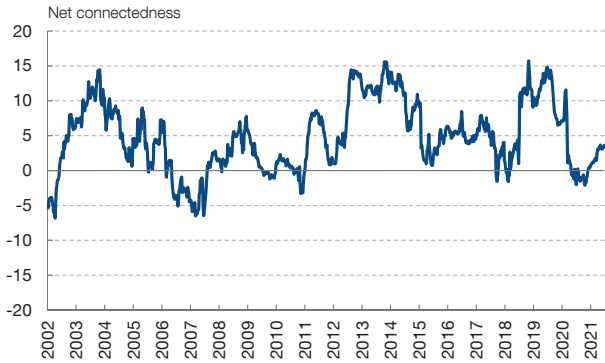
Pairwise net connectedness between Spain and the core and periphery equity markets, respectively, are examined and shown in Chart 5 for equity market volatilities. The chart indicates that, for the most part, Spain is a net receiver of

¹¹ Given that the spillover index is a measure of system-wide interconnectedness, the fact that around 70 %-90 % of forecast error variance decompositions can be attributed to spillovers from one equity market to another underscores the increasing financial integration across the euro area.

Chart 5

NET CONTRIBUTION OF IBEX 35 REALIZED VOLATILITY TO CORE AND PERIPHERAL EQUITY MARKET VOLATILITIES

1 SPAIN VIS-À-VIS CORE COUNTRIES



2 SPAIN VIS-À-VIS PERIPHERAL COUNTRIES



SOURCES: Datastream and own elaboration.

NOTE: The charts above shows the net pairwise connectedness of the IBEX 35 return volatility with respect to core (see Chart 5.1) and peripheral (see Chart 5.2) equity market volatilities. The charts are estimated from a VAR(1) model with a two-year rolling window and a one week prediction horizon. A positive value of the measure indicates that Spain is a net absorber of contagion, while a negative value of the measure indicates that Spain is a net transmitter of contagion.

shocks from core equity markets, while it is a net transmitter of shocks to peripheral equity markets.¹²

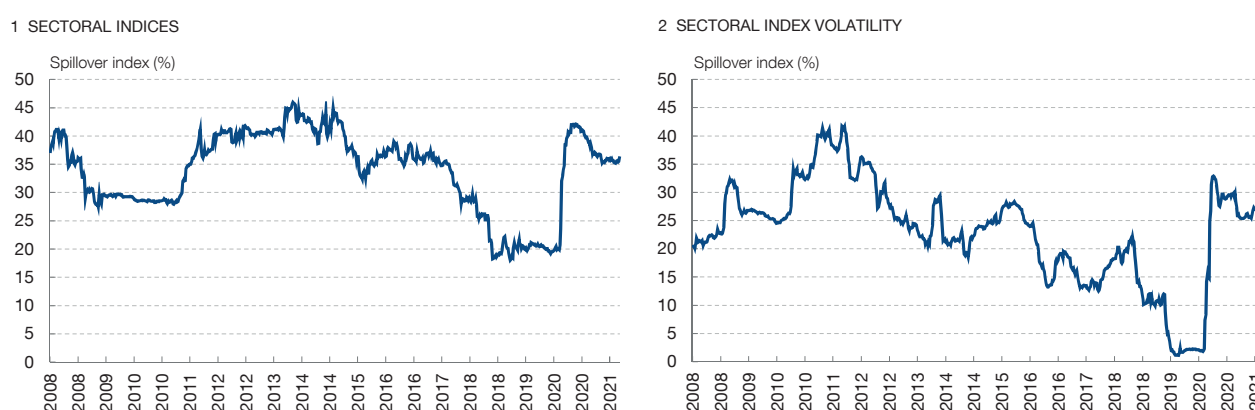
4.2.3 Sectoral indices

Having established how the Spanish sovereign and the Spanish equity markets influence and are influenced by other economies, the analysis turns to the interconnections between sectoral indices within the Spanish economy.¹³ The corresponding spillover indices both for returns and volatilities are shown in Chart 6. The spillover indices for different sectors indicate spikes around the 2010-2014 European sovereign debt crisis, and at the onset of the COVID-19 pandemic in March 2020, the spillover index reached levels close to historical highs. The volatility spillovers in Chart 6.2 show a similar spike around March 2020, though not at the same levels as in sectoral indices.

12 In order to verify whether the results in relation to the spillover index are due to other advanced economies such as the UK and the US, an alternative model is estimated where the S&P 500 and the FTSE are considered as additional variables in the VAR system. The results obtained show that the spillover index retains the same dynamics as that showed in the main text, and that Spain still is a net transmitter of risk to peripheral countries, and a net receiver from core countries. Results are available upon request.

13 In contrast to the earlier estimations, a VARX(1) model is estimated for the purpose of computing the spillover index and the net connectedness measures. The exogenous variables used for estimation are the EURO STOXX 600, and an index of European sovereign bond yields ex-Spain. An alternative estimation is considered, which is to net out the exogenous variables via OLS estimation, following Boeckelmann and Stalla-Bourdillon (2021). Results obtained are quite similar.

Chart 6

SPILLOVER INDEX FOR SPANISH SECTORAL INDEX RETURNS AND RETURN VOLATILITIES

SOURCES: Datastream and own elaboration.

NOTE: The charts above show the total spillover index for sectoral indices (see Chart 6.1) and for sectoral index volatilities (see Chart 6.2) for the Spanish economy. The spillover indices are defined as the sum of all variance decomposition "contributions to others". The values of the index are from 0 to 100, and can be thought of as percentages. The charts are estimated from a VAR(1) model with a two-year rolling window and a one week prediction horizon.

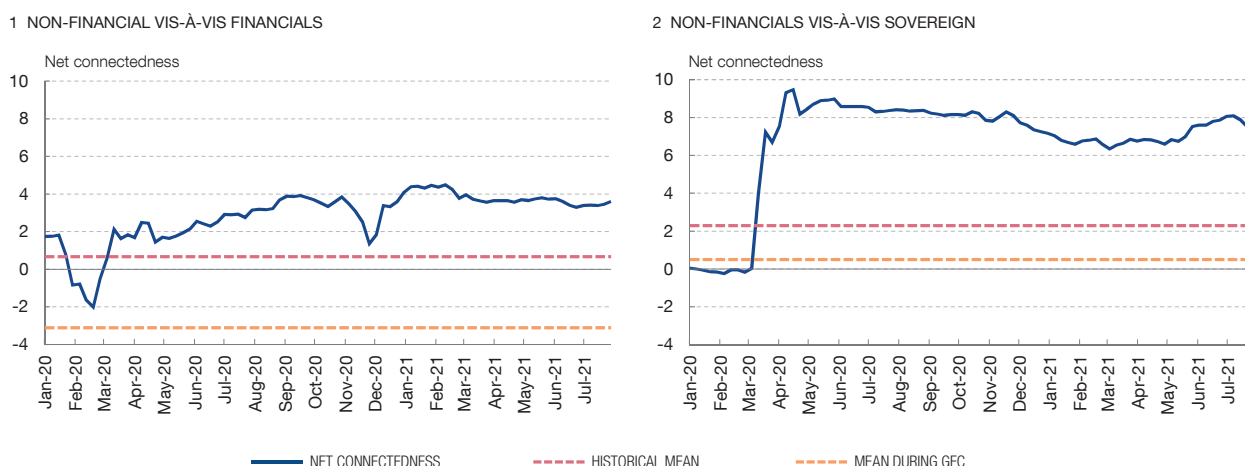
The analysis studies how contagion spreads across different sectors of the Spanish economy, with a particular focus on the recent COVID-19 pandemic, given that spillovers were near the maximum levels reached in the historical data. Chart 7 shows the net connectedness of each of the sectors considered. In the case of Chart 7.1, a positive net connectedness value implies a stronger contagion from the non-financial sector to the financial sector than in the other direction, and vice-versa for negative values. The chart shows that during the onset of the COVID-19 lockdowns, there was an increase in net contagion from the non-financial sector to financial sector. This increase possibly reflects the rise in risks and vulnerabilities of non-financial firms as a result of the COVID-19 pandemic [Banco de España (2021)], thus spilling over to the financial sector due to its exposure to non-financial firms, which moreover increased during this episode as a result of increased lending to such firms.

The increase in contagion was steady until November 2020, which coincides with announcements of the effectivity of some vaccines to fight the COVID-19 virus, and the extension of programs to provide support to non-financial firms. In particular, these programs included the public guarantee facilities managed by the Official Credit Institute (ICO, in its Spanish acronym). While there was another round of increase in net spillovers from non-financial to financial firms earlier in 2021, these dissipated later on. During the pandemic crisis, net spillovers from the non-financial sector to the financial sector have been above the historical mean (marked by the dashed red line in the chart).

Chart 7.2 shows net spillovers between the non-financial sector and the Spanish sovereign bond market. As in Chart 7.1, a positive net connectedness measure implies that the contagion from the non-financial sector to the sovereign is higher

Chart 7

NET CONTRIBUTION OF NON-FINANCIAL SECTORS VIS-À-VIS FINANCIAL AND SOVEREIGN SECTORS



SOURCES: Datastream and own elaboration.

NOTE: The charts show the net connectedness between non-financial and financial sectors (see Chart 7.1) and the non-financial vis-à-vis the sovereign (see Chart 7.2) in Spain. The charts are estimated from a VARX(1) model with a two-year rolling window. The blue line is the net connectedness measure, the red line is the historical mean, while the orange line is the mean of the series during the global financial crisis. A negative value of the measure indicates that the non-financial sector is a net absorber of contagion, while a positive value of the measure indicates that the non-financial sector is a net transmitter of contagion.

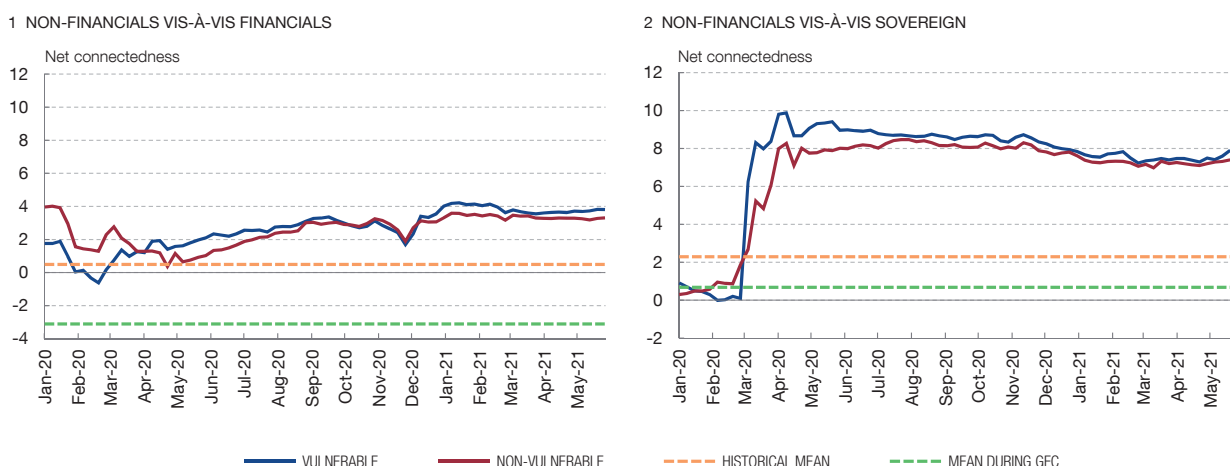
than in the other direction. A sharp increase in contagion from non-financial sectors to the sovereign is found, which continued throughout most of 2020, and then stabilized. This rise in net spillovers from the non-financial sectors can also possibly be associated to the overall fiscal policy response in support of the nonfinancial corporate sector, including public guaranteed loan programs which increased the contingent exposures of the government to the non-financial sector.

Digging deeper into the transmission from the non-financial to the financial sector and conduct a more elaborate analysis is conducted wherein the non-financial sector is divided into vulnerable and non-vulnerable sectors. The results, which are shown in Chart 8, show that during the COVID-19 pandemic, indicate that there was an increase in the transmission of shocks from vulnerable non-financial sectors to the financial sector, while there was a decrease in the transmission of shocks from the non-vulnerable non-financial sectors to the financial sector. From June 2020 onwards, however, both vulnerable and non-vulnerable sectors move together. With respect to the linkages with the sovereign, meanwhile, the results are quite similar in direction.

All in all, these results emphasize the different nature of the COVID-19 crisis from the European sovereign debt crisis. In particular, in the COVID-19 crisis, it was the non-financial sector that affected the other sectors of the economy. This is as opposed to the sovereign debt crisis, wherein we can observe (from the orange line that depicts the mean net spillover during the period) that the non-financial sector was a net receiver of contagion from the financial sector.

Chart 8

COMPARISON BETWEEN VULNERABLE AND NON-VULNERABLE SECTORS



SOURCES: Datastream and own elaboration.

NOTE: The charts show the net connectedness between non-financial and financial sectors (see Chart 8.1) and the non-financial vis-à-vis the sovereign (see Chart 8.2) in Spain. The charts are estimated from a VARX(1) model with a two-year rolling window. The blue line is the net connectedness measure for vulnerable sectors, the red line is the net connectedness measure for non-vulnerable sectors, the orange line is the historical mean, while the green line is the mean of the series during the global financial crisis. A negative value of the measure indicates that the non-financial sector is a net absorber of contagion, while a positive value of the measure indicates that the non-financial sector is a net transmitter of contagion.

4.2.4 Robustness

Finally, the analysis looks at the robustness of the spillover indices to differences in the predictive horizon or to differences in the length of the rolling windows. For brevity in the presentation, the focus is on the results with respect to the sovereign debt markets. Results are presented in Chart 9, which shows the spillover indices for sovereign bond yields.

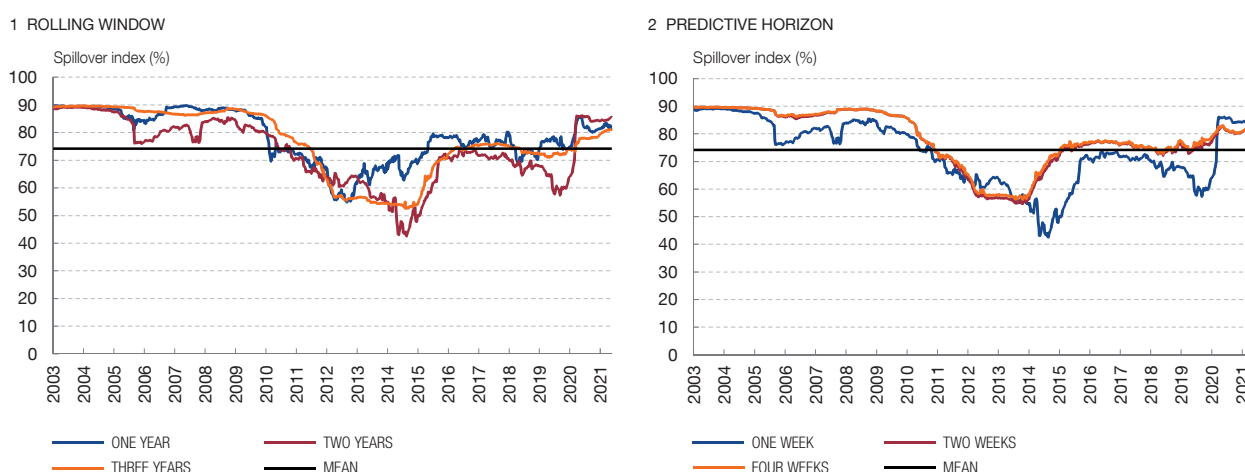
Chart 9.1 shows the estimation results when the size of the rolling window is changed to a smaller size (1 year), or to a wider size (3 years).¹⁴ The finding is that, in general, the spillover index retains the same dynamics. However, another finding is that the smaller window size yields to a higher degree of spikes from 2012 to 2014, which smoothen out the window length increases. Meanwhile, Chart 9.2 shows the estimation results when the predictive horizon changes from one week to four weeks.¹⁵ As the chart indicates, the general pattern remains the same.

¹⁴ As explained by Diebold and Yilmaz (2009), the trade-off between sizes of the rolling window is either one can have a more stable estimation (larger rolling window), or one can capture dynamics better (smaller rolling window).

¹⁵ Diebold and Yilmaz (2009) choose the smaller prediction horizon as it corresponds to the Basel II regulations, and work with the larger prediction horizon because it can capture long-term dynamics more precisely.

Chart 9

ROBUSTNESS OF THE DIEBOLD AND YILMAZ (2009) SPILLOVER INDICES FOR SOVEREIGN BOND YIELDS



SOURCES: Datastream and own elaboration.

NOTE: The charts show the robustness of the spillover measures of Diebold and Yilmaz (2009) when I change the size of the rolling window (see Chart 9.1), or when I change the prediction horizon for the variance decompositions (see Chart 9.2). The spillover indices are defined as the sum of all variance decomposition "contributions to others". The values of the index are from 0 to 100, and can be thought of as percentages. I estimate this model for sovereign bond yields, with a VAR(1) model.

5 Conclusion

This article studies the interconnectedness of different financial markets using the Diebold and Yilmaz connectedness methodology. The spillover indices that result from this estimation show a high degree of connectedness across sovereign debt markets in Europe prior to the 2010-2014 sovereign debt crisis, followed by a decoupling between peripheral and core sovereign bond yields during such crisis, and a partial reintegration afterwards. With respect to equity markets, the estimation shows wide movements in equity market volatility spillovers, which coincide with critical events in financial markets. Finally, estimating sector-wide models for Spain, it is found that there is a net contagion from non-financials to both the financial sector and the Spanish sovereign bond market since the outbreak of the COVID-19 pandemic.

The analysis conducted in this paper suggests several extensions for future work. For instance, while measures of contagion are obtained from market prices, there is no clear identification of structural shocks. Moving in this direction might provide further guidance on the understanding of the movements in the financial market spillovers.

REFERENCES

- Acharya, V., L. Pedersen, T. Philippon and M. Richardson (2017). "Measuring Systemic Risk", *The Review of Financial Studies*, No. 30, pp. 2-47.
- Adrian, T., and M. Brunnermeier (2016). "CoVaR", *American Economic Review*, No. 106, pp. 1705-1741.
- Banco de España (2021). "The effects of the COVID-19 crisis on the productive sectors in Spain: economic and financial implications", Chapter 3, *Annual Report 2020*.
- Billio, M., M. Getmansky, A. Lo and L. Pelizzon (2012). "Econometric measures of connectedness and systemic risk in the finance and insurance sectors", *Journal of Financial Economics*, No. 104, pp. 535-559.
- Blanco, R., S. Mayordomo, A. Menéndez and M. Mulino (2021). *Impact of the COVID-19 crisis on Spanish firms' financial vulnerability*, Occasional Papers, No. 2119, Banco de España.
- Boeckelmann, L., and A. Stalla-Bourdillon (2021). *Structural Estimation of Time-Varying Spillovers: An Application to International Credit Risk Transmission*, Banque de France Working Paper No. 798.
- Brownlees, C., and R. Engle (2017). "SRISK: A conditional capital shortfall measure of systemic risk", *Review of Financial Studies*, No. 30, pp. 48-79.
- Corradin, S., N. Grimm and B. Schwaab (2021). *Euro area sovereign bond risk premia during the COVID-19 pandemic*, ECB Working Paper No. 2561.
- De Santis, R., and S. Zimic (2018). "Spillovers among sovereign debt markets: Identification through absolute magnitude restrictions", *Journal of Applied Econometrics*, No. 33, pp. 727-747.
- Demirer, M., F. X. Diebold, L. Liu and K. Yilmaz (2018). "Estimating Global Bank Network Connectedness", *Journal of Applied Econometrics*, No. 33, pp. 1-15.
- Diebold, F. X., and K. Yilmaz (2009). "Measuring Financial Asset Return and Volatility Spillovers, With Application to Global Equity Markets", *Economic Journal*, No. 119, pp. 158-171.
- Gross, C., and P. L. Siklos (2020). "Analyzing credit risk transmission to the nonfinancial sector in Europe: A network approach", *Journal of Applied Econometrics*, No. 35, pp. 61-81.
- Koop, G., M. H. Pesaran and S. Potter (1996). "Impulse response analysis in nonlinear multivariate models", *Journal of Econometrics*, No. 74, pp. 119-147.
- Pesaran, M. H., and Y. Shin (1998). "Generalized impulse response analysis in linear multivariate models", *Economics Letters*, No. 1, pp. 17-29.
- Schnabel, I. (2021). "The sovereign-bank-corporate nexus – virtuous or vicious?", speech at the LSE conference on "Financial Cycles, Risk, Macroeconomic Causes and Consequences", Frankfurt am Main, 28 January.

The main text describes in words the Diebold and Yilmaz (2009) approach to study interconnectedness. This annex, meanwhile, provides a more formal description of the approach. Suppose that one observes a vector of financial returns $x_t = (x_{1t}, x_{2t}, x_{3t}, \dots, x_{Nt})'$. A vector autoregressive model of order p for these variables can be written as the following equation:

$$x_t = A_1 x_{t-1} + A_2 x_{t-2} + \dots + A_p x_{t-p} + w_t$$

In this equation, the A_p 's are matrixes of the coefficients, p is the lag order, and w_t is a vector of innovations that is normally distributed: $w_t \sim N(0, \Sigma)$. The Wold decomposition of the equation above can be written as $x_t = \sum_{i=1}^{\infty} \Phi_i w_{t-i}$, where the $N \times N$ coefficient matrixes Φ_i obey the following recursion: $\Phi_1 = A_1 \Phi_{1-1} + A_2 \Phi_{1-2} + \dots + A_p \Phi_{1-p}$. The moving average coefficients (or transformations of these, such as impulse responses and variance decompositions), are important for understanding the dynamics of the variables.

The DY methodology focuses on the use of variance decompositions to describe the interconnectedness between several variables. Crucially, variance decompositions allow one to assess the fraction of the H step ahead error variance in forecasting x_i that is due to shocks in x_j , $\forall i \neq j$, for each variable i . The main upper left block of the connectedness table presented in the main text contains the variance decomposition matrix $D^H = [d_{ij}^H]$. To obtain this, we rewrite the VAR system to its moving average representation, and compute H step ahead forecasts. We then compute the corresponding forecast errors and calculate the covariance matrix.

The discussion above assumes orthogonality of the shocks, which permits a relatively easy calculation of the variance decompositions. In general, however, the innovations from a VAR are generally correlated. The usual identification schemes, such as the Cholesky decomposition, however, depend on the ordering of the variables. As such, DY propose to circumvent this problem by relying on generalized variance decompositions (GVD) as proposed by Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998). Specifically, in this framework, the entries of the H step generalized variance decomposition matrix are:

$$d_{ij}^{gH} = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i' A_h \Sigma A_h' e_i)}$$

where e_j is a selection vector with its j -th element equal to one and zeros elsewhere, A_h is the coefficient matrix multiplying the h lagged shock vector in the infinite sum moving-average representation of the non-orthogonalized VAR, and σ_{jj} is the j -th diagonal element of Σ . Because shocks are not necessarily orthogonal in the GVD environment, sums of the forecast error variance decompositions are not necessarily unity. Hence, the measures of connectedness are normalized and based on the following decomposition matrix: $\widetilde{D}^g = \left[\widetilde{d}_{ij}^g \right]$, wherein $\widetilde{d}_{ij}^g = \frac{d_{ij}^g}{\sum_{j=1}^N d_{ij}^g}$. Using this

decomposition, generalized connectedness measures can be computed, as reported in this article.

As DY note, the variance decompositions have a tight link to the network literature. Specifically, the variance decomposition matrix D^H is the adjacency matrix of a weighted, directed network. In this regard, the connectedness measures described earlier have analogous counterparts in the network literature. Specifically, $C_{i \leftarrow}^H$ and $C_{\leftarrow j}^H$ are from- and to-degree measures, respectively, while C^H is simply the mean degree.¹

1 A network is an object that consists of N nodes and L links between the nodes. A node's degree is its link to other nodes. From-degrees correspond to out-degrees, which is the number of outgoing connections a node has to other nodes. To-degrees correspond to in-degrees, which is the number of incoming connections a node has to other nodes. The mean degree is, simply put, the average degree.

Strengthening the cyber resilience of the financial sector. Developments and trends

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Abstract

The debate about the cyber resilience of the financial sector has become more important in recent years. In this article the authors endeavour to clarify the meaning of this concept and why it has become a topic of growing concern for financial institutions and authorities. They analyse how cyber resilience in the financial sector has evolved in recent years, its current situation and the trends observed. Lastly, they define the way in which the different actors involved work towards enhancing it. In particular, they describe the various regulatory and supervisory actions conducted by the sectoral authorities in this field.

Keywords: resilience, operational resilience, cyber resilience, cyber security, cyber incident.

1 Introduction

In recent years references to resilience have become a common topic in all kinds of publications, speeches¹ and debates, both for the authorities and for the private sector, a trend which has been exacerbated by the COVID-19 pandemic. But what does resilience mean?

The term “resilience” comes from the field of psychology and, although there is no single definition, it is usually understood as the ability to adapt to adverse situations. Different terms have derived from this general concept for their use in other fields. One of the most common, particularly relevant from the perspective adopted in this article, is “operational resilience”, which the Basel Committee on Banking Supervision (BCBS) defined in its Principles for Operational Resilience² as the ability of a bank to deliver critical operations through disruption. This definition can be applied not only to banks, but also to all kinds of private firms and public institutions inside and outside the financial sector.

In an increasingly digitalised world where information and communication technologies (ICT) play a key role in financial operations, the fact that cyber resilience has emerged as a specific case of operational resilience comes as no surprise. This article shall use as a reference the Cyber Lexicon of the Financial Stability Board (FSB),³ which defines cyber resilience as the ability of an organisation to continue to

1 See Hernández de Cos (2019).

2 See BCBS (2021a).

3 See FSB (2018).

carry out its mission by anticipating and adapting to cyber threats and other relevant changes in the environment and by withstanding, containing and rapidly recovering from cyber incidents. This definition encompasses both the cyber security component, which is more preventive, and the business continuity component, which focuses on response and recovery when incidents occur.

The definition of cyber incident in the FSB's Cyber Lexicon refers to events resulting from both non-malicious and malicious activity (caused by cyber attacks). In the latter case, which includes events such as natural disasters, human errors or accidental system failures, they may also affect the ability of institutions and the sector to continue operating normally. Accordingly, resilience to these cyber incidents is equally important. However, the article will analyse intentional incidents in greater depth, given their higher potential impact.

The financial sector is a very complex ecosystem, with numerous participants (including market infrastructures, financial institutions and providers) which are closely interconnected and interdependent, and which have different levels of maturity in terms of cyber resilience.

Some of the financial sector's intrinsic characteristics not only generate a high level of exposure for individual institutions to cyber incidents, but may also help extend or amplify their impact to an extent that could jeopardise financial stability.⁴ These characteristics include its strong dependence on technology, its appeal to attackers with different motivations, the high degree of interconnectedness among its members and its high sensitivity to participants' loss of confidence.⁵

For this reason, improving the financial sector's cyber resilience is key for preserving financial stability. This article describes some of the main initiatives that have been or are being carried out by both the private sector and the authorities to help fulfil this objective, with a special focus on those directly affecting the Spanish financial sector.

2 Background

2.1 Digitalisation and exposure to cyber risk

Historically, the financial sector has been very proactive in the use of information technologies to set in place new business models and optimise internal processes. This digital transformation process has accelerated extraordinarily in recent years, becoming essential for the survival of institutions, for various reasons.

⁴ See Herrera, Munera and Williams (2021).

⁵ See ESRB (2020).

First, changes in the expectations of customers, who value the availability of flexible services that are tailored to their needs and are immediately accessible anywhere and on any device. This has been reinforced by the emergence of new competitors for traditional institutions, such as BigTech⁶ and FinTech⁷ firms, which provide customers with highly attractive solutions and are quick to develop new offers.

In addition, the low interest rate economic environment has led institutions to adapt their business models, launching new products and services in their search for alternative sources of income and improving the efficiency of their internal processes to cut costs. All this while harnessing the rapid developments in technology, which have made it possible to multiply systems' capacities while reducing prices.

As a result, the financial sector is highly digitalised, to the point that institutions are completely dependent on their technology, not only as a facilitating instrument for the business, but as a differential and competitive factor. Evidently, the high level of digitalisation increases the risk of cyber incidents (both those caused by system failures and malicious incidents or cyber attacks). Other factors contributing to this increasing risk include the complexity of most financial institutions' technological environment. Thus, legacy applications exist alongside others supported by more innovative technologies resulting not only from transformation processes, but also from the various mergers and acquisitions that have taken place recently in the Spanish financial sector. This complexity makes it difficult for institutions to maintain an adequate control environment and, therefore, makes them more vulnerable.

It is important to note that in order to carry out these digital transformation processes and have access to the technological innovations that can best contribute to their business, financial institutions complement their capacities by procuring external services, investing in start-ups and acquiring third-party products. They also participate in incubators⁸ and accelerators⁹ or cooperate in consortia.

For this reason, the resilience and cyber security of these third parties, particularly providers, has become a growing concern for authorities and institutions. In fact, some of these providers have come to form the backbone of the financial sector, at a level comparable to market infrastructures and systemic institutions. They are

6 According to the FSB, "BigTech firms are large technology companies with extensive established customer networks".

7 The FSB defines FinTech as "technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services".

8 Incubators offer early-stage entrepreneurs and start-ups a physical space with basic services such as telecommunications in which to set an innovative business idea in motion. They generally provide access to a network of contacts and to expert teams that provide advice for the project to materialise.

9 Accelerators accompany start-ups that are already operating (unlike incubators, which help early-stage start-ups and provide basic services). Accelerators help boost start-up growth, acting as mentors in business model definition, trade strategies and even fund raising.

therefore unique points of failure, since the incidents affecting them, including unintentional ones, may have an impact on the sector as a whole.

Less well-known niche providers and other third-party dependencies not duly identified, arising from successive sub-contracting along the outsourcing chain, must be added to the list of large providers commonly considered systemic.

Against this backdrop, the COVID-19 pandemic has acted as a catalyst, accelerating the digitalisation processes already in progress at financial institutions and further increasing their dependence on technology service providers.

First, institutions have been forced to expand their portfolio of remote financial services. This has increased the exposure of their customers to attacks. Thus, a very significant growth in phishing,¹⁰ vishing¹¹ and website and mobile application impersonation, inter alia, has been observed. Although institutions have made, and continue to make, significant efforts to improve customer cyber security education, some customers remain highly vulnerable, particularly those not familiar with digital channels prior to the pandemic.

Second, high teleworking levels have brought about additional risks for institutions and their employees, including those arising from the deployment of new technological infrastructure and the swift implementation of collaborative work solutions, insufficiently securitised access to corporate systems from personal devices and home connection networks, and the handling of confidential data at employees' homes. All of this has generated an increase in the exposure of institutions to cyber threats, exacerbated as a result of the speed imposed by the circumstances, which sometimes led to laxer controls or security analyses in order to continue operating.

In addition, the sudden need to increase the capacity of their systems forced many institutions to acquire additional external services, making them more dependent on third parties, particularly on cloud service providers. This market is highly concentrated in a relatively small number of providers; therefore, any incident at any one of them may have an immediate impact on multiple customer institutions.

The combination of these factors has created a very attractive environment for cyber attackers, who have seized the opportunity. Thus, during the pandemic, the financial sector has been the primary victim of cyber attacks worldwide, second only to the health sector.¹²

10 Phishing attacks are those where the attacker tries to fraudulently obtain confidential information (passwords, bank details, etc.) from legitimate users, by supplanting the digital identity of a trustworthy institution.

11 Vishing is a type of social engineering scam via telephone, where through a call the identity of a trustworthy firm, organisation or person is supplanted. The aim is to obtain the victim's personal and sensitive information.

12 See BIS (2021).

Although some studies suggest that the financial sector is one of the critical sectors best equipped to deal with cyber risks, in part owing to its high level of regulation and supervision, cyber resilience among its participants is uneven. Sometimes the security measures and controls implemented by institutions, particularly smaller ones, are not enough to manage the cyber risks which the pandemic has exacerbated. It is therefore no surprise that among the institutions that have seen the biggest rise in the number of incoming cyber attacks, credit cooperatives, payment institutions and insurance companies (which belong to sectors where many small institutions are concentrated) stand out.¹³

In addition to cyber attacks attributable to organised crime, which pursue an economic benefit, an increase has also been seen in geopolitically motivated cyber attacks, some of which have been very sophisticated and were aimed at different supply chain providers.

2.2 The financial system in the face of geopolitical tensions

Since we have historical records, the economic and financial scenario has been both a cause of conflict and an object of dispute. State security has always been multi-dimensional. Aside from military matters, social, political and economic and financial aspects (the latter two being our concern at hand) have been and continue to be of vital importance. In its role of channelling economic resources and acting as a driving force for the productive business sector, the financial system is an essential element for economic development. For this reason, in the field of geopolitics, the adversaries' financial sector has become a priority for the enemies of any State.

In recent decades cyberspace¹⁴ has become another domain, to be added to the traditional land, sea, air and space domains, as a means for attacking and defending objectives. States are investing ever more resources in developing their capabilities in this field, on both the defensive and offensive fronts.

From the defensive perspective, cyber resilience and the protection of critical financial sector infrastructures are reflected in the national security strategies of a growing number of countries, including Spain.¹⁵ The International Telecommunication Union, a specialised agency of the United Nations for ICT, which publishes a global cyber security index each year, classified Spain in its 2020 edition¹⁶ as one of the countries with the greatest capacity in terms of cyber security and cyber resilience (ranking fourth), a reflection of its maturity in this sphere.

13 *Ibid.*

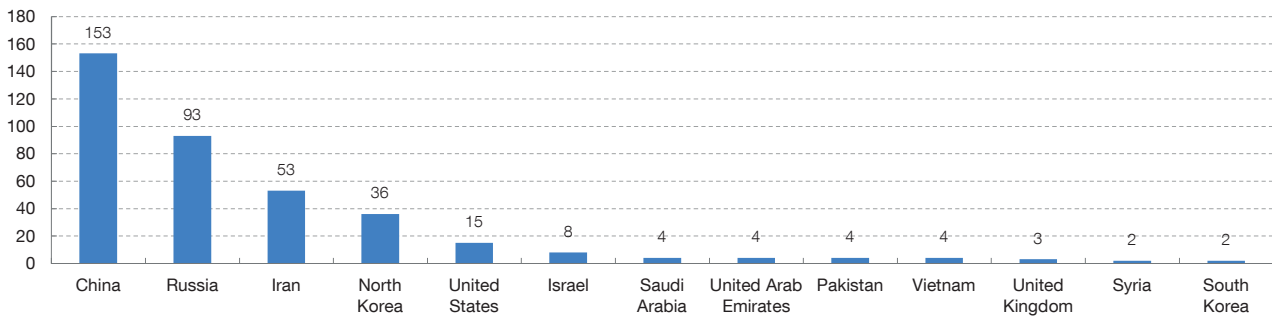
14 NIST defines cyberspace as "a global domain within the information environment consisting of the interdependent network of information systems infrastructures including the Internet, telecommunications networks, computer systems, and embedded processors and controllers".

15 See DSN (2017 and 2019).

16 See International Telecommunication Union (2021).

Chart 1

ESTIMATION OF NUMBER OF STATE-SPONSORED CYBERATTACKS (2005-2020)



SOURCE: Council on Foreign Relations (2021).

As regards the offensive component, the organisation of specialised and operational groups responsible for launching attacks against other powers in cyber space is common, whether integrated in military structures or financed and organised outside them. Since 2005 at least 34 countries are suspected of having sponsored cyber attacks. As shown in Chart 1, it is estimated that China, Russia, Iran and North Korea sponsored 77% of all suspected operations¹⁷ and that, in view of their resources and investment, they are expected to continue to be the most active actors in the future, although other western powers, such as the United States, the United Kingdom and Israel, also play a very significant role.

The term “state-sponsored actors” is generally used to refer to these types of State groups whose priorities, together with cyber espionage and influence operations, are cyber attacks against other States’ critical infrastructures, with the financial sector having become a primary target. Thus, the 2019 Annual Report on National Security issued by Spain’s National Security Department (DSN) indicates that in Spain 54% of cyber attacks against critical infrastructures targeted the financial sector.¹⁸

State groups have a high level of economic support, which enables them to have highly qualified staff and advanced offensive capabilities. Although their cyber attacks are comparatively less frequent, they have a potentially greater impact than campaigns conducted by non-state actors, such as hacktivists¹⁹ or cyber criminals.

One of the main objectives of these groups is to destabilise the States they attack, and undermining confidence in the financial system is a very efficient way of

17 See Council on Foreign Relations (2021).

18 See DSN (2021).

19 Hacktivism (a combination of “hacking” and “activism”), also known as cyber activism, refers to the use of digital tools and attacks for politically motivated purposes.

achieving this. By taking advantage of the high degree of interconnectedness between the different participants in the financial sector, attackers seek to generate cyber incidents that can spread, escalate in magnitude and rapidly generate systemic consequences. In this connection, both the European Central Bank (ECB) and the European Systemic Risk Board (ESRB) have warned about the existence of plausible channels through which a cyber incident might evolve into a serious financial crisis.²⁰

Given their nature, assets managed by financial institutions are easily (if not directly) monetisable and, accordingly, they are especially attractive for cyber attackers. Some of the most harmful State groups, such as those backed by North Korea, are particularly active in launching cyber attacks which aim to perform fraudulent transfers,²¹ steal cryptocurrencies or demand ransom in exchange for returning to their victims and not disseminating the information encrypted by the attackers (ransomware).²² The United Nations Security Council²³ recognises that these groups have become an additional source of financing for the States promoting them and a practical way of averting, or at least mitigating, the effect of international economic sanctions. Data theft is another channel used by attackers to obtain financing; cyber attacks financed by States with the aim of obtaining sensitive information that may be economically useful are increasingly frequent.

Lastly, as mentioned earlier, cyber attacks against third parties have become more numerous and sophisticated. The SolarWinds case is a paradigmatic example of the consequences of these attacks. In December 2020 it was discovered that software²⁴ distributed by SolarWinds had been modified by a group of cyber attackers to install a Trojan²⁵ in all the customers that used this product. The parties affected included numerous US federal agencies, NATO, the European Parliament and firms such as Microsoft, as well as others in various sectors, including the financial sector, around the world. This cyber attack, attributed to Russian intelligence services, which was extremely sophisticated and managed to go undetected for months, is a perfect example of the impact supply chain cyber attacks can have. Despite the time and resources needed to prepare and carry out such a far-reaching operation, the attackers managed to infiltrate thousands of organisations and important firms through a single point of entry, thereby multiplying manifold the attack's effectiveness and efficiency.

20 See ESRB (2020).

21 Attack on the Bangladesh Bank (the central bank of Bangladesh) in which fraudulent transfers were made via the SWIFT network totalling over \$80 million.

22 Ransomware is a type of malicious software that restricts access to certain parts or files of the infected operating system and then demands ransom to remove the restriction.

23 See United Nations (2019).

24 The software, called "Orion", is used by customers to monitor their technological infrastructure.

25 In IT, a Trojan horse or Trojan is a programme that appears to be legitimate and harmless but, when executed, gives the attacker remote access to the infected computer.

3 Cyber resilience and the financial sector

3.1 Developments in cyber resilience in the financial sector

Although the use of the terms “resilience” and “cyber resilience” did not become widespread in the financial sector until 2016, this does not mean that before then there was no concern, both among the authorities and among the institutions themselves, for managing risks with a potential impact on institutions’ resilience and, more specifically, on the technological front.

Back in 2005, concern for technological risk and business continuity, both within the broader field of operational risk management, had started to become widespread. The focus was mainly on technology and the authorities’ perspective was microprudential. In this vein, in 2007 the Banco de España started to conduct the first on-site inspections to analyse the situation of technology and the management of associated risks at the institutions it supervised. For this purpose, it developed an initial methodology, which has been subsequently improved.

Since then, the concepts have evolved significantly, in parallel to the sector’s growing digitalisation and awareness of the significance of these non-financial risks. For instance, the first version of the “Principles for the Sound Management of Operational Risk”, published in 2011²⁶ by the BCBS, only mentioned the word “resilience” once and did not include any reference to the prefix “cyber”. By contrast, the revisions to these principles published in 2021²⁷ mention “resilience” 22 times, use the prefix “cyber” eight times and include a new principle on ICT risk management.

In recent years it has become evident that cyber resilience is a global concern requiring the cooperation of all the actors involved. This has led to the emergence of numerous fora for debate and cooperation in the industry and among authorities, and to a highly significant regulatory and legislative effort. There has also been a shift towards a more holistic approach which does not focus exclusively on managing technology, but grants the same importance to persons and processes in organisations, linking up with existing disciplines, such as business continuity.

In 2014 the European Banking Authority (EBA) began to analyse the regulatory and supervisory status of technological risks in the different European jurisdictions. Since then, the EBA has created specialised working groups and published abundant regulations with much impact on the sector. Notable are the 2017 “Guidelines on ICT risk assessment under the Supervisory Review and Evaluation Process (SREP)”,²⁸ the “Recommendations on outsourcing to cloud service providers”, also published

²⁶ See BCBS (2011).

²⁷ See BCBS (2021b).

²⁸ *EBA Guidelines on ICT risk assessment under the Supervisory Review and Evaluation Process (SREP)* (EBA/GL/2017/05).

in 2017²⁹ (subsequently integrated into the 2019 “Guidelines on outsourcing arrangements”³⁰ and repealed in their original form) and the 2019 “EBA Guidelines on ICT and security risk management”³¹.

The Single Supervisory Mechanism (SSM) also commenced its activity in 2014, centred on the ECB as the banking supervisor for the euro area, and paid special attention to ICT risk from the beginning. Not only did it draw up ad hoc chapters in the supervisory manual for use during targeted on-site inspections, but it also developed a methodology for the ongoing assessment of ICT risk during the supervisory review and evaluation process. It also set up a procedure for institutions to report significant cyber incidents and carried out various horizontal analyses in connection with ICT risk and its management, part of whose findings are shared with the industry.³²

The publication of “Guidance on cyber resilience for financial market infrastructures”³³ by CPMI-IOSCO³⁴ in 2016 and of the Bank of England’s Discussion Paper “Building the UK Financial Sector’s Operational Resilience”³⁵ in 2018 marked a turning point from which the discussion about operational resilience and cyber resilience started to become commonplace in the sector. The underlying idea is that implementing preventive measures to try to avoid cyber incidents is not sufficient. It is necessary to assume that they will occur and be prepared to manage them in order to minimise their impact and be able to continue providing critical functions and services.

Since 2018 all sorts of studies and regulations have been published on cyber resilience. Some notable examples include the publication in 2018 of the FSB’s “Cyber Lexicon”, the ECB’s “Cyber Resilience Oversight Expectations”³⁶ and the BCBS’s “Cyber-resilience: range of practices”.³⁷ The BCBS also published in 2021 “Principles for Operational Resilience”, which has aroused much interest in the sector.

Beyond the regulatory sphere, initiatives regarding the supervision of these risks have also grown significantly in recent years. Most authorities have allocated specialised resources both for ongoing monitoring and on-site inspections of institutions and for horizontal activities on the sector as a whole.

29 *Recommendations on outsourcing to cloud service providers (EBA/REC/2017/03).*

30 *Guidelines on outsourcing (EBA/GL/2019/02).*

31 *EBA Guidelines on ICT and security risk management (EBA/GL/2019/04).*

32 See ECB (2021).

33 See CPMI-IOSCO (2016).

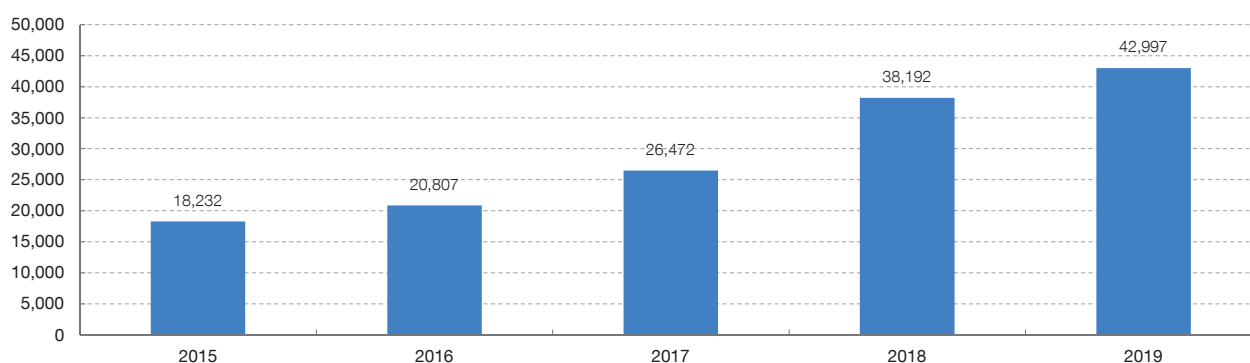
34 Committee on Payments and Market Infrastructures and International Organisation of Securities Commissions.

35 See Bank of England (2018).

36 See ECB (2018).

37 See BCBS (2018).

Chart 2

NUMBER OF INCIDENTS MANAGED BY THE CCN-CERT

SOURCE: Centro Criptológico Nacional (2020).

The Banco de España is one of the European supervisors with the greatest capacity and experience in this area. For this reason, it has contributed and continues to contribute significantly to the development of the main European and global regulatory and legislative initiatives and to the progress of the SSM's actions. From the perspective of market infrastructures, the Banco de España participates in the oversight of euro area payment systems and of central securities depositories, and in the supervisory colleges for central counterparties.

On the domestic front, in addition to exercising its supervisory and oversight responsibilities, it carries out numerous horizontal activities aimed at acquiring overall knowledge of Spanish institutions' technological situation and at improving their – and the overall financial sector's – cyber security and cyber resilience.

3.2 Current situation

As noted above, recent years have seen a substantial rise in the frequency and sophistication of attacks on the financial sector. Chart 2 shows the increase in the number of cyber incidents occurring in Spain and managed by the National Cryptology Centre (CCN),³⁸ a significant proportion of which targeted the financial sector. The CCN figures also show that 64% of the incidents managed in 2019 were classed at a high, very high or critical alert level.³⁹

Accurately quantifying the costs associated with a cyber incident is no easy task since, while numerous studies have been conducted on the matter in recent years,

³⁸ See CCN (2021).

³⁹ In the report *Ciberamenazas y tendencias. Edición 2020*, incidents are classified into five alert levels: critical, very high, high, medium and low.

standard definitions and reliable, homogeneous and comparable historical data are as yet unavailable. There is nonetheless a consensus view that the fallout from cyber incidents (including the associated economic losses) is lessened at companies that have in place suitable measures to safeguard their systems and ensure any incidents are detected early, as well as response and recovery mechanisms to address such incidents.

The COVID-19 crisis (very long-lasting and global in reach) has underscored the pivotal role played by proper ICT management and the importance of cyber resilience for the correct functioning of the financial sector. Indeed, despite increased exposure to cyber incidents and the rise in the number of incoming cyber attacks, the impact on the sector has been limited. It is only fair to acknowledge that this is in large part thanks to the prior efforts and investments that both the authorities and market infrastructures, institutions and their providers (who have emerged as a key component of the ecosystem) have made in recent years in order to enhance their cyber resilience.

Key to achieving this goal is the proper management of all technological assets (everything from infrastructure items to data), through their entire life cycle: identification, classification in terms of criticality, changes required to ensure that assets remain operational in a diligent and secure manner, constant monitoring of their status and controlled elimination where they fall out of use.

Moreover, in response to an environment in which cyber threats are on the rise and attackers are ever more sophisticated, institutions have evolved from an approach centred on safeguarding their connections with the outside world (or perimeter) to a more holistic one, in which considering all potential threat vectors (including internal ones) is paramount. Thus, while continuing to work on perimeter security, they have now turned their attention to segmenting their internal networks or, in other words, to splitting them into isolated sub-networks. This is a crucial security mechanism since it prevents or hinders an attacker who compromises a system from gaining access to other systems outside the compromised sub-network.

As part of this holistic approach, which goes beyond technology and in which the human factor has a key role to play, training and raising the awareness of all of an institution's employees (and those of its providers) is crucial. The importance of these measures cannot be overstated, since employees are the weakest link in the chain and are often the entry vectors most targeted by attackers. With this in mind, institutions have in recent years been developing cyber security training programmes, both for their management and the rest of their staff, including courses and practical exercises, such as simulated phishing and vishing attacks.

As explained above, the concept of cyber resilience implies the capacity to anticipate, withstand, contain and rapidly recover from cyber incidents. Thus, it is important to

work on the assumption that cyber incidents are a given and that there may be disruptions to critical services, calling for recovery. Detection, response and recovery capacities thus take on particular importance, interlinking resilience with the field of business continuity.

With a view to guaranteeing the desired levels of cyber resilience, institutions set in place and trial their business continuity and IT contingency plans, envisaging an array of adverse scenarios, cyber attacks included. Moreover, they conduct crisis management simulations to check that suitable procedures are in place throughout the course of the incident simulated.

3.3 Trends

Rapid breakthroughs in technology and constant changes in the way such technology is deployed in the provision of financial services make up an ever-shifting backdrop, against which the threats and their materialisation in the various risks are also changeable. All of which leaves financial sector participants with no choice but to adapt constantly, as measures that are today effective to ensure the target levels of resilience may be found wanting tomorrow.

Specific cyber security-related measures and controls notwithstanding, institutions must give thought to the cyber security paradigm or model according to which they wish to integrate the implementation of such measures. With this in mind, government agencies such as the NSA⁴⁰ and organisations that lead the field in the technology space such as the NIST⁴¹ have come out in favour of incorporating Zero Trust architectures, a model founded on the two premises detailed above: the assumption that, sooner or later, cyber incidents will occur, and the management of an ever more porous perimeter.

Up until a few years ago, the boundary between an institution and the world outside was clear-cut and easier to identify and manage. Today, those lines have been blurred owing to the multitude of connections required to enable remote access by employees and suppliers, the implementation of Bring Your Own Device⁴² policies and the outsourcing of processes, e.g. to cloud service providers. Each of these new connections (as well as any assets connected to an institution's network) must be monitored and controlled.

The Zero Trust model advocates eliminating the principle of trust from all transactions. In other words, under this architecture, the aim is to segregate each IT asset (including

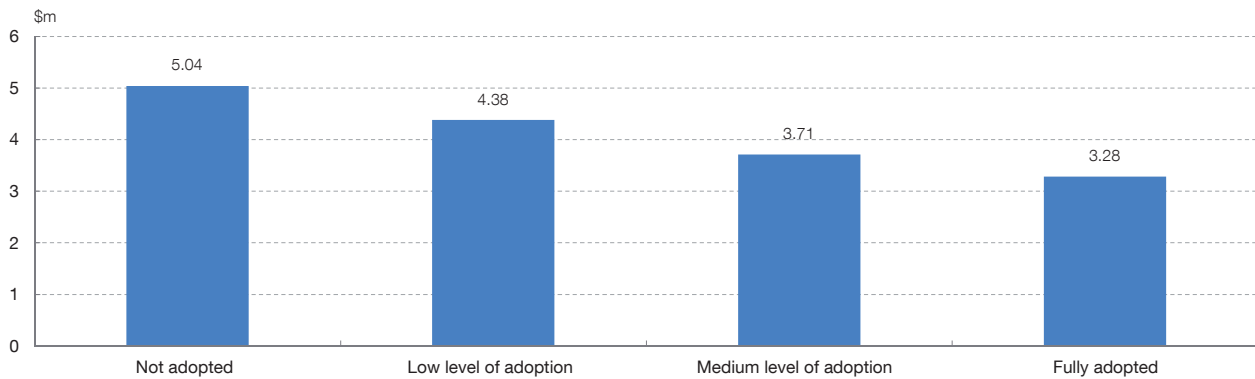
40 See NSA (2021).

41 See NIST (2020).

42 Bring Your Own Device, abbreviated to BYOD, is a corporate policy whereby employees take their own personal devices (laptops, tablets, mobiles, etc.) to their place of work in order to access company resources such as e-mail, databases and server files, as well as personal data and applications.

Chart 3

AVERAGE COST OF DATA BREACH BASED ON THE LEVEL OF ZERO TRUST DEPLOYMENT



SOURCE: IBM-Ponemon (2021).

data), and to apply the principles of least privilege and denial by default, thereby ensuring that users are at all times explicitly identified in every relevant transaction.

Thus, just as the importance of segregating networks has been stressed, making it harder for a successful attack to spread within an institution’s internal network, this approach has now been broadened to include the segregation of all key assets and the performance of identity checks in any transaction that crosses any of the red lines drawn. Needless to say, once rolled out on a widespread basis, this model will enhance the security profile of an institution and reduce the impact of any cyber incidents, as can be seen in Chart 3. Yet it does have certain drawbacks, such as an increase in complexity and the transactional load, or a less user-friendly experience, so the implementation and application of the model calls for a detailed, risk-based study.

As for new technologies, the cyber resilience of financial institutions will be particularly affected by developments in artificial intelligence-related technologies. Here, use cases are identified in the fields of offensive and defensive cyber security, in what could be called a technology race.

On the offensive front, noteworthy examples include the use of artificial intelligence solutions to sidestep traditional access control mechanisms and, more effectively still, those based on images or voice patterns; inserting malware⁴³ in legitimate applications and controlling the use of such applications, or what has been dubbed smart malware, i.e. malicious software that learns an organisation’s (users’ or programs’) permitted usage patterns, mimics them and capitalises on the existing vulnerabilities to escape unnoticed and propagate.

43 Malware refers to any type of software that intentionally performs harmful actions on an IT system without the user’s knowledge.

Notable examples on the defensive side include the modelling of organisations' network traffic behaviour. Artificial intelligence enables the detection of particularly complex anomalous behaviour patterns in huge volumes of information, outperforming human analysts or traditional systems, integrating this within antivirus or intruder detection and prevention systems.

The end result of this race to harness the possibilities offered by artificial intelligence will in large part depend on which applications develop faster and on the pace of adoption by institutions.

Institutions will continue strengthening their recovery models since, in the last instance and assuming a cyber incident occurs, they will in certain adverse circumstances need to recover their services where the integrity, confidentiality or availability of their information has been affected. Of particular interest in this regard are data vaulting measures, a term that refers to the offline, offsite storage of the set of critical data an institution needs to ensure its critical services remain operational.

A case in point is the initiative currently in progress at Sheltered Harbor, a subsidiary of the Financial Services Information Sharing and Analysis Center (FS-ISAC), with the participation and backing of the leading US banking associations.⁴⁴ The operating model set in place requires participating institutions to send their information, encrypted and in the agreed format, to shared data vaulting facilities so that, in the event of a major contingency and thanks to their participation in the initiative, their data can be recovered and processed at the facilities of other participating institutions that have not been affected.

Meanwhile, the authorities continue stepping up their efforts in the area of resilience. Notable from a regulatory standpoint is the development of the Digital Operational Resilience Act (DORA), the European Commission's new legislative proposal for the financial sector. DORA will apply to financial institutions of all types and sizes, in a proportionate manner, and sets out requirements concerning the management of technology-related risks; the identification, classification and reporting to the authorities of significant cyber incidents; the conduct of cyber resilience tests and information-sharing. However, DORA does not merely standardise and tighten the requirements in terms of how financial institutions must manage cyber risk, it also sets in place a ground-breaking framework for the direct oversight of the technology providers deemed critical for Europe's financial sector. Expected to enter into force in 2024, this regulation constitutes a stringent, harmonised standard for financial institutions across the board, and will no doubt help to bolster the sector's resilience.

Elsewhere, authorities across many jurisdictions are working to encourage financial institutions and market infrastructures to conduct cyber security stress tests,

44 See the Sheltered Harbor website.

simulating sophisticated cyber attacks. With this in mind, the Banco de España is now rolling out TIBER-ES, the local adoption of the TIBER-EU cyber security testing framework, with the aim of shoring up the resilience of Spain's financial sector.

Aside from ensuring that institutions undergo such testing individually, it is also important to encourage sector-wide testing, with a view to enhancing coordination and reporting mechanisms to deal with events with a systemic impact. Notable here are the exercise programmes of the G7's Cyber Expert Group, the work of the European Systemic Cyber Group (ESCG) or the mandate to be given by DORA to European financial sector authorities to make further headway in this direction.

It is increasingly clear that, in cyber security more than any other area, cooperation is key. This has been taken on board by institutions, who share among themselves relevant information on cyber incidents and cyber threats (what is generally referred to as "cyber intelligence") in a range of fora organised by the industry, such as the FS-ISAC.⁴⁵ Examples of cooperation between institutions, the authorities and other financial system participants can also be found, such as the CIISI-EU (Cyber Information and Intelligence Sharing Initiative)⁴⁶ platform.

Meanwhile, the authorities are stepping up their cooperation, not only within the financial sector but also with other authorities on a range of cyber security-related matters, such as cyber incident response centres and intelligence agencies.

The role of the financial sector authorities has gradually changed in step with the increasing importance of technology and the goal of enhancing cyber resilience. It has shifted from an approach traditionally focused on the solvency and liquidity of institutions and the smooth running of critical financial functions to considering technology as all-important for the functioning of the sector and supervising its use and development, as well as the risks it entails. Indeed, the authorities are taking on an active role in the cyber resilience space, emerging as a key player in the management and coordination of potential cyber incident-related crises.

Nonetheless, when it comes to bolstering cyber resilience in the financial sector, financial institutions, market infrastructures and providers will continue to take centre stage. Following through on their efforts in this area, they will have to integrate their management of human and organisational factors with their own technological progress and the breakthroughs made in cyber security and business continuity if they wish to successfully address the foreseeable increase in the sophistication and impact of cyber attacks.

45 See the FS-ISAC website.

46 See the CIISI-EU website.

REFERENCES

- Bank of England (2018). *Building the UK financial sector's operational resilience*, Bank of England and Financial Conduct Authority (FCA) Discussion Paper, July.
- Bank for International Settlements (BIS) (2021). *Covid-19 and cyber risk in the financial sector*, *BIS Bulletin* No 37, January.
- Basel Committee on Banking Supervision (BCBS) (2011). *Principles for the Sound Management of Operational Risk*, June.
- Basel Committee on Banking Supervision (2014). *Cyber resilience in financial market infrastructures*, November.
- Basel Committee on Banking Supervision (2018). *Cyber-resilience: Range of practices*, December.
- Basel Committee on Banking Supervision (2012a) *Principles for Operational Resilience*, March.
- Basel Committee on Banking Supervision (2012b). *Revisions to the Principles for the Sound Management of Operational Risk*, March.
- Centro Criptológico Nacional (CCN) (2020). *Ciberamenazas y tendencias. Edición 2020*, CCN-CERT IA-13/20, September.
- Council on Foreign Relations (2021). *Cyber Operations Tracker*, public database on state-sponsored incidents.
- CPMI-IOSCO (2016). *Guidance on cyber resilience for financial market infrastructures*, June.
- Departamento de Seguridad Nacional (DSN) (2017). *Estrategia de seguridad nacional*.
- Departamento de Seguridad Nacional (2019). *Estrategia Nacional de Ciberseguridad*.
- Departamento de Seguridad Nacional (2021). *Informe Anual de Seguridad Nacional 2020*, March.
- European Banking Authority (EBA) (2019). *EBA Guidelines on ICT and security risk management*, November.
- European Central Bank (ECB) (2018). *Cyber resilience oversight expectations for financial market infrastructures*, December.
- European Central Bank (2021). *Annual report on the outcome of the 2020 SREP IT Risk Questionnaire - Feedback to the industry*, July.
- European Systemic Risk Board (ESRB) (2020). *Systemic cyber risk*, European Systemic Cyber Group report, February.
- Financial Stability Board (FSB) (2018). *Cyber Lexicon*, 12 November.
- Hernández de Cos, P. (2019). "Financial technology: the 150-year revolution", keynote speech given as Chairman of the BCBS at the 22nd Euro Finance Week, Frankfurt, 19 November.
- Herrera, F. J., J. Munera and P. Williams (2021). "Cyber risk as a threat to financial stability", *Financial Stability Review* No 40, Spring, Banco de España.
- IBM-Ponemon (2021). *Cost of a Data Breach Report 2021*.
- International Telecommunication Union (2021). *Global Cyber security Index 2020*.
- National Institute of Standards and Technology (NIST) (2020). *Zero Trust Architecture*, NIST Special Publication 800-207, August.
- National Security Agency (NSA) (2021). *Embracing a Zero Trust Security Model*, February.
- United Nations (2019). *Final report of the Panel of Experts of the 1718 DPRK Sanctions Committee*, Security Council report on the Democratic People's Republic of Korea, 5 March.

Regulating for competition with BigTechs: banking-as-a-service and “beyond banking”

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Abstract

This paper analyses “banking-as-a-service” and “beyond banking”, two emerging bank competition strategies. These business models are argued to emulate the transaction-based inroads that BigTechs have made into finance. But they entail new risks that call for adequate regulatory responses along a dual track. First, it is argued that regulation of the disruptive competition model of BigTechs at the confluence of finance and technology requires new tools to coordinate the different regulatory policies involved (banking, payments, competition, data, digital) and a new approach to the treatment of mixed business conglomerates that consolidate multiple business lines and risks. Second, the reliance of “banking-as-a-service” on a quasi-renting-out of the banking licence to non-financial companies as a way of obtaining a transactional base poses moral hazard and model risks that require specific treatments not unlike the originate-to-distribute business model did. The prospects for success of the pure version of the “beyond banking” model, where banks become sponsors of full-fledged platforms, are assessed as dim, but hybrid versions still entail new risks.

Keywords: BigTechs, open banking, bank regulation, banking-as-a-service, beyond banking, competition policy, data.

1 Introduction

The intent of this article is to highlight and analyse a selected number of banking and general regulation issues raised by the increasing digitalisation of the financial sector and, more specifically, by the prevalence of the economic platform model of distribution in a part of the market. Digitalisation has shaken up the competition space for retail banks [Siciliani (2018) and Vives (2019)]. New players taking either the form of nimble specialised operators (FinTechs) or big technology companies (BigTechs) are challenging bank incumbents.¹

The contest at the intersection of technology and banking can be roughly described as a race for innovation and customers. In addition to gaining efficiency in ancillary processes, banks need to adapt their core services to the new technologies rapidly unless they want to risk losing customers. The challenge for banks is twofold: mastering the experience-enhancing features of fintech solutions that permit the customisation of products and services for customers as well as being capable of sponsoring

¹ In this article, small letters and capital letters are used to distinguish between services and actors, i.e. fintech is an activity and FinTechs and BigTechs are categories of providers.

economic platform distribution models or participating in those largely sponsored by BigTechs. Some of the alternatives they face seem daunting, like facing more intense competition in the short-term and risking being cornered by some BigTech oligopoly in the long term [De la Mano and Padilla (2018)]. Admittedly, customers' trust in banks may prove to be a sufficient protection against such scenarios.

But such defence ultimately hinges on the ability of regulation to reconcile stability and innovation. The dynamics of competition and market structure at the confluence of finance and technology is proving to be instrumental for such reconciliation. European authorities are tracking the issue closely, as evidenced by the European Banking Authority (2018 and 2021) where the focus is placed on the open banking arrangements that implement the linkages between banks' infrastructure and the new external actors (FinTechs and BigTechs). The distinction between integration platforms where multiple side effects prevail (economic platforms) and technical platforms that target mainly local integration proves crucial to tell apart two versions of the regulatory reconciliation challenges: a demanding one that deals largely with fintech issues and a formidable one that confronts the agglomeration economics deployed by BigTechs.

Against this general backdrop, this article focuses on two emerging bank business models ("beyond banking" and banking-as-a-service) and their specific ways of addressing the challenges of competition with BigTechs. The "beyond banking" strategy contemplates an extension of the range of products and services offered by banks in the new digital environment as a way to compete on an equal footing with BigTechs. In turn, the "banking-as-a-service" strategy seeks to expand the universe of new digital customers through "white-labelling" arrangements.

Technology adaptation is a must in both cases, but banks attempt to compete as economic platforms in the first case while acting cooperatively in the second one. The reasons for the selection of these business models as topics of research from the broader universe of open banking arrangements are threefold. First, there are arguably distinct regimes of coexistence between BigTechs and banks in the long run, i.e. structural market outcomes of the end-game of the "innovation vs customers" race that avoid the specialisation profile of most open banking arrangements. The second and third sections of this article build the argument that banking-as-a-service (BaaS) offers an adaptive way of doing banking while "beyond banking" emerges as a sort of tit-for-tat strategy against competition by BigTechs. Second, these business models highlight the relevance of the scale and agglomeration effects typical of digital competition in the BigTech part of the market. Third, they have received little attention and present specific regulatory challenges.

In particular, under BaaS banks may exhibit a profile of dependency on BigTechs that requires specific regulatory and supervisory measures. This dependency can be expressed economically in terms of moral hazard and model risks, especially if the banks' partners are not accessible to the scrutiny of supervisors. Moreover, as a

“white-label” business model, where banks rent out their bank licences to non-financial partners, BaaS is argued to need some standardisation in order to be properly understood and treated by regulation. On the other hand, the “beyond banking” model will be argued to be largely unfeasible in its purest version, despite some attempts to implement it, and prone to raise challenges for both banks and regulators. This result follows largely from the entrenched nature of competition between economic platforms as a result of their propensity to entail lock-in and agglomeration effects, in contrast to the less sticky competition forms relying on technical platforms only.

The analysis of these new emerging business models also lays bare the broader challenges involved in reshaping the regulatory framework for the banking and payment system in the new world. The multiplicity of public goals at stake in the digital space complicates coordination between authorities. The dynamic tension between the preservation of financial stability objectives and the promotion of innovations that enhance customer service has endowed authorities with a complex role as arbiters of the process. Moreover, competition, data, digital and financial policies become less separable, which raises issues related to their respective ranking and associated institutionalisation and international coordination. Initial high-level principles to deal with some facets of these regulatory challenges, like the asymmetries between entity and activities-based licensing and regulation, have already been identified as being inconsistent and need to be reviewed. The policy challenges posed by BigTechs would require specific entity-based rules to be developed to complement insufficient activities-based requirements [Carstens et al. (2021)]. In this context, which invites BigTechs to be particularly cautious, the analysis of partnership arrangements like banking-as-a-service is important because they may allow direct regulation to be circumvented.

The concrete and systematic way to regulate the inroads made by BigTechs into finance is less clear, although some policy initiatives with cross-sectoral scope, particularly in Europe, may end up striking the right balance. In any case, the number of relevant authorities and public goals at stake will increase to such an extent that a “Sawteeth” model of banking regulation will be needed, a term that graphically extends “Twin Peaks” to a situation with multiple authorities.² Antitrust and data authorities have a significant role to play now. The usual high-level principles defining the institutional perimeter of action for regulation and supervision have already been called into question [Restoy (2021)]. A sound way to start is by mapping the dependencies created by digital interlinkages, as planned by the European Banking Authority (2021).

The systematic exposition and discussion of all these ideas is structured as follows. The second section identifies the main innovations at stake and their

² Unlike “Twin Peaks”, which is based on inspiration from fiction, a Sawteeth model has real mountains as the counterpart of its graphical message.

economic significance. The third section explains the motives for “beyond banking” and “banking-as-a-service” within the overall open banking landscape and highlights their connection with the so far mainly transactional motives leading the incursion of BigTechs into finance. The final section on regulatory issues addresses the regulatory side of the discussion, both in relation to general issues and the specific challenges raised by “banking-as-a-service” and “beyond banking”.

2 Key transformations

Three major IT innovations stand behind the transformation that the business model of multiple industries is undergoing and, in particular, the one under way in the banking sector, despite its traditionally strong IT background: namely, (i) the perfection of an effective digital technology for communication between machines (APIs); (ii) the ability to store and process information with a relational focus on a large scale; and (iii) the development of distributed database technologies (DLT) that can even out the right of access to information and threaten its intermediaries. The resulting boost to digitisation has shaken banking and the ability of regulation to ensure fair and sound financial intermediation.

2.1 APIs: “datification” of economic interactions

Application program interfaces (APIs) represent a milestone in the ability to configure digital communication links with a disruptive economic impact. The ability to remotely emulate with APIs the architecture of various traditional business models (e-commerce, telecommunications, remote banking, etc.) or to create new ones (social media, for example) has increased steadily since the time they mainly underpinned internet interactions through browsers [Zachariadis and Ozcan (2017)]. APIs can be defined as an expanded case of use of internet technology to facilitate communication between machines, i.e. a software intermediary that allows other applications to communicate, allowing them to share data. This fundamental capacity enabled early on the configuration of web pages as technical platforms, i.e. as a base for two-way business/social interaction between users and sponsors. The web was no longer just a static window onto the world but a configurable platform for interaction between buyers, sellers and sponsors. The dynamic data-oriented design of APIs (hence “datification”) forms the backbone of new business models, even if data are just ancillary components of the ultimate exchange. But it turns out that in banking information and data are instrumental.

APIs are no substitute for sound business models, but the economic impact of both their ability to emulate traditional models flexibly and to build new business opportunities based on data have proved to be transformative. In particular, the digital transformation surrounding API deployment has entailed a gradual

convergence between industries closely related in terms of their technological underpinnings. In particular, e-commerce, telecommunications and finance have increased their area of overlap. This general process has ended up exposing the often asymmetric sectoral regulatory frameworks for the traditional and the digital economy as the main determinant of switching costs for users. In any case, deepening contestability in a broad range of industries has expanded the duality between incumbents and new players across multiple data-intense industries.

The strong reliance of banks on information has long made banking a natural ground for the operation of the transformative effects of digital technology. The largely immaterial nature of the inputs and the financial services provided by banks led to anticipation of an earlier adoption of APIs as a remote business emulation technology. But the first APIs were deployed much later in banking than in, for example, e-commerce. The close link between subsequent API adoption in banking and the deepening of e-commerce with heterogeneous applications across products indicates that technology is not the only factor to consider in banking (see the section below on natural market domains). Philippon (2015) even argues that advances in financial technology have failed to reduce intermediation costs, possibly for oligopolistic competition reasons. In any case, this observation does not detract from the power of technology to transform the market structure by allowing competition on a remote basis and the entry of new players. But an alternative transformation of market structure leading to an intensification of oligopolistic competition in the long run is also possible in the presence of network effects (see the section below on the industrialisation of data-based interactions).

The profile of the new players empowered in banking by their expertise in API-related technology obviously exhibits a particular strength in the software techniques underlying API deployment. But this characterisation is not sufficiently specific from the structural and regulatory perspective of this article. The breadth of the characterisation leads to inclusion in the same bag of both nimble players capable of providing a data-financial services mix to a bounded range of customers (FinTechs) and the big technology operators that can run data and financial business at scale (BigTechs). BigTechs may be characterised as evolved and highly successful forms of FinTechs as regards their technology orientation. The ultimate differentiating feature between FinTechs and BigTechs proves to be the economic and managerial drivers for their expansion into finance. A broadly held consensus taken on board here is the differential role of data in the business operations of FinTechs and BigTechs. The Bank for International Settlements (BIS) has coined the acronym DNA loop to characterise the distinct identity of BigTechs where “D” stands for data, “N” for network and “A” for activities [Bank for International Settlements (2020)].

The dichotomic characterisation of the new players based on their scale of expertise in API technology is only a useful approximation. It turns out that, in some emerging market (EM) countries, it is not uncommon to witness telecom companies, such as

M-Pesa in Kenya, that have ventured into financial services on the basis of a comparative advantage afforded by their competences in the network hardware layer rather than the software one [Jack and Suri (2011)]. Also the meaning of the scale of the financial operations and the use of APIs requires qualifications. Neo-banks, i.e. fully digital banks that operate only online, also seek scale in their operations, albeit in a production function sense, based on the use of basic software modules. The next subsection clarifies the more transformative meaning of scale that shapes the regulatory challenges posed by BigTechs.

2.2 Industrialisation of data-based interactions

The ability to source, process and store data at large scale imparts a multiplicative effect to the transformations unleashed by API-based service delivery models. The magnitude of the disruptions under those conditions is summarised by the winner-takes-all proposition regarding the nature of BigTechs' power.

The disruptive economics of industrialised data-based interactions is fundamentally grounded in the presence of strong direct and, especially, indirect network effects, i.e. the “N” of the BIS acronym “DNA”. Direct network effects result from the economies of scale associated with the per-participant surplus of a larger coalition of buyers and sellers. In turn, indirect network effects arise through the improved opportunities to interact as a result of the depth made possible by thick connectivity [Farrell and Klemperer (2007)].

Enhanced processing power and connectivity capabilities have enabled cloud computing, a technological breakthrough that underpins the role of direct network effects as the economic driver of new business models, as well as “software as a service”, an approach to exploit IT resources that seeks economies of scale by sharing investment and maintenance costs across a large number of users. This has proved to be a powerful source of economies of scale for BigTechs. Moreover, cloud computing facilitates the economy of data agglomeration and its ensuing multiplicative effects, all of them under the control of the same small group of large technological firms. The ability to apply and deepen AI or machine learning techniques in such an integrated environment is a fundamental mechanism that sustains actionable models of data monetisation [Ciuriak (2018)]. Data gluttony proves also to be self-reinforcing and reserved to the big operators.

The comparative advantage of these “industrial” new players is thus twofold. First, the agglomeration processes that they can sustain on the basis of their ability to exploit data and data processing technology at scale. Second, the dependence of incumbents in other sectors on these technological firms in their transition from their legacy technology [Baker et al. (2020)]. The threat of a squeeze on the business model of incumbents shapes the fundamental step of regulating BigTechs' entry into finance (see the section below on general policy issues and tools).

In banking, the role of data and information has traditionally departed from the model applied by BigTechs. The “internal” monetisation of information in the former contrasts with the “external” or relational approach in the latter. The term “internal” here is intended to mean the use of information as an input for cross-selling or risk mitigation. In contrast, the meaning of “external” refers to the recourse to the working of actual markets for information as a mechanism to boost revenues [Bergemann and Bonatti (2019)]. This information market in principle faces no limitations as regards the goods and services markets that it may support. Monetisation of data based on the social data model by BigTechs exploits the mark-up resulting from the difference between the value of the information provided by users of BigTech services and the (usually free) services provided to them [Bergemann and Bonatti (2019)].

Importantly, leaving aside the handicap for banks posed by legacy IT systems and the potential inertia of regulatory regimes to adapt to the new conditions, a fundamental asymmetry prevails as regards their data monetisation abilities. BigTechs can exploit data either way. The different business models for data imply different intrinsic growth dynamics, competitive threats and risks. BigTechs’ ability to capture supply and demand in some business or social ecosystem online tends to be rewarded by a more than proportional expansion of their revenues through a “data multiplier”. In turn, banks’ growth dynamics largely reflect the working of the credit and payment mechanisms. Their ability to access markets for information is more difficult and riskier. Large scale entry of banks into informational markets may be very difficult because their current scale might be insufficient to obtain sufficient benefits from data aggregation. Only a challenging expansion of banks to a “beyond banking” business model could result in some parallels with the use of data by BigTechs.

The asymmetric access to data of BigTechs and bank incumbents impinges also on their lending technology and ability to compete across the spectrum of financial services. The screening of credit by banks balances soft information with hard data, like financial statements, credit scores and collateral, depending on intrinsic features of the portfolios, such as borrowers’ opacity and the transactional character of the deals. The monitoring may also include significant variables like deposit account flows and repayment patterns. In turn, in the absence of bank-type relationships with their customers, FinTechs and BigTechs can simply exploit alternative data and customised algorithmic scores when considering entry into credit intermediation. The competitive advantage across products of bank incumbents and new players should not be expected to be homogeneous. Rather it should correlate both with the relative intensity of the hard vs soft information sources necessary to service the different products and the convenience of the quantitative tools employed, if any [Balyuk et al. (2020)].

All in all, data-based competition between BigTechs and bank incumbents is not entirely determined by the agglomeration advantages of the former, as the advantages of data specificity enjoyed by incumbents can also be exploited. Portfolios better served with soft and relational information are thus a natural space for banks to occupy. In turn,

transactional portfolios are the natural battleground for competition. Regulation should be expected to be crucial in the protection of a competitive balance that hinges on information, especially in hybrid business models like BaaS where screening may follow an intermediate bank-BigTech logic (see the section below on BaaS and regulation). Also, data regulators are already examining the different customer protection issues associated with big data and bank scoring tools [Hurley and Adebayo (2017)].

2.3 Distributed Ledger Technology (DLT)

The representation of information through chains of blocks of it (“blockchain”) is another noteworthy and disruptive innovation. Its impact on payments intermediation could be deeply transformative. The ability to create physically distributed databases subject to secure collective validation mechanisms gives rise to scenarios where the structures of collaboration between economic agents may change radically. In particular, the feasibility of collective certification of the integrity of databases representative of information on economic or financial transactions might undermine the logic of financial intermediation and even external enforcement if the DLT allows smart-contracting

Unsurprisingly, DLT technology³ features prominently in the main building blocks of the strategic initiatives of some of the new financial services players. The diversity of services envisaged to benefit from DLT use is broad. Fully decentralised arrangements (DeFi) seek to replace bank intermediation entirely. But the thrust of DLT has proved to be especially strong in the field of payment and money-like instruments replacing classical chains of value with tokens. In particular, “stablecoins” stand out as another potential disruptor of value storage and transfer mechanisms due to a hybrid profile that seeks DLT-based innovation and asset-backed stability.

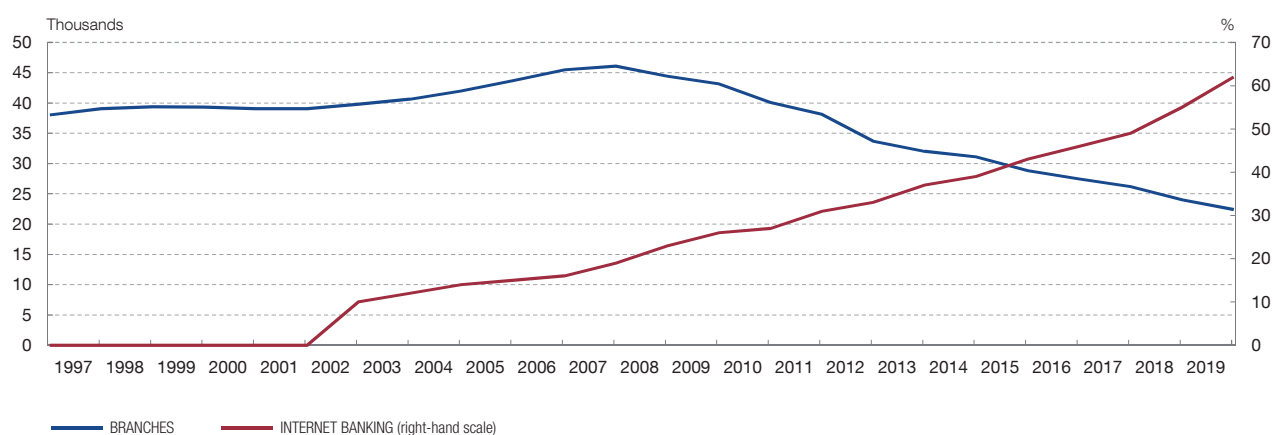
The delivery of services in economic platforms endowed with proprietary tokens or capable of entering into smart contracts proves to be particularly sticky. The barriers to entry to the platform and the switching costs out of it are magnified both when tokens create value local to the platform and when the smart contracting ability reduces monitoring/enforcement costs.

3 Competition between incumbents and newcomers. From branches to BaaS or platforms?

The IT innovations described above are already leaving a footprint on banking competition and market structure. Some of the symptoms of the transformations under way in banking are well known. Chart 1 displays for the specific case of Spain

³ DLT refers to the technology that allows the operation of a decentralized distributed database, in particular validation and immutable record updating at the different sites of the computer network.

Chart 1

NUMBER OF BANK BRANCHES AND INTERNET BANKING PENETRATION IN SPAIN

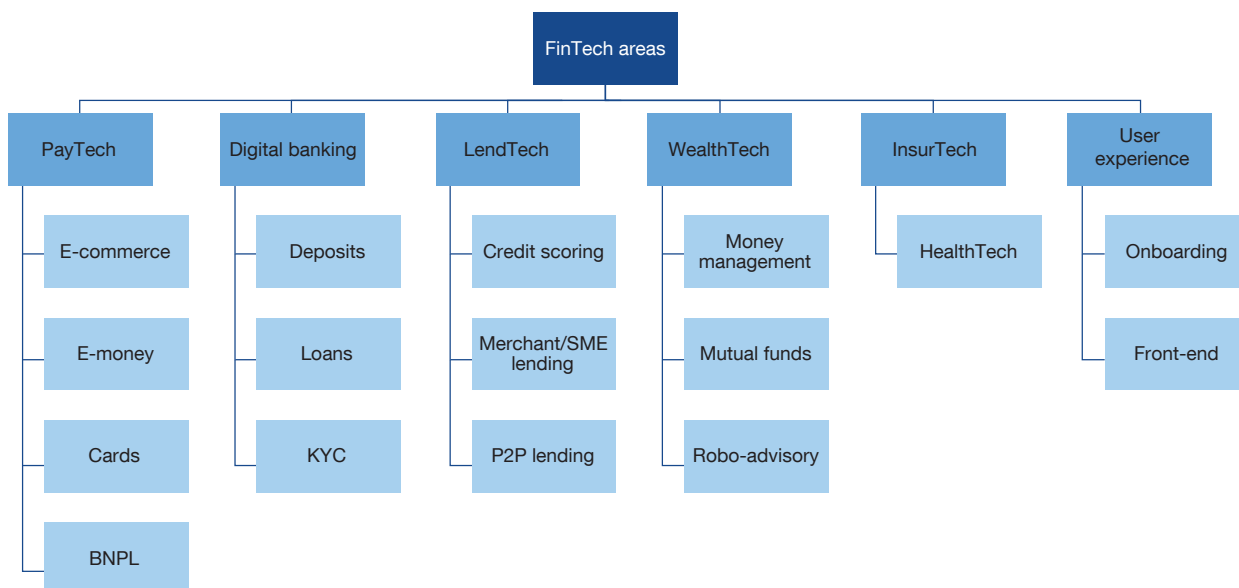
SOURCES: Number of bank branches, Banco de España and Eurostat.

the substitution of distribution channels in banking as internet penetration has deepened.

Understanding the nature of competition and market structure proves to be crucial for any regulatory initiative. This section attempts to identify some of the salient features of changes in market structure resulting from the technological innovations described, in order to frame the specific regulatory questions addressed in the final section. Analytical evidence on the matter is only very partial, both from a geographic and sectoral perspective. Surveys conducted by authorities [European Banking Authority (2019)] and consultants highlight the increasing engagement of banks in partnerships with a diversity of FinTechs and the fears raised both by BigTechs and the possibility of intense competition with peers. Market reports highlight the strong specialisation and corporate dynamism around fintech activity across the world. Chart 2 conveys a sense of the FinTech-related specialisation in multiple niches.

The specialisation and diversity of FinTech-related activities indicate the operation of mechanisms of unbundling. APIs naturally strengthen the ability to undertake targeted improvements of customers' experience and to compete accordingly. The vertical integration traditional in the provision or retail banking services is thus naturally undermined by the value creation incentives generated by technical innovation, unless banks can achieve it organically in time to confront new competitors. Importantly, the market structure determined by technological forces may interact with other unbundling mechanisms, possibly rooted in regulation, to reinforce fragmentation and shadow banking. For example, the ability of some non-banks in the United States to originate mortgages that feed agencies' issuance of mortgage-backed securities is further reinforced by the new screening technologies brought by FinTechs [Buchak et al. (2018)].

OVERVIEW OF FIELDS OF FINTECH ACTIVITY



SOURCE: Own elaboration.

3.1 The strategic race activated by IT innovations

The race between banking incumbents and new players entails straightforward strategic challenges for both. The former must adapt their technology and/or business model in accordance with the requirements posed by the relevant technological innovations. The latter have to attract bank customers and build their own franchises. Regulation can be a friction, an arbiter or an enabler in this race.

The specific strategies of the different parties should be shaped by their respective vision of the transformation at stake. A vision on the bank incumbent side that emphasises the need for piecemeal productivity and customer experience improvements can be satisfied by a correspondingly targeted technology adaptation based on APIs operating on a standalone basis. Traditional banks which have to fight on several innovation fronts at once can seldom avoid having to cooperate with a relevant set of FinTechs or hiring their services. In any case, they must be ready to open up their infrastructure and customer base to partnerships that enhance the delivery of services or improve ancillary processes. This strategy of opening up the bank infrastructure (open banking) to outsiders reaches out to both FinTechs and BigTechs, although its effect is modulated by their different business models.

The strategic risks for banks associated with open banking may lead to tepid IT adaptations in which open banking is complemented or entirely substituted by an internal technology update of the bank in question [Bahri and Lobo (2020)].

Interestingly, the success of FinTechs in the open banking “co-opetition” landscape often leads to re-bundling through their incorporation as banks. Banking would thus still be a safe harbour in the rough waters shaken by innovation [Lantery et al. (2021)]. Customers’ trust in regulated banking provides a backstop.

In turn, an open banking vision that recognises the strong network effects present in digital economic platforms requires bank incumbents to move beyond partial adaptations and change their business model in a way that also seeks network effects or an expanded transactional base. This is the general economic logic that differentiates “beyond banking” and “banking-as-a-service” from other restricted open banking models.

The strategies available to the new potential players mirror those of bank incumbents. When their innovations merely bring productivity gains, they may be tempted to either seek partnerships with incumbents to leverage their customer base or to license their technology. Their operation on a standalone basis faces the drawbacks of having to build their customer base. When their innovative abilities include the provision of services generating strong network effects (BigTechs), they can aspire to build their own customer base. But even in this case the scope for success in banking depends on the overlap between the natural customer base of these non-financial companies and the community of bank customers.

Importantly, the strategic game should be expected to operate heterogeneously across banking services. As discussed above, access to data does not grant a uniform comparative advantage to BigTechs or to banks across products. Moreover, entry into the different banking segments is just an option for newcomers. The contribution to the value of their overall franchise may not justify moving into every segment if that compromises more valuable segments. BigTechs have in fact evidenced a cautious pace of entry in banking lines of activity other than those related to transactional services and payments. All in all, the trust link may both selectively bind bank customers to banks and keep BigTechs at bay from them other than in the case of products aligned with their strengths.

3.2 Natural market domains

The distribution of competitive advantage in a sector tends to shape its natural market structure. The strategic need to innovate or lose clients in banking has led to intrinsic diversity to cope with those challenges and reactions [Bahri and Lobo (2020)]. Some of the salient features of a rebalanced distribution of competitive advantage are widespread unbundling and operational fragmentation. But this conclusion taken from a granular perspective is consistent with a larger scale segmentation into domains where either the distribution of competitive advantage is scattered (banks partnering with FinTechs) or concentrated, as a result of the

operation of agglomeration processes as described in 2.1.2. The overall picture is thus consistent with the dynamic coexistence of a diversity of business models like broad open banking and other open banking arrangements like platform-based competition and BaaS, i.e. banks partnering with NFCs.

In the words of Gambacorta et al. (2020) regulators must deal with a barbell-like market structure. The rapid growth dynamics of ventures that systematically exploit e-commerce-based network externalities determine the bulky domain held by BigTechs. In contrast, productivity enhancing innovations typical of plain open banking tend to exhibit a high critical mass for agglomeration [Economides and Himmelberg (1995)]. BaaS emerges as a bridge arrangement to reconcile traditional and emerging business models.

The breakdown by products of the fintech-related activity of the different segments is an important question as it shapes the regulatory hot spots. However, a systematic statistical description is hampered by the fragmentation and unregulated nature of the markets. Payment services, including consumer credit, represent the largest chunk of the open banking and platform segments. But credit provision increasingly plays a role in the open banking segment, especially in countries where non-bank institutional investors play a major role in the financial system [Ziegler et al. (2021)]. Chart 3 provides an overview up to 2019 of the role of FinTechs and BigTechs in the granting of credit. In terms of geographical quota, existing surveys suggest that the broad regulatory crackdown on BigTech activity in China in 2020 and 2021 has brought the United States to the top in terms of overall volume of activity. The chart also highlights the cautious approach of BigTechs to credit discussed later.

3.2.1 Open banking

There is no standard definition for open banking. Originally, the term was shaped by the regulatory and payment services connotations in PSD2.⁴ But PSD2 has accelerated the digital transformation of banks in Europe [Cortet et al. (2016)], while the term has taken an autonomous market-led path in the United States and Asia.⁵ Open banking has thus surpassed the constrained meaning of opening a bank's own infrastructure to payment initiations or account aggregators (as in PSD2) to a broader one centred around the use of API technology as a strategic tool for the delivery of banking services in general. This meaning of open banking in a broad sense includes the different variants of IT driven competition and can be also called platformisation [European Banking Authority (2021)], given the reliance on technical platforms to implement the new forms of interconnection between entities via APIs. Note that

4 Directive (EU) 2015/2366, which regulates payment services and payment service providers in the European Union and the European Economic Area.

5 In the United States the standardisation of APIs undertaken by the National Automated Clearing House Association (NACHA) has been an enabler for the adoption.

Chart 3

CREDIT GRANTED BY FINTECHS AND BIGTECHS IN DIFFERENT REGIONS (2013-2019)



SOURCE: Cornelli et al. (2020).

platformisation should not be confused with operations based on economic platforms, as argued in the following section.

The economic roots of open banking lie in the attempt to unbundle banking services to create value through inter-connection, specialisation and partnership. The fact that value creation can no longer be attributed to a unique organisational frontier in the open banking paradigm naturally shapes its strategic and regulatory challenges. Complexity and fragmentation are general attributes of open banking. The European Banking Authority (2021) provides a taxonomy of broad open banking arrangements following a perspective based on the type of interconnected players. BaaS and “beyond banking” represent specific economic arrangements of particular interest as will become clear.

Unsurprisingly, the challenge for bank incumbents to adapt to open banking consists mainly in the how and where. The taxonomy of options available is broad. A blanket

adoption of open banking across instruments entails an adaptive strategy that stresses uniformity in the impact of technological innovation across markets. Under this view, the replacement of the old products and distributional channels with new digital “rails” and instruments becomes a competitive imperative on its own. Innovation is warranted even if it just emulates existing business models with lower costs and higher customer satisfaction. Neobanks, i.e. entirely virtual and digitally native banks, follow an extreme version of this approach. Banking incumbents typically face significant adaptation costs to a blanket overhaul of their technology [Ramdani et al. (2020)] and most adapt gradually.

The retooling of traditional banks with APIs follows a restricted open banking paradigm that prioritises the range of services adapted. In other words, the deployment of APIs tends to be targeted in scope and launched in partnership with a diverse set of FinTechs in accordance with their specialisation.⁶ The business priorities leading to the deployment of each API reflect either regulatory priorities or its relevance to the business model of the bank in question. Payments processing and transactional services count as natural areas for deployment of APIs by banks.

The priorities in terms of products served through APIs result from the basic principle of financial services value. That is to say, the financial service often does not address a primary client need, but it is a solution to the problem that arises when the genuine primary need must be satisfied. Two powerful implications in terms of deployment of APIs are the relevance of (i) a logic of unfilled primary needs, or (ii) the presence of strong complementarity relations.

The relevance of the first implication is confirmed by the increasing role of “vertical banking”, i.e. the arrangement of digital services delivery with a community in mind that is dispersed, but united by some specific feature (gender, demographic, geographic, profession, risk profile, etc.) and whose needs have been traditionally underserved. As regards the second implication, the spread of digital consumer finance and payment processing solutions matches the fundamental complementarity that exists between trade and settlement. In a similar vein, open banking APIs should be expected to be deployed with an ecosystem perspective. The life-cycle of customers’ experience of products in it should dictate the range of complementary services offered with an API. This scenario may apply to car loans or business loans as well. Onboarding, KYC and AML APIs⁷ also thrive among banks as they determine customer experience at the very basic point of the initial relationship.

Open banking solutions typically create value within the limits of the complementarity chain excluding the satisfaction of the final need of the customer. In other words, the

6 CapGemini (2021) estimates that around 89% of banks partner with FinTechs as opposed to organic innovation.

7 Onboarding APIs facilitate customers becoming familiar with the bank, its products or services. KYC (Know Your Customer) APIs implement standards designed to protect financial institutions against fraud and corruption based on digital identification and additional processes. AML APIs facilitate the control of anti-money laundering rules.

provision of financial services to acquire a good at a point of sale (contextual finance) typically predominates over the alternative of arranging both the provision of the good and the financing of its sale to the customer. However, this business model is not entirely alien to traditional retail banking (leasing or a certain range of shopping). Ultimately, financing and buying a product may be naturally separate processes but their combination may create customer value under some circumstances. The potential application of these ideas in the digital banking world defines some of the features of a strategy that goes beyond traditional banking (as discussed below).

The range of applications of APIs by banks is broader. APIs can be also applied by banks to deliver corporate services. Trade finance can be significantly facilitated, especially through the recourse to DLT techniques. The delivery of corporate services through APIs to large companies and SMEs is also possible but tends to be less straightforward due to the heterogeneity of requirements, including IT integration at the premises of the customer. The recourse of banks to APIs that score the credit quality of customers looks counterintuitive, but is increasingly necessary for small ticket business in a disintegrated banking market. Credit scoring APIs entail rating customers based on big data rather than soft or bank hard data and, thus, assuming the trade-off between data availability and quality.

All in all, open banking in a restricted sense is a strategy of targeted customisation of value that shifts banking organisations from a silo culture to collaborative arrangements with innovators. Technically it requires an inter-operable and actionable exchange of data in accordance with the business models covered. But it also poses the governance challenges associated with the joint delivery of services. Financial transaction or account data needs to be shared in a secure way, which banks can provide.

Restricted open banking paves the way for the two other modalities of competition highlighted. First, restricted open banking faces an implicit trade-off. Innovation that does not generate external effects tends to scale up only with difficulty due to the handicaps of competition and imitation. It may still entail success, i.e. a cycle of growth and transformation into licensed banks for successful FinTechs or transformation for an incumbent bank. But the activation of agglomeration effects by BigTechs alter qualitatively the competitive challenges. Second, restricted open banking lacks a strategic foundation if it entails merely a focus on the implementation of use cases. BaaS emerges as a dedicated strategy to leverage the potential of systematic open banking.

3.2.2 Platforms and banking

The meaning of the term platform is not uniform across contexts. Technical platforms facilitate interaction, broadly speaking, and accord with the meaning in European

Banking Authority (2021). From this perspective, open banking environments that operate financial service market places and connect customers to a diversity of potential providers qualify as platforms. Similarly, platform also refers to one-stop shops in a multi-seller setting. The classical paradigm of platforms are medieval portals (another denomination for platforms these days) where buyers and sellers gathered in a shared environment. Retail banks have also exploited the multi-party and multi-product logic of platforms by setting the location of their branches in shopping areas in proximity to other retail businesses. The modern economic notion of platforms emerges when these portals become economic actors competing “for the market” as opposed to providers of some specific product in some market [Geroski (2003)].

Economic platforms supplement the facilitation of interaction of technical platforms with additional functionalities aimed at actively creating synergies. The relevance of platforms as an economic concept has grown over the last twenty years in parallel with the advances in digital technology that have facilitated that process. In general terms, the disruptive character of platforms emerges from the synergies enabled by an optimised matching of buyers and sellers in a way that triggers circuits of customer satisfaction and platform growth. Platform sponsors provide the economic intelligence that sustains the operation of these transactional growth-oriented environments.

BigTechs tend to be successful operators of such economic platforms. Digital technology has empowered them to optimise market matching processes in disruptive ways. The economic intelligence deployed tends to rely on different forms of monetising data and/or cross-subsidising their services. The disruptive force of platforms operated by BigTechs follows from the intelligence deployed in their management to achieve transaction multiplier effects. The result is a market with a qualitatively new set of pricing and behavioural features that significantly affect the nature of competition with traditional operators and the ability of competition regulators to ensure fair markets. Their scale of operations needs to be extremely large as it has to match the need to remotely congregate and steer buyers and sellers. As a matter of fact, their scale is not only large but also elastic, because platform sponsors tend to also engage in the provision of external cloud computing services. Thus, their IT enabling business seems to be strongly complementary to their transactional one in a way that boosts their total franchise value.

The economic principles exploited in the “intelligent” management of platforms are well known and differ from those for plain market places. Rochet and Tirole (2003) characterised platforms as a two-sided market environment where the end-users (both buyers and sellers) do not internalise the welfare impact of their use of the platform on their counterparts. This paves the way for platform sponsors to manage the overall effect of the externalities typically in a way that optimises sponsors’ market value. The peculiar features of economic platforms stem directly

from the ability of sponsors to manage the non-linear effects of demand and supply externalities. The asymmetrical patterns of platform pricing for suppliers and customers characterised by Rochet and Tirole (2003) include free services and ultimately reflect the willingness of sponsors to devote resources to gain benefits from the different elasticities of demand and supply. Bergemann et al. (2019) identify the data externality generated by transaction initiators that sustains the working of BigTechs' economic platforms. Moreover, they argue that the scale of their operations creates barriers to entry due to the ability to exploit huge amounts of data with AI techniques. Rietveld et al. (2019) highlight the selective promotion of complement products listed on platforms to indicate the general approach to platform management.

The scope rather than the role of BigTechs in banking is the relevant open question. A full-scope platform cannot operate properly without built-in financial services that improve customers' experience. BigTech companies thus develop quite naturally the profile of some financial services in the area of payment services provision, consumer credit and insurance. The strong complementarity of these services with the underlying e-commerce business is well known to lead to bundling practices, which underpin the competitive advantage of BigTechs as regards access to data.

But the complementarity argument does not necessarily imply a strong involvement of general purpose e-commerce platforms in the provision of financial services like term loans, investment products etc. unconnected with their transactional business. This would require a broadening of their business model from one based on flow of income sourced from transactional fees to one that also includes financial intermediation income. Certainly, this transformation was happening in China until the crackdown by the authorities in 2020. Such rapid evolution and involution in China can be accounted for by a range of local factors like pre-existing conditions of development in the financial sector [Gorjon (2018)], the access of BigTechs to central bank infrastructure and ensuing exponential growth. Elsewhere, BigTechs have been very cautious to venture uncooperatively into financial intermediation. Table 1 borrows from Crisanto et al. (2020) to highlight the e-commerce/internet driver of their involvement in finance services and its focus on payments.

The significance of payments for platforms correlates with the incentive for GAFAs⁸ to obtain particular types of licences. They are licensed as e-transfer service providers in the United States, and as payment service providers in the EU (with the exception of Apple), whilst none of them have a banking licence. Embedding financial products in the platform typically requires either the inclusion of a financial company as a platform provider, a partnership with such a company or the possession of a licence. Significantly, the first model has been more common in Chinese BigTechs, while American players rely on partnerships when they do not use their own licences.

8 Acronym stemming from Google, Apple, Facebook and Amazon.

Table 1

OVERVIEW OF BIGTECH ACTIVITY AND INVOLVEMENT IN FINANCE

BigTech	Business	Banking	Credit	Payments	Investment
Google	Internet	X		X	
Apple	Tech		X	X	
Facebook	Social media			X	
Amazon	E-commerce		X	X	X
Alibaba	E-commerce	X	X	X	X
Baidu	Internet	X	X	X	X
Tencent	Social media	X	X	X	X

SOURCE: Crisanto et al. (2021).

Furthermore, financial services in platforms can be provided either under arrangements of exclusivity or that allow the entry of different banks.

The still constrained range of financial services offered by digital platforms, focused so far on consumer transaction banking, does not detract from their systemic relevance and expansion potential. The expanded open banking space that results from the inclusion of these digital platforms within its realm leaves an unbalanced size profile. The agglomeration economics of platforms stemming from the multi-product multi-party matching offering and the industrial exploitation of data determine the “bulge bracket” profile of digital platforms in an expanded open banking. Moreover, the expanded open banking world amounts effectively to an enlargement of shadow banking.

The basis for a further expansion across bank instruments beyond transactional services is still unsettled. The degree of comparative advantage provided by data agglomeration may hold the key. On the one hand, screening models based on big data may be inferior to the ones combining soft and hard data in banks on non-transactional products. Hardening soft information through credit scoring technology seems to have its limits [Filomeni et al. (2016)]. On the other hand, Gambacorta et al. (2020) argue that the use of massive amounts of data by BigTechs to assess firms’ creditworthiness could reduce the need for collateral to resolve asymmetric information problems in credit markets. The significance of digital platforms as non-bank competitors thus raises many questions as to the reactions of banks and regulators and the soundness of the new financial market despite their currently restricted range of operations.

The recourse by banks to a “beyond banking” model has been proposed as a potential defensive strategy. The “beyond banking” model amounts to an attempt to organise banking services provision under a platform model. Traditionally, universal banks have been loosely called platforms due to their one-stop shop multi-product

nature. The “beyond banking” model expands the range of products covered by bank platforms to bring transactional depth to their global offer. Not unlike what happens in the BigTech space, proponents of this nowadays fringe strategy also highlight the multiplier effects that deepening the recourse to data sources could have for banking when combined with advanced analytics services [Ernst and Young (2021)]. A weaker form of the “beyond banking” model renounces the benefits of two-sided platforms to promote instead “digital ecosystems”, i.e. conglomerates of several distinct services accessible digitally.

The “beyond banking” model can be said to emerge ultimately through an apparent data mirage as a way of competing with BigTechs. The agglomeration dynamics of BigTechs’ portals sustained by smart data management are grounded on their ability to satisfy the transactional needs of customers in the first place. Absent such capacity on the side of incumbents, better data management on their part can have an impact that, albeit weaker, is still significant. For example, a focus by incumbents on supporting the satisfaction of the primary needs of customers would lead naturally to arrangements that permit the identification of the need, in the right context and at the right time. “Contextual finance” solutions can be a natural strategy for incumbents to counteract their lack of a transactional base. But they are typically only possible under partnership arrangements with non-bank companies that lead to BaaS (as discussed below).

Ultimately, effective imitation of the BigTech model by banks would seem to entail the construction of an entire transactional business platform. Such a “beyond banking” model of banking amounts to the creation of one-stop shops for the purchase of both banking products and goods. The closest arrangement to such an ecosystem has been developed in Asia by BigTechs rather than banks. The difficulties for banks to become sponsors of new portals, going beyond their traditional role can be substantial [Jacobides (2019)].

Nonetheless, “beyond banking” can mean something less ambitious than a fully-fledged portal. A restricted form of platform banking means a limited extension of the ecosystem notion of products to include final needs close to the bank financial services actually provided. For example, in the field of mortgage banking, platform complementarity would dictate that banks not only provide loans, but also facilitate homeowner’s insurance, house maintenance services, or even furniture.

Nonetheless, a “beyond banking” model of banking has already made inroads in some jurisdictions like Russia. The section below on platforms and banks summarises some of the regulatory concerns with this model. A fundamental reason for those concerns is the sustainability of such a strategy in the light of the disparity of IT capacity between banks and BigTechs. In this regard, it is worth remembering that the stock market capitalisation of GAFA hovers around two times that of the world’s 30 largest banks.

3.2.3 Banking-as-a-service (BaaS)

The lack of a transactional base to implement a pure economic platform model has led banks to seek partnerships and associations with non-banks. The result is BaaS, a “white-label” form of banking. The distribution of “white-label” goods is a consolidated practice outside the financial services market. The logic is typically grounded in the desire of retailers to enhance their share of profits in the vertical product chain [Berges-Sennou et al. (2004)]. Private label banking, in contrast, follows a supply side logic. The API revolution has made possible a diversity of collaborative arrangements with non-banks or FinTechs that break with the traditional model of distributing banking services.

Like in software-as-a-service (SaaS) and similar composites, the delivery of BaaS consists in replacing the business capital that would normally underpin the provision of banking services with a contract that grants the right to have direct access to the flow of those services. More specifically, the capital at stake under BaaS is the banking licence and the services of a bank with their associated balance of rights and duties. The non-financial company in the position of buyer under a BaaS contract acquires the right to outsource the provision of banking services to a licensed bank that finances the transactions of the former with its clients.

BaaS makes it possible for non-banks to “provide” banking services to their customers by drawing on the services of the bank acting in a “white-label” capacity. For the bank itself, BaaS widens the network of customers accessible via such a context-based model of distribution. The working of the arrangement resembles legally the combination of bank agency and outsourcing contracts that substitutes for the network of branches. Ideally, BaaS offers scalability, something that distinguishes it from strategic partnerships with FinTechs. Multiple non-bank partners may access a BaaS platform that replaces customised arrangements more typical of partnerships with FinTechs in the pure open banking model with some degree of standardisation.

The potential for seamless deployment of BaaS via APIs makes it a unique form of bank competition. BaaS apparently allows the competition from BigTechs to be confronted by accessing external transactional pools of goods. Furthermore, their scope is potentially broader than the expected pool of goods in e-commerce platforms, which is generally limited to personal items. In other words, the overall bank balance sheet could notionally feed BaaS business if the technical platform for consistent deployment of multiple APIs is functional. In that scenario, the main constraint would be the risk appetite for such a model of distribution.

However, cursory evidence suggests that BaaS still covers mainly the money ecosystem of bank offerings, i.e. debit and credit card processing, BNPL instruments and current account services [CapGemini (2021)]. Credit screening or underwriting that falls outside the credit consumer perimeter appears to be less frequent although

Table 2

PROMINENT EXAMPLES OF BAAS DEALS

BigTech	BaaS bank	Partnership	Notes
Google	Citi + 11 community banks	PLEX deposit account	Checking account and services integrated in Google Play with access to Citi ATMs
Apple	Goldman Sachs	4x1 Card	Credit, Debit, Wallet and P2P payments in one. Incentives to acquire Apple
Amazon	Goldman Sachs	SME credit lines	Credit line for SMEs vendors in Amazon Access to data included
Uber	BBVA	Deposit accounts for drivers	Deposit and debit card for Uber drivers in Mexico

SOURCE: Own elaboration from press sources.

increasingly present. The outcome should be determined by a mix of complementarity, risk appetite and customer convenience determinants. Interestingly, the indirect access to a transactional base ideally permits BaaS banks to monetise data in ways that traditional banks have never succeeded in doing. Although banks have had lots of information, the absence of a transactional base as a strategic lever has led to entrenched silos of information within the organisation.

Non-bank partners in BaaS contracts are not constrained to be technological companies thanks to the flexibility of APIs. Retailers, providers of hospitality or healthcare services and even providers of mobility services are reported to have associated with banks in BaaS arrangements. These partnerships are primarily perceived to deepen the recognition of trademarks, in addition to the service provided to the customers. Even banks can be partners of payments-as-a-service arrangements that implement in a plug-and-play way cards, payments clearing, cross-border payments, etc., that can moreover be distributed to end-customers. FinTechs also count as potential partners.

However, BigTechs stand out as the most significant partners in BaaS arrangements (see Table 2). The advance of BaaS arrangements with BigTechs is especially noticeable in the United States. The biggest e-commerce and internet companies (GAFA) have consolidated partnerships with either major banks or even networks of banks. The inclusion of a chequing account within the offering of a BigTech app in 2021 (PLEX) and its swift removal soon afterwards despite signs of its good reception by customers, constitute a case that raises questions as to the limits of BigTech involvement in the provision of regulated financial services provision.

But, as mentioned before, BigTechs are also important actors in the provision of inputs for BaaS. The ability of banks to smoothly provide bank services in a distributed way across a broad range of products hinges on computer applications running in the cloud. Banks need to transform their traditional IT infrastructure into a Lego-like

architecture to deliver the functionalities required by the different APIs. This is more easily done de novo on virtual machines in the cloud. BaaS banks thus need to enter into service agreements with the cloud subsidiaries of BigTechs. But the market share of the three largest cloud infrastructure providers hovers around 60% and software services exhibit significant vertical integration. The dependency can become both economic and technological.

BigTechs can thus squeeze the business model of BaaS banks through two simultaneous relationships. A strong reliance on BigTechs can constrain the revenues of these banks at the same time as their IT costs are shaped by them. Moreover, the capital expenditure required to update the overall technological model means that BaaS is only accessible to banks of a certain size. Ultimately, BaaS may end up becoming a “utility trap” if the banks adopting this strategy fail to diversify or differentiate their BaaS offering. The risk of a market place developing that concentrates the supply of BaaS “commodities” would be a doom outcome for banks. Banks therefore need to taint their “white-offering” with some traces of “grey” to be recognisable. Additionally, the diversification of BaaS partners is a fundamental strategy to avoid these perils. If economic dependency on BigTechs is to be avoided then the technical platforms need to be exploited under multiple BaaS contracts. The regulatory challenges posed by BaaS are covered in Section 4.2.

4 Regulatory issues

This section covers selected policy implications of the “beyond banking” and banking-as-a-service models of competition. A systematic analysis of regulatory fintech issues is beyond the scope of this work. The Basel Committee has included in its work programme for 2021-2022 the analysis of the impact of ongoing digitalisation and financial disintermediation on banks’ business models and the banking system more generally [Basel Committee on Banking Supervision (2021)].

The selection of topics addressed here corresponds to some of the salient issues highlighted in the previous section, namely, the challenges posed by competition with BigTechs’ platforms and banks “lending” their licences under BaaS contracts. The first topic is addressed in two parts: (1) the general issue of coordinating a more diverse set of relevant policies to address open banking and BigTechs’ entry into financial services; (2) the specific challenges of a banking model where banks develop their own platforms.

4.1 General policy issues and tools

The territory in which competition, regulatory and supervisory policies have traditionally operated has been altered by the structural and behavioural effects of

digital technology. Some relevant features of broad open banking environments are fragmentation of the value chain, dependencies and concentration risks, especially in the space covered by BigTechs.

Fragmentation raises a diversity of new risks and concerns like operational risks, data integrity, enhanced competition or regulatory/supervisory instruments. Fragmentation issues have a broader scope than considered in the current article, and the policy-oriented literature on different aspects is blossoming. Ehrentraud et al. (2021) provide a review of cross-country policies adopted to deal with a diversity of cases of use of fintech. Krahn and Langenbacher (2020) and Langenbacher et al. (2020) highlight regulatory and supervisory lessons from the default of Wirecard and the need to lift the veil created by the complex mix of financial and technology activities of FinTechs. Restoy (2021) goes further by outlining an adjustment to the “same activities, same regulation” principle to also include a holistic notion of risks in the determination of the regulatory/supervisory perimeter in the complex world of fintech services. Siciliani (2018) uncovers the pattern of the strategic reactions of banks to the enhanced competition prompted by fintech and highlights the game-changing effect of public policies regarding access to public infrastructure like central bank books.

The various risks posed by dependencies resulting from unbundling have also been highlighted by the European Banking Authority (2021). It highlights both the importance of visibility regarding the complex pattern of digital interrelations to start with, as well as their measurement with indicators that track the risk of dependencies.

BigTechs expand the range of policy issues. Fragmentation-related issues are still relevant. But the relevance of competition, data and complexity issues acquires a new dimension corresponding to the role of those issues in shaping their singular business models. All in all, the integrated coverage of the new broad range of challenges posed by BigTechs makes the coordination of policies a first order question. Drawing on the mountains-based analogy that underpins the so called “Twin Peaks” model of organising banks’ supervision,⁹ it is tempting to say that BigTech regulation requires a “Sawteeth” model of institutional arrangements, as well as new holistic tools to grasp the multi-dimensional mix of externalities posed by the scale, diversity and complexity of BigTech operations .

To start with, the challenge to coordinate competition and data policies with financial regulation as regards BigTech activity reflects the ongoing struggle to find a balanced fit of digital platforms in society as a whole in Asia, the United States and Europe. The quest for a ranking of, or a way of ranking, multiple public policy goals around

⁹ In the “Twin Peaks” supervisory model, consumer protection and prudential regulation are carried out by two separate regulatory agencies. The name of the “Sawteeth” model is simply intended to highlight, also graphically, the additional number of authorities need. The Sawteeth mountains lie in the state of New York whereas “Twin Peaks” are fictional.

BigTechs, including in the areas of competition, financial stability and rights to data protection, is still open.

In the past arrangements for the coordination of policies relevant to banking have seldom been explicit. The trade-off identified between competition and stability [Martínez-Miera and Repullo (2010)], together with less-than-ideal regulatory instruments, means that some form of implicit coordination is unavoidable [Vives (2011)]. In Europe, such coordination has effectively been implicit and top-down, drawing on inquiries undertaken by competition authorities that have prompted legislative amendments and ultimately the adaptation of bank regulation [Maudos and Vives (2019)]. For example, it was a competition investigation of retail personal accounts that led to the open banking legislative remedy that has shaken banking. Banks were mandated to disclose data on individual consumer transactions, with consumer consent, to third-party service providers via a common open application interface.

But the dimension of the competition issues raised by BigTechs has also shaken the understanding across the world of the orientation of competition and structural measures themselves. The strength of the forces driving the success of BigTechs is leading to extensive reviews of the role of digital platforms in the economy and society as a whole in China, Europe and the United States. The different principles and methods adopted in this ongoing review in different jurisdictions is, at this stage, hindering the emergence of a unified model of policy coordination. The risks of cross-border fragmentation in platform regulation cannot be countered nowadays by international principles and best practice. Even an international agenda on the matter is absent today.

The disparities in the competition reviews undertaken across regions reveal cultural and political priorities. China has been implementing a broad range of measures to curtail both the role of digital platforms in the economy as a whole and their financial operations. On the antitrust front, the publication of Antitrust Guidelines for the Platform Economy has targeted the entrenched market power of digital platforms and has enabled enforcement actions. On the data front, the legal establishment of data rights has been supplemented by obligations to feed information into the public scoring system Baihang. The significance of payment management for platforms has led to a diverse set of measures to limit the financial return obtained from holdings of customer balances (quantitative limits and zero-rate remuneration) and to reinforce the role of clearers in the management of customer transfers in order to eliminate direct interactions between BigTechs and commercial banks. In addition, authorities have imposed tougher anti-monopoly measures on companies in the non-bank payments market.

The US leadership in digital platforms markets has not hindered an increasingly far-reaching review of the need for checks and balances. But the application of

competition policy instruments based on long-standing theories of harm dating back to the Chicago School of Antitrust Law faces hurdles as a result of the subtle economics of platforms that allows for the provision of apparently free services [Wu (2018) and De la Mano and Padilla (2018)]. Against this backdrop, insights from the data policy camp are gaining weight in the debate despite the lack of a uniform law on personal data. Radical formulations of principles on data policy emphasise the absence of any allocation of property rights over data in the internet economy and the continuous appropriation of them by BigTechs [Zuboff (2019)]. Rebalancing the working of digital markets would require, from this viewpoint, an allocation of rights that would limit data free-riding by BigTechs. The intensity of the debate has increased to the point that the threat of splitting up BigTechs' franchises has been raised [United States Congress (2020)].

In Europe, the Digital Markets Act (DMA) regulates on a cross-sectoral basis the delivery of services to customers by platforms. This framework will pave the way for administrative antitrust-like procedures adapted to the economics of platforms. As a result, the experience of the EU with lengthy antitrust procedures has led to the introduction of a new administrative screening mechanism that should facilitate prompt intervention and remedies to contain the distortions caused by systemic platforms (gatekeepers). A tool envisaged in the DMA responds to a long-standing demand for access to data gathered by gatekeepers and contributed by their customers through search engines to be opened up to third parties on fair terms. But the effectiveness of this remedy may be limited unless the beneficiary third parties have a business model with a transactional dimension.

Against this general backdrop of platform policy initiatives, the emerging financial regulatory debate on platforms is informed by the consideration that the benefits of technological innovation should not come at the cost of higher risks for bank customers, investors and society as a whole. The evolving state of affairs has made it difficult to devise a blueprint for the "Sawteeth" model of multiple regulators. A basic impediment relates to the difficulty of ranking policy goals that fall into different silos of the legitimacy pyramid. This problem is aggravated when the broader challenge is considered, i.e. how to coordinate international policies on global players like BigTechs. But even proposals for a "Digital Stability Board", modelled on the FSB, to carry out the coordination of data policies fail to address the full range of policies to be aligned.

Still, some have seen the "advisory councils for the digital economy" created in a number of countries as providing a starting point. A common agenda would have to be worked out based on topics at the intersection of technology, competition and regulation, like the ones covered below. This inter-disciplinary approach, based on heterogeneous colleges, might facilitate the task of selectively expanding the reach of notions like consolidated regulation and supervision to the different sorts of partnerships witnessed in the confluence of finance and technology.

A more direct alternative, taking into account the urgency of the matter, would be for bank regulators to lead the regulatory process straight away by redefining the perimeter of regulation. Under this vision, implicit in Restoy (2021), fair recognition of the externalities posed by BigTechs would require activity-based rules to be adjusted in accordance with entity risk considerations, including scale, complexity and IT resilience. But putting these ideas into practice would be far from immediate. A potential route in that direction in Europe could be via the overhaul of the financial conglomerates directive, as suggested by Noble (2020).

4.2 Banking-as-a-service and regulation

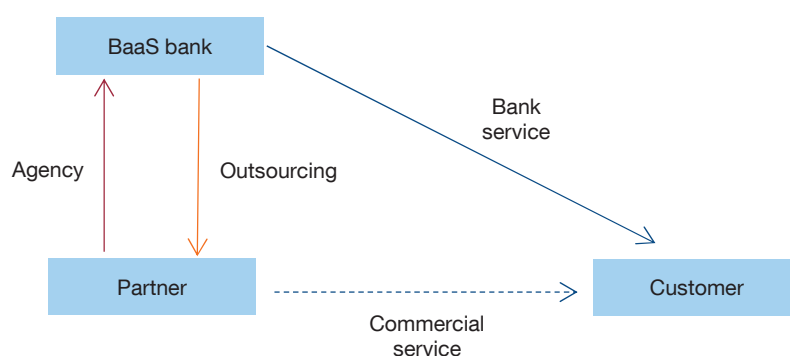
BaaS has been presented as a middle ground strategy for banks in the digital transformation landscape. But the hope it offers as a way of countering competition from BigTechs by cooperating with them comes not only with IT intricacies, but also legal and regulatory ones.

BaaS requires specific regulation that allocates rights and risks in an intrinsically commingled way of doing banking. Acting as a “white-label” bank serving non-bank players entails contractual and regulatory intricacies. Although the arrangement does not need to be driven by regulatory arbitrage goals, it could end up having such a goal if it is the non-bank partner who effectively has a dominant position and makes the due diligence, funding or underwriting decisions in the lending business. The market power of BigTechs as BaaS partners of banks with a limited ability to negotiate elevates the practical significance of this risk because the former might avoid having to request a licence. The outcome of this scenario would be a line of business plagued by moral hazard issues similar in nature to those arising under the originate-to-distribute model.

The mitigation of the moral hazard risks resulting from a potential control of the arrangement by BigTechs could eventually have to rely on sectoral macro-prudential policies if the problem acquires systemic dimensions. The adaptation of techniques used to deal with the distortions of securitisation markets stemming from the originate-to-distribute model comes immediately to mind. The consolidation of externally originated exposures onto the books of the party that truly exerts control over the trade has made strides since Enron and after the Great Financial Crisis risk retention policies enhanced incentives by compelling skin to be put in the game. Admittedly, the application of consolidation techniques and risk-retention policies in the context of BaaS contracts with BigTechs would require the institution of a perimeter of financial regulation and supervision of these players. The use of economic and technological indicators of dependency can provide a basis for that institution.

BaaS with non-BigTech partners may also give rise to credit underwriting issues. BaaS entails a potential departure from ordinary risk segmentation systems simply because the data quality available from the non-financial partner may not match the

STYLISTED DECOMPOSITION OF A BAAS CONTRACT



SOURCE: Own elaboration.

modelling practices of the BaaS bank. In particular, the integration of soft and hard information may not be feasible with normal in-house procedures. The problem grows with the size of the palette of non-financial partners. BaaS thus requires specific guidance on model risk to be consistent with sound banking practice.¹⁰ The adopted governance framework should have an end-to-end perspective, i.e. from implementation to use. But the lasting impact of partners' on-boarding decisions means that their contribution is particularly important.

The intricacies of BaaS contracts extend to customer protection and data property issues. The fact that the bank and its partner reciprocally exchange services with the ultimate aim that they both serve the customer of the former departs from conventional agency or outsourcing arrangements. Chart 4 portrays the nature of the commitments in a BaaS contract. The ultimate customer proves to be both a customer of the bank in a regulatory sense, as it provides its banking licence as an input in the transaction, and of the BaaS partner in a commercial sense.

Customer protection issues may emerge as a result of such commingled allocation of responsibilities under the various service agreements to serve the needs of the customer. The "ownership" of the customer itself may raise conflicts between the parties as regards access to customer data. The more integrated the arrangement in the non-bank partner platform, the bigger the risk of confusion of transactional data with banking data. The protection of ownership or confidentiality rights over data may lead to confrontations between bank and partner or to contractual restrictions. Data issues may be especially relevant when the partner is a FinTech trying to establish itself via stickiness based on data.

¹⁰ For a discussion of several issues need to be taken into account to integrate alternative credit scoring models into the traditional Basel Framework, see Alonso and Carbó (2020).

BaaS could benefit from several regulatory initiatives. The complexity and risks of BaaS arrangements suggest that some standardisation of its main terms could be useful. A template that highlights the main contractual events and options to deal with them would not only facilitate contracting but also the understanding by regulators and supervisors of a complex arrangement. In particular, from an outsourcing analysis perspective it would be challenging to map these contracts onto a third-party risks analysis breakdown. Embedding these arrangements into third-party service or outsourcing rules would contribute towards more balanced relationships between banks and their non-bank partners. In particular, when the latter are BigTechs, it should lead to the requirement that technology providers involved in the conduct of financial services activities are held to similar standards of governance, risk management and resilience as financial institutions.

4.3 Platforms and banks

The sponsorship of platforms by banks themselves has been argued to be a possible strategic response to BigTech competition. This still fringe strategy, deservedly known as “beyond banking” could be challenging for regulators if its importance increases in the future. Although this strategy would only be accessible to large banks or to consortia of banks, the amount of resources required to be diverted for a bank to also operate as a quasi-BigTech potentially entails prudential risks.

But these risks may not be entirely confined to the future. “Beyond banking” can be an evolved form of ecosystem-based banking, a strategy that is already widespread. This evolution has run more quickly in countries that have maintained some independence in their internet technology, like Russia. The state-owned bank Sberbank has registered with its regulator its plan to become a leader in technology and financial technologies, rather than solely in banking. A similar set of less advanced initiatives aimed at launching ecosystems of financial and non-financial services has led the Russian authorities to examine regulatory measures [Bank of Russia (2021)] to deal with the new risks.

The need to regulate the transformation of banks into economic platform ventures arises from a twofold rationale. First, the ability to venture into a “beyond banking” strategy depends on the toughness of regulation as regards the provision of non-financial services. Jurisdictions where a separation of commerce and banking prevails, like the United States, only permit the provision of services ancillary to the financial activities. This may restrain the ability to compete in a market where network externalities based on transactional data may be crucial. Second, the authorisation of a non-cooperative strategy to counter BigTechs’ forays into finance, such as “beyond banking”, entails new risks that may affect the banking franchise itself.

“Beyond banking” exhibits major strategic, governance and IT risks. This model may only be feasible when the critical mass needed to replicate the digital platforms of BigTechs is low thanks to some sort of national shield like the ones that have allowed the internet industry in Russia to remain autonomous. Moreover, although the immobilisation of resources to achieve the critical mass may be within the financing capabilities of a bank, it may significantly alter the bank’s liquidity and solvency if funded with deposits. Prudential bank policy will thus play a role in determining the economic incentives and capacity to expand into the creation of technological platforms. The dispersion of governance efforts to manage a multiplicity of both financial and non-financial ventures is also an important source of execution risk. The margin for conflicts of interest with suppliers of products on the platform who are also bank borrowers is one example of trade-offs between the platform and the banking business. Willingness to engage in cross-subsidisation also puts bank solvency at risk. The presence of IT risks in this list of execution challenges should not be a surprise at a time when banks increasingly have to resort to outsourcing a large chunk of their IT operations to BigTechs due to their magnitude and sophistication.

Enabling the “beyond banking” model by lifting rules that separate commerce and banking can be both a cultural and legal problem. The separation of commerce and banking is a high-level principle unevenly applied across countries that is intended to contain the moral hazard risks of running both banking and commercial ventures under a common roof and prevent the safety net spreading across the commercial sector. Whereas the United States has preserved structural separation rules in banking rooted in that principle, Europe and Japan have embraced universal banking, but generally denied banks the possibility of venturing into commerce. The issue is not just of intellectual or historical importance, as demonstrated by the refusal in 2005 of Walmart’s application for a bank charter and its aftermath and the interest of BigTechs [Barth and Sou (2014)]. In the less restricted universal banking jurisdictions the cultural debate has not yet begun.

In dealing with the strategic, governance and IT risks of the “beyond banking” model the Bank of Russia adopts a flexible approach based on specific regulation of banks’ investments in assets with limited liquidity and uncertain potential for earnings generation, the application of internal capital assessment procedures and capital add-ons when the platform acquires an unduly large size. The proposals are flexible to the extent that they allow banks to offer platform services, but also reflect prudential concerns. In an attempt to limit contagion risks, the weight of capital in the funding of the platform is required to be higher than that of deposits. The incorporation of platform ventures into the internal capital assessment process paves the way for a closer understanding of the risks by supervisors.

Regulation of bank sponsored platforms may be susceptible to conflicts between competition and financial regulators. The choice between open or proprietary

platforms exposes the conflicts between competition and stability highlighted above. Open platforms not only have to allow consumers and providers to move quickly to different ecosystems but should also provide options for financing transactions by different banks with the ensuing effect in terms of excess competition.

5 Conclusions

Regulating the forays of BigTechs into finance is a daunting task. Regulation needs structural pivots to act, but the mix of global commerce, technology and finance of BigTechs without local attachment points defies conventional models of public action. Regulatory authorities thus need to be arbiters of innovation and financial stability pressures with only incipient tools. In the meantime, risks of different sorts may accumulate, especially in the transactional segments less subject to more holistic risk-based regulations where BigTechs venture more confidently.

An initial difficulty finding the right tools is the size and dynamic nature of the problem. As a matter of fact, the agglomeration model of business followed by BigTechs across the world has exposed broader economic and social concerns than the ones relating to their incursions into finance. The broad set of authorities affected by this range of concerns (data, competition, banking and securities, AML, digital economy, etc.) needs to work out a structured agenda on the matter that builds a consistent policy space. In the past, structural regulation, such as rules separating commerce and banking, would have sufficed to differentiate and regulate activities. However, surgical actions may be more difficult to implement now in a world with integrated markets, while antitrust measures are still blunt tools. Moreover, the challenge for national authorities is compounded by the lack of an international agenda that identifies acceptable sound principles for consistent action across their respective concerns.

Against this backdrop, the characterisation in this article of the main competition modalities of banks in an era shaped by FinTech innovation and BigTech muscle is intended to enhance the understanding by authorities of the relevant business models that require regulation. Traditional and evolved forms of banking, like bank partnerships with FinTechs and neo-banks, are well known and will continue to be a widespread reality in the dynamic world of open banking.

But the banking-as-a-service and “beyond banking” models covered in this article are emerging new modalities that deserve the attention of regulators in future. The inherent feature of banking-as-a-service or “white-label” banking of providing the banking licence involves new risks and challenges. Banking-as-a-service is a biting reality in which commercial, banking and outsourcing relationships are comingled without proper standardisation or regulatory treatment. Banks are squeezed as suppliers of banking services, recipients of cloud service inputs and partners of

BigTechs. A consolidated view of the overall input-output relationship highlights the risk of moral hazard and the potential role of remedies like risk retention and incisive third-part risks and I service rules.

In turn, the “beyond banking” model is currently only an emerging and fringe outcome that may also require specific regulation in future possibly based on refinements of that applied to mixed conglomerates. The diversion of resources and managerial capacity from banking to a broad ecosystem of products entails strategic and execution risks that might have negative consequences for banks.

REFERENCES

- Alonso, A., and J. M. Carbó (2020). *Machine learning in credit risk: measuring the dilemma between prediction and supervisory cost*, Banco de España, Working Paper No. 2032.
- Bahri, G., and T. Lobo (2020). "The seven highly effective strategies to survive in the open banking world", *Journal of Digital Banking*, 5(2), pp. 102-109.
- Baker, C., D. Fratto and L. Reiners (2020). *Banking on the Cloud*, Tenn. J. Bus. L., Vol 21(2).
- Balyuk, T., A. N. Berger and J. Hackney (2020). "What is Fueling FinTech Lending? The Role of Banking Market Structure", *Empirical Studies of Firms & Markets eJournal*.
- Bank for International Settlements (2020). *Annual Economic Report 2020*, June.
- Bank of Russia (2021). *Ecosystems: regulatory approaches*, Consultative report.
- Barth, J. R., and M. Sou (2014). *Walmart: The New 'Go-To' Bank?*, Available at SSRN 2530010.
- Basel Committee on Banking Supervision (2021). *Basel Committee work programme and strategic priorities for 2021/22*, 16 April.
- Bergemann, D., and A. Bonatti (2019). "Markets for information: An introduction", *Annual Review of Economics*, Vol. 11, pp. 85-107.
- Bergemann, D., A. Bonatti and T. Gan (2019). *The economics of social data*, Mimeo.
- Bergemann, D., A. Bonatti and A. Smolin (2018). "The design and price of information", *American Economic Review*, Vol. 108(1), pp. 1-48.
- Berges-Sennou, F., P. Bontems and V. Réquillart (2004). "Economics of private labels: A survey of literature", *Journal of Agricultural & Food Industrial Organization*, Vol. 2(1), pp. 1-25.
- Buchak, G., G. Matvos, T. Piskorski and A. Seru (2018). "Fintech, regulatory arbitrage, and the rise of shadow banks", *Journal of Financial Economics*, Vol. 130(3), pp. 453-483.
- CapGemini (2021). *World Retail Banking Report 2021*.
- Carstens, A., S. Claessens, F. Restoy and H. S. Shin (2021). "Regulating big techs in finance", *BIS Bulletin*, No. 45, 2 August.
- Ciuriak, D. (2018). "The economics of data: implications for the data-driven economy", Chapter 2, in *Data Governance in the Digital Age*, Centre for International Governance Innovation.
- Cornelli, G., J. Frost, L. Gambacorta, R. Rau, R. Wardrop and T. Ziegler (2020). *Fintech and big tech credit: a new database*, BIS Working Paper, No. 887, 22 September.
- Cortet, M., T. Rijks and S. Nijland (2016). "PSD2: The digital transformation accelerator for banks", *Journal of Payments Strategy & Systems*, Vol. 10(1), pp.13-27.
- Crisanto, J. C., J. Ehrentraud and M. Fabian (2021). "Big techs in finance: regulatory approaches and policy options", *FSI Briefs*, No. 12, March.
- De la Mano, M., and J. Padilla (2018). "Big tech banking", *Journal of Competition Law and Economics*, Vol. 14(4), pp. 494-526.
- Economides, N., and C. Himmelberg (1995). *Critical mass and network size with application to the US fax market*, NYU Stern School of Business Working Paper.
- Ehrentraud, J., D. García Ocampo, L. Garzoni and M. Piccolo (2020). "Policy responses to fintech: a cross-country overview", *FSI Insights*, No. 23.
- Ernst and Young (2021). *Global banking outlook 2021*.
- European Banking Authority (2018). *The EBA's fintech roadmap*, March.
- European Banking Authority (2019). *EBA Report on the impact of FinTech on payment institutions' and e-money institutions' business models*, July.
- European Banking Authority (2021). *Report on the use of digital platforms in the EU banking and payments sector*, September.

- Farrell, J., and P. Klemperer (2007). "Coordination and lock-in: Competition with switching costs and network effects", *Handbook of industrial organization*, Vol. 3. pp. 1967-2072.
- Filomeni, S., G. Udell and A. Zazzaro (2016). *Hardening soft information: How far has technology taken us?*, Money & Finance Research Group Working Paper.
- Financial Stability Board (2019). *BigTech in finance: Market developments and potential financial stability implications*, 9 December.
- Gambacorta, L., Y. Huang, Z. Li, H. Qiu and S. Chen (2020). *Data vs collateral*, BIS Working Paper, No. 881, September.
- Geroski, P. A. (2003). "Competition in markets and competition for markets", *Journal of Industry, Competition and Trade*, Vol. 3(3), pp. 151-166.
- Gorjón, S. (2018). "The growth of the FinTech industry in China: a singular case", Analytical Articles, *Economic Bulletin*, 4/2018, Banco de España.
- Hurley, M., and J. Adebayo (2017). "Credit scoring in the era of big data", *Yale JL & Tech.*, Vol. 18(1).
- Jack, W., and T. Suri (2011). *Mobile money: The economics of M-PESA*, National Bureau of Economic Research Working Paper No. 16721, January.
- Jacobides, M. G. (2019). "In the ecosystem economy, what's your strategy?", *Harvard Business Review*, Vol. 97(5), pp. 128-137.
- Krahnen, J. P., and K. Langenbucher (2020). "The Wirecard lessons: A reform proposal for the supervision of securities markets in Europe", *SAFE Policy Letter*, No. 88, July.
- Langenbucher, K., C. Leuz, J. P. Krahnen and L. Pelizzon (2020). *What are the wider supervisory implications of the Wirecard case?*, Study requested by the ECON Committee of the European Parliament, October.
- Lantery, A., M. Esposito and T. Tse (2021). "From fintechs to banking as a service: global trends", *London School of Economics Business Review* (blog).
- Martínez-Miera, D., and R. Repullo (2010). "Does competition reduce the risk of bank failure?", *Review of Financial Studies*, pp. 3638-3664.
- Maudos, J., and X. Vives (2019). "Competition policy in banking in the European Union", *Review of Industrial Organization*, Vol. 55, pp. 27-46.
- Noble, E. (2020). "The Next Generation of Financial Conglomerates: BigTech and Beyond", *Butterworths Journal of International Banking and Financial Law*, forthcoming.
- Philippon, T. (2015). "Has the US finance industry become less efficient? On the theory and measurement of financial intermediation", *American Economic Review*, Vol. 105(4), pp.1408-1438.
- Ramdani, B., B. Rothwell and E. Boukrami (2020). "Open banking: The emergence of new digital business models", *International Journal of Innovation and Technology Management*, Vol. 17(5), 2050033.
- Restoy, F. (2021). "Regulating fintech: is an activity-based approach the solution?", Speech delivered virtually to the fintech working group at the European Parliament, 16 June.
- Rietveld, J., and M. A. Schilling (2021). "Platform competition: A systematic and interdisciplinary review of the literature", *Journal of Management*, Vol. 47(6), pp. 1528-1563.
- Rietveld, J., M. A. Schilling and C. Bellavitis (2019). "Platform strategy: Managing ecosystem value through selective promotion of complements", *Organization Science*, Vol. 30(6), pp. 1232-1251.
- Rochet, J.-C., and J. Tirole (2003). "Platform competition in two-sided markets", *Journal of the European Economic Association*, Vol. 1, Issue 4(1), pp. 990-1029.
- Siciliani, P. (2018). "The Disruption of Retail Banking: A Competition Analysis of the Implications for Financial Stability and Monetary Policy", *Journal of Financial Regulation*, Vol. 4(2), pp. 167-189.
- Tarullo, D. (2008). *Banking on Basel: the future of international financial regulation*, Peterson Institute for International Economics.
- United States Congress (2020). *Investigation of competition in digital markets*, Majority staff report and recommendations by the Subcommittee on Antitrust, Commercial and Administrative Law of the Committee of the Judiciary, 6 October.
- Vives, X. (2011). "Competition policy in banking", *Oxford Review of Economic Policy*, Vol. 27(3), pp. 479-497.

- Vives, X. (2019). "Digital disruption in banking", *Annual Review of Financial Economics*, Vol. 11, pp. 243-272.
- Volcker, P. (2009). *The Wall Street Journal Future of Finance Initiative*.
- Wu, T. (2018). *The curse of bigness. Antitrust in the new gilded age*, Columbia Law School.
- Zachariadis, M., and P. Ozcan (2017). "The API economy and digital transformation in financial services: The case of open banking", *Comparative Political Economy: Regulation eJournal*.
- Ziegler, T., et al. (2021). *The 2nd Global Alternative Finance Market Benchmarking Report*, Cambridge Centre for Alternative Finance.
- Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*, Profile books.

Regulatory developments in bank solvency, recovery and resolvability

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Abstract

Most of the amendments to prudential and resolution legislation introduced in the European Union (EU) in 2019 have already been implemented for credit institutions over the course of 2021. These include a broad set of measures aimed at reducing risks in the banking sector, boosting its strength and progressing towards the completion of the Banking Union. These risk mitigation measures give continuity to the substantial change in prudential rules carried out in 2013 in response to the shortcomings identified in the financial sector in the wake of the financial crisis and which prompted the adoption of the Basel III framework in the EU. They also give continuity to the resolution framework introduced in 2014 to ensure the orderly resolution of non-viable banks, minimising the repercussions of banking crises on the real economy, taxpayers and depositors. The fresh revision of European rules here at hand aims to make progress in the pass-through to European regulations of the internationally agreed reforms. It also aims to change certain aspects in light of the experience accumulated and the inefficiencies detected in the years during which the previous regulations were applied. This article reviews the most salient prudential and resolution measures introduced, presents some reforms that have already been rolled out and describes certain aspects that have not yet been addressed.

Keywords: Basel, prudential regulations, solvency, macroprudential, resolution, MREL.

1 Introduction

In June 2013 the European Parliament and the Council of the European Union approved Directive 2013/36/EU¹ on access to the activity of credit institutions and their prudential supervision (known as CRD IV) and Regulation (EU) No 575/2013² on prudential requirements for credit institutions (known as the CRR), substantially modifying prudential rules for credit institutions. Thus, the international regulatory framework known as Basel III was introduced (agreed by the Basel Committee on Banking Supervision - BCBS) to respond to the shortcomings identified in the financial sector as a result of the financial crisis. Basel III included new prudential requirements,

1 Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC.

2 Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and amending Regulation (EU) No 648/2012.

such as the leverage ratio, the liquidity ratios or the capital buffers. It substantially improved the quality and quantity of regulatory capital and introduced improvements in the treatment of market and counterparty risks. The goal of all this was to improve the solvency of credit institutions and the stability of the financial system as a whole.

Despite this progress, at end 2015³ the European Commission recognised the need to implement risk mitigation measures to continue weakening the link between banks and sovereign debt⁴ and to adopt the latest internationally agreed regulatory reforms to solve the problems detected during the crisis. In addition to further boosting the resilience of the EU's banking system, these risk-reduction measures would help to continue making progress in the completion of the Banking Union.

The regulatory framework for banking resolution in the EU has been amply developed since the publication in 2014 of Directive 2014/59/EU (BRRD),⁵ which equipped the authorities with tools and competencies to ensure the orderly resolution of non-viable credit institutions, with the aim of minimising the repercussions thereof on the real economy, taxpayers and depositors. Following its entry into force, the shareholders and creditors of the institution are the first ones to bear the costs of resolution, while deposits up to €100,000 are exempt from assuming losses and are protected by deposit guarantee schemes. The Single Resolution Fund (SRF) may be used to implement the resolution tools once the shareholders and creditors have borne the losses and recapitalised the institution for an amount equal to at least 8% of its total liabilities, including own funds (TLOF).

In November 2016 the European Commission unveiled the package of legislative proposals which sought to reduce risks in the banking sector, known as risk-reducing measures (RRM). Following a lengthy negotiation between the European Parliament and the Council, on 7 June 2019 the Regulation and Directive amending the CRR and the CRD (CRR II⁶ and CRD V⁷, respectively) and the Directive amending the BRRD (BRRD II)⁸ were published in the Official Journal of the European Union. This revision of the CRD, the CRR and the BRRD had two main objectives:

3 See European Commission (2015).

4 Best known as the bank-sovereign doom loop whereby, in summary, public support to the financial sector is ultimately detrimental for public finances, the economy and, lastly, once again, bank assets.

5 Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms.

6 Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements, and Regulation (EU) No 648/2012.

7 Directive (EU) 2019/878 of the European Parliament and of the Council of 20 May 2019 amending Directive 2013/36/EU as regards exempted entities, financial holding companies, mixed financial holding companies, remuneration, supervisory measures and powers and capital conservation measures.

8 Directive (EU) 2019/879 of the European Parliament and of the Council of 20 May 2019 amending Directive 2014/59/EU as regards the loss-absorbing and recapitalisation capacity of credit institutions and investment firms, and Directive 98/26/EC.

- Transposing into European legislation the reforms agreed at international level which had not been completed in the previous reform. These include most notably: introduction of new counterparty and market risk frameworks; certain adjustments to the large exposures regime; introduction of a net stable funding ratio; introduction of a leverage ratio in Pillar 1; introduction of the new interest rate risk framework; and implementation of the total loss-absorbing capacity (TLAC) standard published by the Financial Stability Board (FSB).
- Changing certain aspects of the regulations in light of the experience accumulated and the inefficiencies detected in their implementation, highlighting the following: the treatment of holding companies; the introduction of the need to create an intermediate parent; the introduction of greater proportionality; changes in the supporting factor for SMEs and the introduction of another supporting factor for infrastructures; the Pillar 2 reform and the adjustments to the macroprudential regime, particularly regarding buffer requirements, with notable changes in the systemic risk buffer to incorporate a sectoral component, and with the introduction of a new leverage ratio buffer for global systemically important institutions (G-SIIs); and the introduction of a series of technical improvements to the resolution framework, specifically for determining the minimum requirement for own funds and eligible liabilities (MREL).

After a transposition period allowed for institutions to prepare, at end-2020 most of the provisions of CRD V and BRRD II had been implemented, as was, in general, CRR II in June, with some exceptions.⁹

It is important to note that the following amendment of the CRR and CRD texts (CRR III and CRD VI), which will incorporate into EU law the finalisation of Basel III, is already in motion and, accordingly, the reform to which this article refers did not address many of the main Basel III changes agreed in 2017, such as, inter alia, those relating to credit risk, operational risk or the output floor.

Section 2 details the most important measures introduced by CRR II and CRD V in the prudential framework, their application date and how the transposition is being conducted in Spain. The Basel III finalisation reforms and their pass-through to EU legislation are also discussed. Section 3 describes the most significant reforms introduced regarding resolution, and certain aspects not yet addressed that will, at

⁹ There have been other partial amendments between the two large prudential reforms mentioned above (in 2013 and 2019). One of the main ones took place in 2017 as a result of the review of the regulatory and prudential treatment of securitisations within the Basel III framework, which aimed to reduce reliance on external credit ratings, simplify and limit the number of methods used to calculate capital requirements and increase the requirements for riskier exposures. Other amendments during this period included, for instance, those concerning the transitional arrangements owing to the introduction of IFRS 9, the minimum loss coverage for non-performing exposures, the liquidity coverage requirement and the leverage ratio.

least partially, be the object of a coming reform (BRRD III). Lastly, Section 4 sets out some conclusions.

2 Reform of the prudential framework

The main developments introduced by CRR II and CRD V, grouped into key issues, are discussed below.

2.1 Parent companies and other issues relating to the scope of application

Financial holding companies are companies whose main activity consists of holding shares and which are the parent of a banking group. Under CRD IV, these companies were subject to prudential requirements on a consolidated basis. However, the subsidiaries of these groups were not always able to ensure compliance with these requirements at group level, nor did the supervisors have powers over these companies at individual level.

The CRD V amendments provide for a specific administrative approval procedure in Article 21a, as well as adequate supervisory measures to ensure compliance with the requirements applicable to the group on a consolidated basis. To obtain such approval, the financial holding company must have both the capacity to manage the group and characteristics allowing for an effective consolidated supervision of the procedures and the assignment of functions within the group, the group's structural organisation, and the suitability of its shareholders and senior officers. If a series of conditions are met (such as not making management or financial decisions with an impact on the group), the company may be exempt from requiring approval.

With this amendment, the scope of application of prudential requirements on a consolidated basis and of the direct supervisory powers envisaged in the prudential regulations is extended to these holding companies. The competent authority may thus directly require the holding company to comply with the group requirements at consolidated or sub-consolidated level, without being subject to additional prudential requirements on an individual basis.

Article 21b of CRD V introduces the requirement of an intermediate parent undertaking (IPU) with the aim of simplifying consolidation and resolution at European level for third-country groups operating in the EU. Thus, when two or more EU institutions are part of a third-country group, they are required to establish an IPU on which all the subsidiaries depend when they jointly exceed a balance sheet threshold of €40 billion (including branches). The IPU must be a credit institution or a holding company. In certain cases, two IPUs will be allowed.

2.2 Own funds and eligible liabilities

With respect to the changes made to own funds requirements, of note is the change in the name of Part Two of the CRR to “own funds and eligible liabilities”, since a key goal of the CRR II amendments has been to transpose into EU law the FSB’s standard on total loss-absorbing capacity (the TLAC Term Sheet) (see the Section “Reform of the resolution framework”). In this connection, the criteria arising from resolution provisions that ensure the loss-absorbing capacity of instruments have been included in the conditions for calculating own funds and eligible liabilities. As regards other issues, aside from simplifying administrative procedures related to own funds instruments, no substantial changes (only certain adjustments) have been made to the framework defined in the previous reform.

As regards deductions, it is established that new deferred tax assets generated from 23 November 2016 must be deducted from regulatory own funds, even if their recovery does not depend on future income, which does not have a direct impact on previously generated assets.¹⁰ Investments in software, considered as intangible assets, may be exempt from deduction if, based on criteria defined by the European Banking Authority (EBA) and adopted by the European Commission,¹¹ they have been prudently valued and their value is not negatively affected by procedures of resolution, insolvency or liquidation of the institution.¹²

Under the CRR, the calculation of capital instruments issued by subsidiaries in third countries was hampered, since subsidiaries were required to be institutions or companies subject to the CRD and the trigger for converting Additional Tier 1 (AT1) capital into Common Equity Tier 1 (CET1) capital had to be calculated by applying CRR rules. Following the reform, in issuances outside the EU, the issuer may be a holding company if it is subject to prudential requirements as stringent as those to which third-country credit institutions are subject and the European Commission has decided that these rules are equivalent to those of the CRR. Also, the trigger in AT1 instruments may be calculated in accordance with the national law of a third country if the competent authority of the European institution, after consulting the EBA, is satisfied that the law and the contractual provisions governing such instruments are at least equivalent to those set out in the CRR.

2.3 Proportionality principle

The CRR already provided for the application of some proportionality through risk measurement approaches of varying complexity (standardised approach / internal

¹⁰ Article 39 of the CRR.

¹¹ Commission Delegated Regulation (EU) 2020/2176 of 12 November 2020 amending Delegated Regulation (EU) No 241/2014 as regards the deduction of software assets from Common Equity Tier 1 items.

¹² Article 36 of the CRR.

models) or in the form of exemption from certain requirements. This would be the case of institutions with small trading books, whose trading exposures are not subject to the market risk framework, but to the credit risk framework.

The amendment made establishes the principle that new prudential requirements should not be overly burdensome for smaller institutions, such that they may be applied in a more proportionate manner. To this end, the definition of a “small and non-complex institution”¹³ is introduced based on certain quantitative and qualitative requirements: its total average assets do not exceed €5 billion (Member States may lower that threshold, an option not exercised in Spain); the size of the trading book is considered small; the total value of its derivative positions and the volume of cross-border activity outside the European Economic Area (EEA) do not exceed certain thresholds; it does not use internal models; and it is subject to simplified obligations in relation to recovery and resolution. Even if these requirements are met, the competent authority may exclude an institution from the small and non-complex category.

The foregoing definition is established as the basis for applying the principle of proportionality in several CRR and CRD areas, such as reporting,¹⁴ Pillar 3,¹⁵ the net stable funding ratio and interest rate risk. Other areas of the regulations also address the principle of proportionality, albeit on the basis of criteria other than those addressed in the definition, e.g. the supervisory review and evaluation process (SREP) and remuneration rules.

2.4 Pillar 1

Although the revision of the credit risk framework according to the latest international standards, approved in December 2017, has not been the object of this reform, certain measures have nonetheless been introduced. These include most notably the adjustment for offsetting the effect of losses arising in sales of portfolios in default, from 23 November 2016 to up to three years after the entry into force of CRR II, in estimates of loss-given default (LGD).¹⁶ The purpose of this measure is to make it easier for banks to remove bad assets from their balance sheets and hence improve their lending capacity, preventing bulk sales of these assets from unduly penalising their loss estimates. However, the application of this measure (possible from 27 June 2019) has run into interpretation problems because its wording is not very precise.

13 Article 4(1)(145) of the CRR.

14 Part Seven A of the CRR specifically relating to reporting (formerly a chapter of Part Three) has been created, although there are still specific provisions in other parts of the CRR. References to minimum frequencies are eliminated.

15 Part Eight of the CRR on institutions' disclosures has been reformed to adjust the content and frequency of this information depending on the size and complexity of the institution and to adapt it to international standards.

16 Article 500 of the CRR.

In credit risk, the SME supporting factor has been revised to extend its scope,¹⁷ increasing from €1.5 million to €2.5 million the amount of the exposure to SMEs that benefits from a reduction by applying a factor of 0.7619 to capital requirements, and incorporating a reduction factor of 0.85 for exposures over €2.5 million. A supporting factor of 0.75 has also been introduced for infrastructure projects,¹⁸ provided they meet a series of criteria enabling them to reduce their risk profile and improve cash flow predictability. Both factors are mainly economic policy measures, but their prudential motivation is debatable and some regulators consider they should be eliminated.¹⁹

A new standardised approach has been introduced for counterparty credit risk (SA-CCR) in replacement of the standardised method and the market price valuation method, with the aim of overcoming their limitations.²⁰ Also, the possibility of applying simplified methods based on the size of an institution's derivatives business is envisaged. For this purpose, the original exposure method has been recalibrated and a simplified approach (based on the SA-CCR) has been developed. The rule applies from 28 June 2021 and will have an impact on other areas, such as the leverage ratio and the limits to large exposures.

Following the financial crisis, it was observed that the current market risk framework had limitations regarding sensitivity to risk, an aspect which prompted a comprehensive revision to the framework at international level, known as the Fundamental Review of the Trading Book (FRTB). The standardised and internal model-based approaches have been reviewed and redesigned,²¹ in an attempt to correct the limitations regarding sensitivity to risk detected during the financial crisis. In the EU, the reporting requirements under the new framework will be implemented first.²² Capital requirements will be introduced subsequently, with a new legislative proposal. Until then, institutions will continue to apply the current framework for capital requirements and market disclosure purposes. This design has gained preference over the alternative approach of phasing-in the requirements gradually. Also notable is the increase in the trading business volume threshold from €15 million to €50 million as one of the criteria for exempting an institution from applying market risk requirements and replacing them with credit risk requirements.

Regarding the large exposures limit, certain aspects of the Basel framework published in 2014, which were not included previously, have been introduced in the

17 Article 501 of the CRR.

18 Article 501a of the CRR.

19 For instance, the EBA in its recommendations in response to the call for advice on the Basel III reforms (see EBA (2019)).

20 Chapter 6, on counterparty credit risk, of Title II of Part Three of the CRR.

21 Title IV of Part Three of the CRR (Articles 325 to 325bp are created).

22 Reporting under the alternative standardised approach is mandatory from 30 September 2021. Reporting under the new internal model approach will be mandatory three years after the entry into force of the latest regulatory technical standards envisaged in the CRR (Article 430b(3)). At the cut-off date for this article, the EBA had published its proposed regulatory technical standards, but the European Commission had not yet adopted them.

CRR.²³ Thus, the base used to calculate Tier 1 capital limits has been restricted and a lower limit has been set for G-SII exposures to other G-SIIs: 15% compared with the general 25% limit (see the section on macroprudential aspects). Also included are new automatic and other discretionary exemptions for the competent authority, which the latter must justify.

As regards liquidity risk, CRR I incorporated the liquidity coverage ratio (LCR), whereby institutions must hold a volume of liquid assets sufficient to cover net cash outflows over 30 days in situations of stress. In addition, reporting requirements were incorporated for competent authorities to assess whether an adequate long-term funding structure was in place, as were other monitoring tools reflecting the profile, nature and complexity of institutions' activities. CRR II²⁴ introduces a net stable funding ratio (NSFR) requirement of at least 100%. Also, a simplified metric (sNSFR) and the possibility of applying proportionality in monitoring tools are introduced for small and non-complex institutions. Lastly, certain definitions and concepts are adjusted.

2.5 Leverage ratio

An important development in the previous prudential regulatory reform was the introduction of a leverage ratio based on a simple measure not linked to risk, which aimed to avoid the build-up of excessive leveraging by institutions and to supplement risk-based requirements. At the same time, it would resolve the problem of risk underestimation by institutions' internal models. However, capital requirements were not imposed initially and there were only ratio calculation, supervisory reporting and disclosure obligations. Also, the risk of excessive leverage was introduced as a Pillar 2 risk, which banks should manage and the competent authorities should include in the supervisory review and evaluation process.

In the current CRR reform,²⁵ a minimum requirement of 3% of institutions' total exposure measure, which applies from 28 June 2021, has been introduced. Also, new exemptions are recognised to prevent the new requirement from penalising certain business models and lines (e.g. loans from public development banks, officially supported export credits, exposures between institutions in an institutional protection scheme (IPS)), or to facilitate the application of monetary policies (temporary exemption of certain exposures to central banks under exceptional macroeconomic circumstances). This involves incorporating the Basel III standard on the leverage ratio, in accordance with the December 2017 reform, which specified certain aspects of the ratio's design.

23 Part Four of the CRR.

24 Part Six of the CRR (Articles 428a to 428az are created).

25 Part Seven of the CRR.

In addition, a leverage ratio buffer requirement for G-SIIs has been introduced. It is set at 50% of their risk-based buffer rate (see the section on macroprudential aspects).

2.6 Pillar 2

CRD IV envisaged the possibility of imposing supervisory measures (Pillar 2), including most notably the additional own funds requirement for risks not covered by the CRR. These uncovered risks could be micro or macroprudential.

Pillar 2 has been redesigned in the current reform, splitting it into a requirement (P2R), implemented in Article 104a, and a supervisory guidance (P2G)²⁶, laid down in Article 104b, that should be limited to covering microprudential risks, since they are both specific to each institution. Thus, the P2R will cover elements not covered or not sufficiently covered by own funds requirements for risks other than excessive leverage. Its minimum composition has also been established. At least three fourths must be covered with Tier 1 capital, of which another three fourths will be CET1 capital. However, the competent authority may require a more stringent composition when necessary, taking into account the specific circumstances of the institution.

The P2G, for its part, is a guidance – not a requirement – on additional own funds for risks other than excessive leverage. This supervisory expectation, for the purpose of addressing prospective stress scenarios, is based on a review of the institution's estimated internal capital and the supervisory stress exercise. As it is a guidance, failure to reach the P2G level would not trigger restrictions on distributions in case of failure to meet buffer requirements (if the combined buffer requirement is met) nor, in principle, have direct consequences. In the event of repeatedly failing to comply with the P2G, the competent authority may convert it into a P2R (requiring the supervisor to submit a compliance restoration plan). Disclosure of P2G will not be mandatory, although the competent authority may require it, nor has a minimum composition been set.

With the introduction of a leverage ratio, an independent P2R and P2G are established (P2R-LR and P2G-LR), as laid down in the aforementioned articles of CRD V, taking as a reference the total exposure measure instead of the total amount of the risk exposure (commonly known as risk weighted assets - RWAs). From this viewpoint, P2R-LR will cover elements not sufficiently covered by own funds requirements for excessive leverage risk, while P2G-LR will be guidance in parallel with P2G for excessive leverage risk.

²⁶ Some of the elements introduced in Pillar 2, such as P2G or the minimum composition of P2R, had already been incorporated by the EBA in its guidelines for common procedures and methodologies for the supervisory review and evaluation process.

The assessment of the risks an institution poses to the financial system is eliminated in the SREP. This gives the exercise a mainly microprudential perspective. New elements are introduced, such as the assessment of the suitability of governance mechanisms, the business model and the institution's diligence regarding the prevention of money laundering and terrorist financing (AML/CTF). Also, the EBA is urged to assess the advisability of including environmental, social and governance risks.

As regards the interest rate risk, under CRD IV institutions were required to assess and manage the interest rate risk arising from non-trading book activities, and provided for the adoption of supervisory measures at least when the economic value of an institution decreased by more than 20% of its own funds in the event of certain interest rate changes.

CRD V introduces a standardised methodology for quantifying the impact of interest rate changes on economic value and on net interest income, as well as a simplified standardised methodology for small and non-complex institutions.²⁷ Thus, competent authorities may require the use of the standardised approach (or institutions may choose to adopt it) when the internal systems are not satisfactory or when the simplified methodology does not adequately capture the risk. The EBA will have to develop the two methodologies in a regulatory technical standard.

Supervisory measures are also envisaged,²⁸ at least where an institution's economic value changes by more than 15% of its Tier 1 capital under six supervisory scenarios, or in the event of a large decline in net interest income under two supervisory scenarios. The EBA shall develop in a regulatory technical standard the supervisory shock scenarios, the methodological and parametric assumptions, and the definition of a large decline in net interest income.

Although the mandates expired on 28 June 2020, the work has not concluded and the uniform European regime has not yet been published.

2.7 Macroprudential aspects

The macroprudential policy framework contained in the CRD and the CRR has also changed substantially, driven by the experience gained in recent years in the EU in the use of macroprudential tools. The CRR II and CRD V amendments aim to make the current framework more flexible, improve the delimitation of its scope and ensure that the tools are used in a manner consistent with their purpose. In line with these objectives, and as mentioned previously, Pillar 2 has been restricted to the

²⁷ Article 84 of the CRD.

²⁸ Article 98 of the CRD.

microprudential field, in order to deal only with the risks specific to each regulated institution, discarding its use for addressing systemic risks or vulnerabilities, which is the object of macroprudential policy.

As regards the measures relating to the application of capital buffers, the key new developments are found in Articles 131 and 133 of the CRD, on capital buffers for G-SIIs and other systemically important institutions (O-SIIs) and on the systemic risk buffer, respectively, and in Article 92 of the CRR, which introduces the leverage ratio buffer requirement for G-SIIs.

In the CRD, the most significant change is probably that made to the design of the systemic risk buffer, which can now be applied at sectoral level, as opposed to the previous situation in which it only applied to risk-weighted assets (RWAs).²⁹ For this purpose, four main sectors are specified: i) retail exposures to natural persons secured by residential property; ii) exposures to legal persons secured by commercial property; iii) exposures to legal persons other than those specified in point ii); and iv) exposures to natural persons other than those specified in point i).³⁰ Also, the minimum buffer level of 1% required by CRD IV in the event of activation of this tool is eliminated.

If an authority were to activate an overall buffer (on all exposures) and one or several sectoral buffers, the total buffer requirement would be the sum of all the buffers activated. When the combined systemic risk buffer exceeds 3% of any of the exposures to which it is applied, the opinion of the European Commission must be sought; for levels over 5%, its authorisation is required.

Also, it is specified that the systemic risk buffer should not be used to address risks covered by the buffers for G-SIIs or O-SIIs – a practice followed to date by some European national authorities that considered that the maximum limit set for the O-SII capital buffer was too low – or for risks covered by the countercyclical capital buffer.

The CRD V amendments also increase the maximum limit set for the O-SII capital buffer, up to 3% (formerly, 2%) of RWAs; this level may be exceeded with the authorisation of the European Commission. The upper limit for O-SII buffers applicable to the subsidiaries of groups identified as G-SIIs or O-SIIs now stands at the lower of the

29 The possibility of applying this buffer at country level remains, both for exposures located in the Member State that sets the measure and for those located in other countries. It may be recalled that all the buffers envisaged in the CRD – the systemic risk buffer, the capital conservation buffer, the countercyclical capital buffer and the buffers for systemically important institutions – must be calculated as a percentage of RWAs and be met with CET1 capital. They differ from the leverage ratio buffer in both aspects, as explained below.

30 The EBA fulfilled its mandate of defining subsets for each of these sectors by publishing guidelines for the authorities: Guidelines on the appropriate subsets of sectoral exposures to which competent or designated authorities may apply a systemic risk buffer in accordance with Article 133(5)(f) of Directive 2013/36/EU (EBA/GL/2020/13) of 30 September 2020. These guidelines do not identify specific subsets. Rather, they define several dimensions, elements and sub-dimensions on the basis of which each authority may determine the subsets of the most significant exposures in order to address the systemic risks they identify.

G-SII or the O-SII buffer rate applicable to the group on a consolidated basis plus 1 percentage point and 3% of the subsidiary's RWAs (or, as appropriate, the percentage authorised by the European Commission for application to the consolidated group).

Regarding G-SIIs, the main new development relates to the introduction of an additional method for identifying such institutions which differs from the BCBS methodology in that exposures to counterparties in Member States participating in the Single Resolution Mechanism will not be treated as cross-border exposures in the cross-border activity indicator.³¹ The systemic importance score resulting from this method may be used, in the exercise of sound supervisory judgment, to re-allocate a G-SII in a lower sub-category from that applicable under the BCBS methodology, with the corresponding change in the capital buffer requirement. Also, the limit of 3.5% that existed for this G-SII buffer is eliminated.

In all circumstances under the new framework the G-SII and O-SII buffers and the systemic risk buffer become additive, up to a limit of 5%; over that limit, the authorisation of the European Commission will be necessary.

As regards the amendments to CRR II, the change with the greatest impact is probably the introduction of a new leverage ratio buffer for G-SIIs, included in the Basel III reform of 2017. This buffer is calculated by multiplying the total exposure measure of an institution's leverage ratio by 50% of the G-SII buffer rate, which, like the leverage ratio, must be met with Tier 1 capital.³² Failure to meet this new requirement is associated with restrictions on distributions; the farther the institution is from compliance, the greater the restrictions, in line with those associated with failure to comply with the combined buffer requirement.

The powers conferred in Articles 124 and 164 of the CRR – which, respectively, allow increasing credit risk weights on mortgage portfolios subject to the standardised approach and increasing the loss given default (LGD) parameter for institutions authorised to use internal ratings-based (IRB) approaches – previously lay with the competent (microprudential) authority in CRD IV. Under the new regulations, Member States may assign responsibility for these buffers to the national authority designated to use macroprudential tools. In the case of Spain, this responsibility falls to the Banco de España.³³

31 This additional method for identifying G-SIIs has been implemented in Commission Delegated Regulation (EU) 2021/539 of 11 February 2021 amending Delegated Regulation (EU) No 1222/2014 supplementing Directive 2013/36/EU of the European Parliament and of the Council with regard to regulatory technical standards for the specification of the methodology for the identification of global systemically important institutions and for the definition of subcategories of global systemically important institutions.

32 For example, in the case of Banco Santander (the only Spanish G-SII at present), whose G-SII buffer is 1% of its RWAs, the leverage ratio buffer would be 0.5% of its total leverage exposure.

33 In accordance with Article 15(1)(d) of Royal Decree 102/2019 of 1 March 2019 creating the Spanish macroprudential authority (AMCESFI), establishing its legal regime and implementing certain aspects relating to macroprudential tools.

A change is also introduced in the large exposures framework, following, as mentioned earlier, the Basel 2014 framework: the limit for exposures between G-SIIs is reduced to 15% of the Tier 1 capital of the lending institution, compared with the general 25% limit. The aim is to reduce systemic risks deriving from interconnections between large institutions and the impact a G-SII's default may have on financial stability.

As regards Article 458 of the CRR, known as “the flexibility package”, which allows designated authorities to apply stricter macroprudential measures than those envisaged in the CRD or the CRR to address systemic risks in their jurisdiction, under certain conditions (in particular, the Council of the EU's authorisation), the most significant development is the extension from one to two years of the period during which these measures (or their extensions) remain in force.

In the institutional realm it should be noted that the coordination and oversight role of the European Systemic Risk Board (ESRB) in connection with the macroprudential measures adopted in the EU by the various authorities is strengthened, with the aim of ensuring its sufficiency, consistency and lack of overlaps. The ESRB's dissemination of information in this respect is also reinforced.³⁴

Lastly, of note is the renewal of the European Commission's mandate to review the macroprudential framework, by virtue of which it must submit a report to the European Parliament and the Council and, if appropriate, a legislative proposal in December 2022. The current mandate adds new aspects to be assessed. Notable among these are the possibility of adding new types of instruments, such as those targeting borrowers (e.g. limits on lending), to the macroprudential tools available, and the possible extension of the leverage ratio buffer requirement to institutions other than G-SIIs (in particular, O-SIIs). The European Commission should conduct this review every five years. Also, the fallout from the COVID-19 crisis has provided more food for thought in this review of the adequacy of the macroprudential framework, such as the advisability of increasing the share of releasable buffers, as opposed to structural buffers, or the practical difficulties faced by institutions when using their buffers.

2.8 Restrictions due to failure to meet buffer requirements and calculation of the maximum distributable amount

CRD IV restricts the distribution of CET1 items, the payment of AT1 coupons and variable remuneration in the event of a failure to meet the combined buffer requirement. Any institutions finding themselves in this scenario must calculate the

³⁴ ESRB (2020).

maximum distributable amount (MDA), thereby capping any distributions that may be made by any of the above means.

The changes introduced by CRD V include adjustments aimed at ensuring that earnings generated throughout the year (and not simply since the last distribution) can be included in the MDA, thereby increasing the amount of the profits to be factored in.³⁵ Moreover, the combined buffer requirement is not met where an institution does not have own funds in an amount and of the quality needed to meet at the same time the combined buffer requirement, and the Pillar 1 and Pillar 2 requirements.³⁶

Meanwhile, following the introduction of a leverage ratio buffer, leverage-based restrictions have also been placed on Tier 1 capital distributions.³⁷ This requirement will not be met where an institution does not have Tier 1 capital in an amount and of the quality needed to meet the leverage ratio, the P2R covering the risk of excessive leverage and the G-SII leverage buffer.³⁸ Institutions must calculate the leverage ratio related maximum distributable amount (L-MDA), using a calculation methodology almost identical to that for the MDA, as well as the distribution percentages.

Figure 1 sets out a summary of the order in which the various requirements must be met, and of the two visions (risks and assets) present in Pillar 1, Pillar 2 and the capital buffers.

The guidance on additional own funds (P2G) constitutes a capital target on top of the minimum requirements for own funds (P1), the additional own funds requirements (P2R) and the combined buffer or leverage ratio buffer requirements. Failure to meet this target does not trigger any distribution-related restrictions.

The leverage-based own funds requirement is a requirement parallel to the risk-based own funds requirements. The requirement of additional own funds to cover the risk of excessive leverage (P2R-L) must be added to the 3% minimum leverage ratio (P1), and not the risk-based minimum own funds requirement.

While own funds may be used interchangeably for either stack of requirements, they cannot be used to comply with several requirements simultaneously within a single stack.

2.9 Governance and remuneration

The current legislation requires some clarification as regards the suitability requirements for members of the board of directors, the scope of such requirements

35 Article 141 of the CRD.

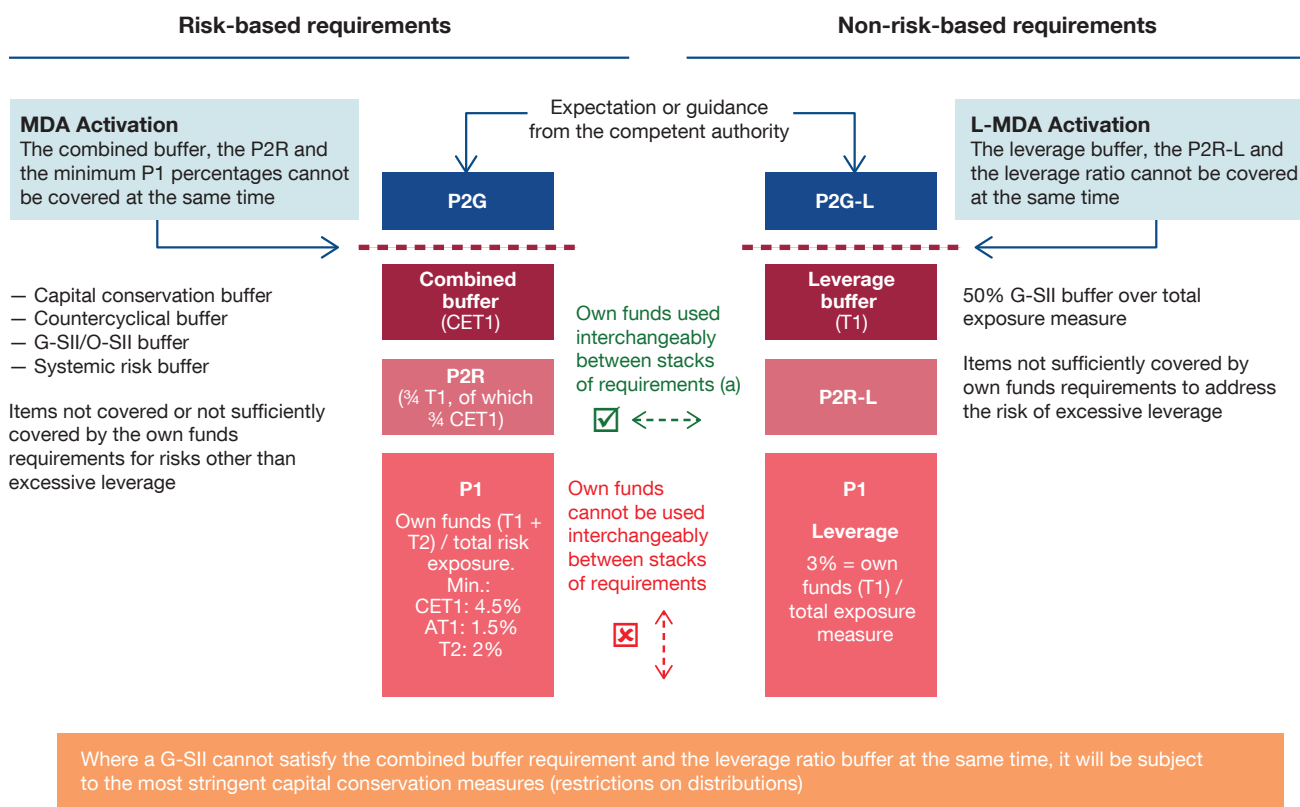
36 Article 141a of the CRD.

37 Article 141b of the CRD.

38 Article 141c of the CRD.

Figure 1

HIERARCHIES OF CAPITAL REQUIREMENTS AND GUIDANCE



SOURCE: Devised by authors.

a There are certain TLAC/MREL-related restrictions.

or the ability of the competent authorities to remove members where they fail to meet them. Such requirements will be assessed, in particular, where the authorities have reasonable grounds to suspect that money laundering or terrorist financing has taken place or where there is an increased risk of such activity.³⁹ Institutions must now document any loans to members of the management body or related parties, and such information must be kept at the disposal of the competent authorities.

New AML/CFT requirements have been introduced in various aspects of the CRD; for example, in the assessments by competent authorities of the adequacy of institutions' corporate governance and of the suitability of members of the board of directors.⁴⁰

In terms of remuneration, greater proportionality has been sought in certain variable remuneration requirements, such as deferral and payment in instruments or the

39 Article 91 of the CRD.

40 Article 97 of the CRD.

retention of discretionary pension benefits, since these could prove excessively punitive for smaller institutions.⁴¹ Thus, such requirements will not apply to an institution that does not meet the definition of large institution under the CRR⁴² and whose total assets are valued at €5 billion or less, or to staff members whose annual variable remuneration does not exceed €50,000 and does not represent more than one third of their total annual remuneration. Member States may lower or increase the asset threshold, provided it is appropriate to do so in light of the nature, scope and complexity of an institution's activities, its internal organisation or the characteristics of the group to which it belongs (where increased, the institution must meet certain requirements as regards the definition of small and non-complex institution, and the threshold may on no account exceed €15 billion). In Spain, the amendment to Law 10/2014⁴³ has empowered the Banco de España only to lower the asset threshold (i.e., to tighten the restriction). Member States may also decide that staff members that do not exceed the above thresholds are not subject to the exemption, given the specific features of the national market in terms of remuneration practices or owing to the nature of the responsibilities and job profile of such staff members.

Thus, based on a series of requirements, Article 92 of the CRD determines who must, at least, be included among the “identified staff”, i.e. staff whose remuneration is subject to conditions under the CRD, because their activities have a material impact on an institution's risk profile. The requirements for including as identified staff personnel who are not members of the board of directors or senior management, or who do not have managerial responsibility over the institution's control functions or material business units, must now be met cumulatively, representing an easing of the criteria on classification as identified staff. Also, remuneration policies now include a gender-neutral requirement, as well as related reporting obligations.

2.10 Date of implementation and transposition in Spain

While both the Regulation and the Directive entered into force on 27 June 2019, the dates of implementation of the different measures envisaged vary. The general date of implementation of the changes to the CRR falls two years after the date of entry into force (i.e. as from 28 June 2021), although some aspects, essentially those relating to own funds, are applicable from the date of entry into force. Meanwhile, the changes made to the CRD generally apply 18 months after it enters into force (as from 29 December 2020), once the deadline for its transposition into the different

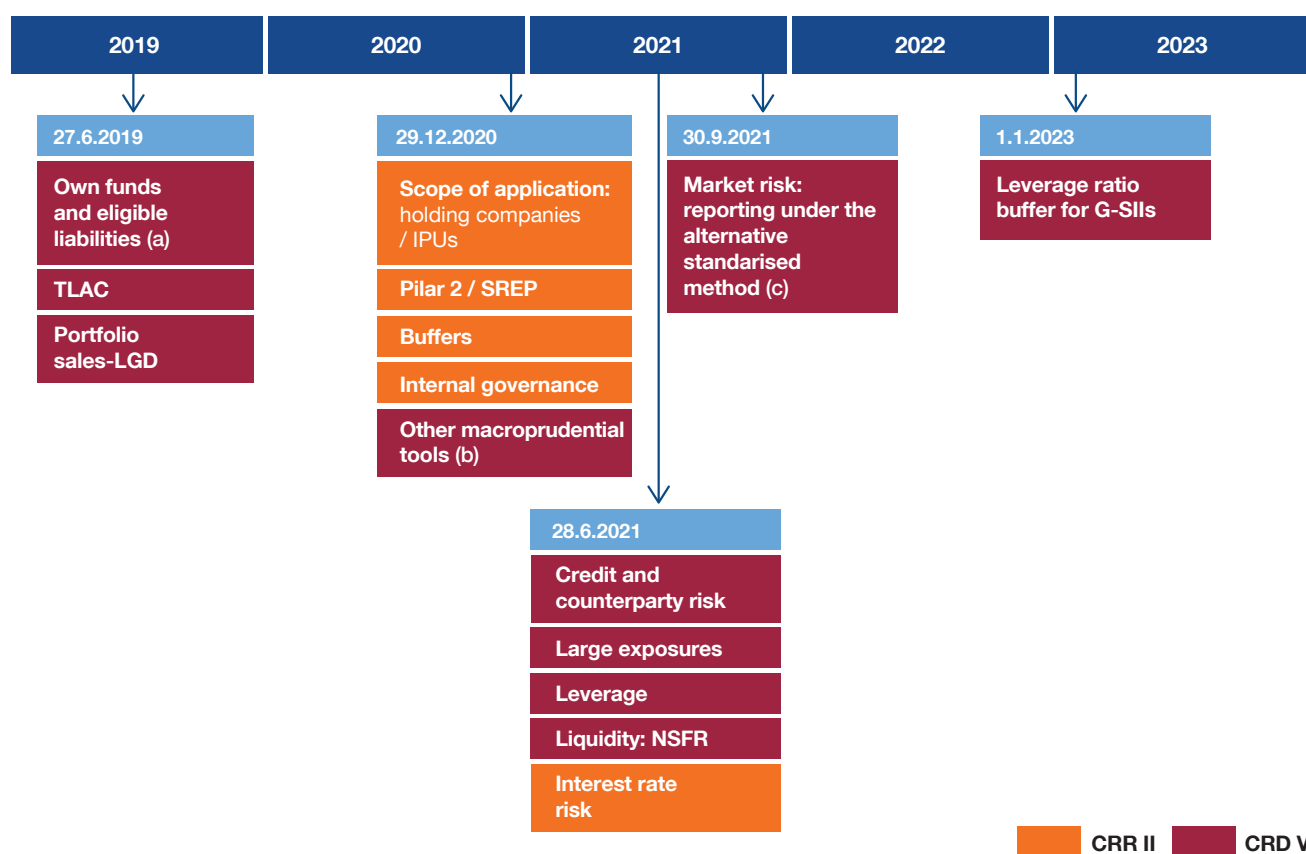
41 Article 94 of the CRD.

42 Large institution means an institution that meets any of the following conditions: a) it is a G-SII; b) it has been identified as an O-SII; c) it is, in the Member State in which it is established, one of the three largest institutions in terms of total value of assets; d) the total value of its assets on an individual basis or, where applicable, on the basis of its consolidated situation, is equal to or greater than €30 billion (Article 4(1)(146) of the CRR).

43 Law 10/2014 of 23 June 2014 on the regulation, supervision and solvency of credit institutions.

Figure 2

MAIN CHANGES IN CRR II AND CRD V AND IMPLEMENTATION DATES



SOURCE: Devised by authors.

- a Except for the exemption from deduction of software, which will be applicable from the date of entry into force of the regulatory technical standards drawn up by the EBA.
- b Applicable from 28.12.2020.
- c Reporting under the new internal model approach will be mandatory three years after the entry into force of the latest regulatory technical standards envisaged in the CRR (see footnote 22).

domestic legal systems has elapsed. There are nonetheless certain exceptions, such as the interest rate risk, which will apply at the same time as the modifications to Pillar 1 risks envisaged in the CRR, i.e. as from 28 June 2021 (see Figure 2).

It is also worth noting that the CRR was again amended in June 2020⁴⁴ in response to the COVID-19 crisis, bringing forward the application of certain measures, such as the SME and infrastructure supporting factors, as well as the new prudential treatment of software assets. Elsewhere, the application of the leverage ratio buffer (initially enforceable as from 2022) has been pushed back to 1 January 2023.

44 Regulation (EU) 2020/873 of the European Parliament and of the Council of 24 June 2020 amending Regulations (EU) No 575/2013 and (EU) 2019/876 as regards certain adjustments in response to the COVID-19 pandemic (known as the "quick fix").

Directives must be transposed into the domestic legislation of the different EU Member States, whereas regulations apply directly. Thus, work on transposing CRD V in Spain has begun with the publication of Royal Decree-Law 7/2021⁴⁵ of 27 April 2021, amending, inter alia, Law 10/2014 and Law 11/2015,⁴⁶ followed by the publication of Royal Decree 970/2021,⁴⁷ amending Royal Decree 84/2015 of 13 February 2015, implementing Law 10/2014. The process will come to an end with the amendment of Circular 2/2016.⁴⁸ Matters have been somewhat delayed by the COVID-19 pandemic, as well as by the process of transposition in Spain in the form of three pieces of legislation (using legal instruments of increasing technical complexity).

In addition to transposition of the changes to the CRD into domestic law, the national discretions and options contained in both the Regulation and the Directive must also be reviewed, both at Member State and competent authority level, also entailing the amendment of Circular 2/2014.⁴⁹ Moreover, in order to ensure that such regulations are applicable in full, the European Banking Authority has been mandated to prepare numerous technical standards and guidelines.

2.11 Incorporation of the finalisation of Basel III into EU law

2021 has seen the first application of most of the measures set in place by CRR II and CRD V, as well as the recent publication of the European Commission's legislative proposal that will transpose the finalisation of Basel III agreed at end-2017 into EU legislation. This will represent a further far-reaching review of the CRR and the CRD.

One of the aims of this new reform is to restore the credibility of RWA calculations and improve their comparability. A key reform has been made to the standardised approach to credit risk, while also restricting the use of IRB approaches by placing limits on some of the parameters used to calculate capital requirements. The robustness and risk sensitivity of standardised approaches to credit valuation adjustment (CVA) risk have also been enhanced, while eliminating the possibility of using internal models to capture such risks. Meanwhile, the current floor for aggregated results of capital requirements under Basel I has been replaced by a

45 Royal Decree-Law 7/2021 of 27 April 2021, transposing European Union Directives on matters of competition, anti-money laundering, credit institutions, telecommunications, tax measures, prevention and repair of environmental damage, postings of workers providing cross-border services and consumer protection.

46 Law 11/2015 of 18 June 2015 on the recovery and resolution of credit institutions and investment firms.

47 Royal Decree 970/2021 of 8 November 2021, amending Royal Decree 1644/1997 of 31 October 1997, concerning the rules on administrative authorisation and solvency requirements of reguarantee companies, Royal Decree 2660/1998 of 14 December 1998 on currency exchange services at establishments open to the public, and Royal Decree 84/2015 of 13 February 2015, implementing Law 10/2014 of 26 June 2014 on the regulation, supervision and solvency of credit institutions.

48 Banco de España Circular 2/2016 of 2 February 2016, to credit institutions, on supervision and solvency, completing the transposition into Spanish legislation of Directive 2013/36/EU and Regulation (EU) No 575/2013.

49 Banco de España Circular 2/2014 of 31 January 2014, to credit institutions, on the exercise of various regulatory options contained in the CRR.

more robust, risk-sensitive floor based on the revised standardised approaches under Basel III (output floor). This reform will also include the capital requirements under the new market risk framework following the fundamental review (FRTB) conducted by the BCBS, which was only included in CRR II for reporting purposes.

3 Reform of the resolution framework

Among the key modifications ushered in by BRRD II⁵⁰ was the review of the methodology for determining MREL, to ensure that institutions maintain at all times instruments with loss-absorbing and recapitalisation capacity in the event of failure. Moreover, the MREL requirement is now expressed in terms of the total amount of an institution's risk exposure (RWAs)⁵¹ and of the total exposure measure (TEM),⁵² in line with the rules on total loss-absorbing capacity published by the FSB in 2015 (TLAC Term Sheet). BRRD II also introduces a requirement akin to TLAC⁵³ for G-SIIs, while also bringing the criteria to be met by liabilities deemed eligible for MREL purposes⁵⁴ into line with the TLAC Term Sheet, with the aim of ensuring their loss-absorbing and recapitalisation capacity in resolution. Nonetheless, one of the key differences is that some of the European requirements (far more stringent, in general, than the TLAC) may be covered with unsubordinated instruments.⁵⁵

The MREL requirement must be met at consolidated resolution group level, which does not necessarily coincide with the consolidated group for prudential purposes. For this purpose, the own funds instruments eligible at a consolidated level and the liabilities mainly issued by the resolution entity (i.e. the “point of entry” to which the resolution tool chosen in each case is to be applied) are admissible. Moreover, the subsidiaries of the resolution group must issue their internal MREL, directly or indirectly, to the resolution entity, thereby ensuring, in the event of failure, that such instruments contribute to the loss absorption and recapitalisation of the subsidiary, which will remain under the group's control, without entering resolution.

BRRD II also introduces reporting obligations for both supervisory and resolution authorities and the markets, with a view to promoting transparency, and the consequences in the event of a failure to meet the MREL requirement. These include a prohibition on making dividend distributions or interest payments associated with Tier 1 capital instruments and the payment of variable remuneration or discretionary

50 Certain aspects, such as the eligibility criteria and the TLAC requirement for G-SIIs, are regulated in Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 (CRR II).

51 Calculated according to Article 92(3) of Regulation (EU) 575/2013.

52 Calculated according to Articles 429 and 429a of Regulation (EU) 575/2013.

53 18% RWAs and 6.75% TEM as from 1 January 2022 (16% and 6%, respectively, since 27 June 2019, according to the transitional provision of Article 494 of CRR II).

54 Introduced by Articles 72a to 72c of Regulation (EU) 575/2013.

55 There are other differences, such as the eligibility of structured notes or liabilities issued by subsidiaries to third-party shareholders, under certain conditions.

pension benefits where an institution is unable to meet its MREL requirement in addition to its combined buffer requirement.⁵⁶

With a view to limiting institutions' dependence on retail customers and better protecting such customers, BRRD II has placed restrictions on the marketing of financial debt instruments that are eligible subordinated liabilities,⁵⁷ which, when transposed in Spain,⁵⁸ have been extended to all debt instruments that constitute eligible marketable liabilities.

Lastly, the resolution authorities have the power to suspend an institution's contractual obligations, for up to two business days, with a view to ensuring the time required to ascertain whether the resolution is necessary in the public interest and, in such case, to select and effectively implement the most suitable resolution tool. The suspension of such obligations extends to eligible deposits,⁵⁹ although the authorities may permit depositors to draw a minimum daily amount, to be established on a case-by-case basis.

The co-legislators have nonetheless avoided addressing certain aspects that have for some time been up for debate in European circles, such as the uneven playing field for depositors in the different Member States or the possibility that winding up small institutions under national insolvency proceedings may have a serious impact on financial stability.

3.1 Liquidity in resolution

In an ideal world, a post-resolution institution will have regained the confidence of the markets, which it can therefore access to finance itself. In practice, the various agents (among them, the ratings agencies) may need some time to reassess the financial situation of the institution. Unless it has been acquired by another institution that can provide such confidence, it will have limited access to markets and, in all likelihood, few assets that can be used as collateral in dealings with the European Central Bank (ECB). It may also have suffered significant liquidity outflows, particularly in the form of a bank run.

Against this backdrop, the SRF is the first port of call for post-resolution institutions. In December 2020, the Eurogroup reached an agreement to bring the

56 CET1 capital required to meet the obligation to have in place a capital conservation buffer, plus, where applicable; a) a countercyclical capital buffer specific to each institution; b) a G-SII buffer; c) an O-SII buffer, and d) a systemic risk buffer.

57 Financial debt instruments envisaged in section a) point 2 of the Annex to this Law, which are, in turn, bail-inable liabilities for resolution and non-resolution entities per the provisions of section 4.^a of Chapter VI of Law 11/2015.

58 Royal Decree-Law 7/2021 of 27 April 2021.

59 Eligible deposits are those not excluded from protection per Article 5 of the Directive of the European Parliament and of the Council of 16 April 2014 on deposit guarantee schemes.

creation of a common backstop for the SRF forward to 2022, and the European Stability Mechanism (ESM) will therefore back the SRF for an amount equal to the size of the fund, up to a limit of €68 billion, in the form of a line of credit that may be drawn on once the funds in the SRF have been used in full. The support provided by the backstop will be recovered in the form of ex post contributions from institutions.

Nonetheless, even with the backstop, the size of the SRF (1% of covered deposits in the Banking Union from 31 December 2023; it is expected to stand at around €70 billion at that date)⁶⁰ would prove insufficient to meet the liquidity needs of certain large institutions, or several institutions simultaneously in the event of systemic crises. Indeed, it is estimated that the liquidity measures arranged in the form of state aid between 2008 and 2012 amounted to over €3,600 billion, of which around €1,300 billion was used.⁶¹

Given that this issue falls outside the scope of the Directive, and cannot therefore be attributed to an oversight on the part of the co-legislators, it is essential that the Single Resolution Board (SRB) be equipped with sufficient resources should it ultimately need to support the liquidity of an institution under resolution, ensuring that such resources can be accessed immediately given the urgency of such a scenario. With this in mind, various alternatives have been put forward, such as the Eurosystem Resolution Liquidity proposed by the ECB, consisting of a guarantee granted by the ESM to the ECB to cover the SRF, or the loan of bonds issued by the SRF to institutions under liquidation, to be used as collateral (or, alternatively, to be acquired by the ECB). Nonetheless, as things stand, there is no consensus among Member States on the measures that should be taken.

3.2 Legislative framework for small and medium-sized institutions

There are doubts at a European level as to whether the current resolution framework would work for small and medium-sized institutions, financed essentially with deposits. Such institutions have limited (and in all likelihood very costly) access to markets, and would therefore be hard pressed to meet their MREL goals without seriously harming profitability.⁶² A state of affairs that could even encourage greater risk-taking in a bid to boost profits, with an undesirable outcome contrary to that sought.⁶³ Indeed, it is notable that the MREL requirements are applied to all institutions in the EU, regardless of size, while the TLAC Term Sheet applies only to

60 The amount set aside as at 31 July 2021 amounted to €52 billion.

61 Amamou et al. (2020).

62 See EBA (2020). The results show different funding structures: while the liabilities of G-SIIs and O-SIIs that can easily be substituted by eligible liabilities range between 43% and 58%, institutions with assets totalling less than €100 billion fall within the 5%-23% range.

63 Restoy, Urbaski and Walters (2020).

G-SIIs, whose requirements are for the most part fewer than those of Europe's small and medium-sized institutions.⁶⁴

While such institutions may admittedly be wound up rather than entering a resolution process, domestic insolvency regimes are not best suited to credit institutions, since such processes are extremely slow, leading to great loss of value, and creditors (including uncovered deposits) would have to wait a long time before receiving the recoverable portion of their claims, with the resulting knock-on effect on the real economy.

This issue came to light in 2017 when, having decided that the resolution of Veneto Banca and Banca Popolare di Vicenza could not be justified on grounds of public interest, the Italian authorities designed a bespoke insolvency proceeding to wind them up. Thus, they introduced quasi-resolution tools into the existing domestic insolvency regime, enabling the assets of these institutions to be transferred to Intesa Sanpaolo, at a lower cost for shareholders and creditors than would have been the case under a resolution, thanks to the contribution of guarantees and government support. The Italian solution revealed that, where it is decided that there is no public interest, measures are then adopted at national level and may include government support, thus running contrary to the goal of setting in place a harmonised European framework applicable to institutions across the board, and giving rise to an uneven playing field among Member States. The European market is thus fragmented, without correcting the bank-sovereign doom loop, and creditor protection therefore depends on the financial strength of each Member State.

It seems clear that the solution to managing the failure of these institutions lies in transfer tools (sale of the business or bridge institution). The debate now centres on whether such tools should be introduced under a harmonised insolvency regime, or rather the concept of public interest should be broadened to ensure that these institutions fall under the umbrella of resolution in the event of failure. The aim in both cases is to guarantee the orderly exit of such institutions from the market, albeit requiring, alongside the possibility of using these tools, mechanisms to be set in place to enable such tools to be deployed without the need to seek public support, aside from the use of the SRF (only accessible in the event of resolution), the terms and conditions of which (bail-in on the part of shareholders and creditors in an amount equal to at least 8% of TLOF) would in many cases imply bail-in on the part of depositors, with the contagion risk this entails.

The use of deposit guarantee schemes constitutes the most viable alternative, and one that has already been successfully rolled out in other jurisdictions (such as the United States) to facilitate the sale of such institutions, providing financial support to purchasers in the form of price discounts or loss-sharing arrangements. In practice,

64 Restoy (2018).

however, this is not a viable option in the EU, since use of the fund is limited to the amount payable in a winding-up process to pay covered deposits, and the super-preference of such deposits (deposit guarantee schemes are subrogated to the rights of the depositors, who therefore recover the amount contributed ahead of any other creditor) means that the amount available is very small.⁶⁵

Against this backdrop, the European Commission has commenced its review of the banking crisis management and deposit guarantee framework (known as BRRD III) in order to make it more flexible and guarantee a level playing field for depositors. This review is part of the agenda to complete the Banking Union, which will culminate in the creation of a European Deposit Insurance Scheme (EDIS). The European Commission is also contemplating harmonising insolvency regimes,⁶⁶ which would include quasi-resolution tools for the administrative winding-up of credit institutions and would ensure the support of insolvency deposit insurance schemes as an alternative to paying covered deposits.⁶⁷ The proposal for a Directive is expected to be published at end-2021.

3.3 Multiple point of entry vs. single point of entry

The BRRD contemplates the possibility of applying a resolution via a multiple point of entry (MPE) or a single point of entry (SPE). The choice of one approach or another depends on a group's structure and, specifically, on the extent to which its subsidiaries manage their capital and liquidity autonomously and operate with financial and legal independence. From a resolution standpoint, the MPE model, comprising various resolution groups within one single consolidated group, usually coinciding with the geographic distribution of the subsidiaries, is the more desirable, since this reduces the risk of contagion, as intra-group exposures are very limited (essentially restricted to the stake held in the subsidiaries' capital). The SPE model, meanwhile, maintains one single resolution group at consolidated level, based on a centralised management model in which it is the parent that accesses wholesale funding, and then directly finances its subsidiaries' local activities. The Spanish financial institutions with the largest international footprint (Santander and BBVA) adopted the MPE model for their expansion outside the EU following the Latin American crisis of the late nineties. Though costlier, this model has proven effective for avoiding contagion risk and encouraging subsidiaries to control their own risk management, since it falls to them to access the markets without the support of their parent.

In an almost verbatim transposition from the TLAC Term Sheet, CRR II provides for a regime of deductions for MPE resolution groups of exposures to other resolution

65 Article 11(6) of Directive 2014/49/EU of the European Parliament and of the Council of 16 April 2014 on deposit guarantee schemes.

66 European Commission (2019b).

67 European Commission (2020).

groups, which, based on the deduction of all such exposures, enables the amount of the deduction to be reduced by an amount equal to the subsidiary's surplus over its own TLAC/MREL requirements. However, this formula⁶⁸ has caused numerous problems in terms of its practical application, in particular at subsidiaries in third countries that are not technically resolution groups (BRRD II only contemplates European resolution groups), whose jurisdictions have yet to set in place a resolution regime, and which are not therefore subject to requirements equivalent to the European TLAC/MREL.

Meanwhile, CRR II provides for an obligation to compare the sum total of the TLAC/MREL requirements of all an MPE's resolution groups⁶⁹ with the requirement that would theoretically correspond to the consolidated group if it were an SPE. Where the first figure is higher than the second, BRRD II⁷⁰ obliges the resolution authorities to assess the need to make an adjustment to eliminate the difference, albeit without necessarily requiring that they reach an agreement on the application of the adjustment. This methodology does not ensure a level playing field for MPE and SPE groups, thus creating an incentive for the former to extinguish themselves and reappear in the form of an SPE as a means of reducing their issuance needs. It should be borne in mind that the MREL requirement is always the same in an SPE model, regardless of any existing intra-group exposures, since these are eliminated in the consolidation process.

Moreover, the co-legislators overlooked the fact that the MPE model enables risk to be diversified across different geographic regions, thereby reducing the likelihood that all of the subsidiaries might fail at the same time.

4 Conclusions

The major reform of the prudential framework undertaken in 2013 led to the introduction in the EU of the Basel III response to the shortcomings in the financial sector identified in the wake of the financial crisis. A range of innovative concepts were included, such as the leverage ratio (to avoid the risk of excessive leverage); liquidity ratios (a risk that had hitherto only been addressed by Pillar 2); a rethink of the definition of capital, which was improved qualitatively and quantitatively; and the macroprudential framework, dealing with systemic risks. The approach to law-making also broke new ground, taking the form of not only a directive (i.e. CRD IV), but also a regulation (i.e. CRR I) that applies directly to Member States, thus giving countries less leeway in the transposition process.

68 Article 72e(4) of CRR II.

69 Article 12a of CRR II.

70 Article 45h(2) of BRRD II.

The reform addressed in this article is the amendment to these pieces of legislation (CRD V and CRR II) approved in 2019, though most of their provisions first apply to institutions in 2021. Unlike the previous reform, no major new concepts have been introduced. Rather, adjustments or improvements have been made to those already in place, drawing on the experience of implementation in the preceding years, while work has continued on bringing the legislation into line with the latest reforms agreed at international level (Basel III). Indeed, some of the reforms introduced (to market or interest rate risk) still require considerable regulatory development before they can be rolled out in full. Other modifications have their origin in the principle whereby requirements must be applied more proportionately to smaller, less complex institutions, thus ensuring that they do not shoulder an excessive burden.

The changes made to the macroprudential framework have enhanced the flexibility and range of the tools available to the authorities under the CRD and the CRR. They have also served to more clearly delimit their scope of application and purpose. The co-legislators were nonetheless aware that such progress is insufficient, and work has therefore continued on further developing and perfecting the framework. All of which explains the European Commission's mandate to present a new review in 2022, a mere three years after the new rules were published and before some of them are yet applicable. The experience gained in recent years will enable work to continue on fine-tuning and developing the macroprudential toolkit available under EU legislation, enhancing its effectiveness, efficiency and reach. Lastly, it is also hoped that further progress will be made, to the extent possible, on streamlining the framework, without burdening institutions with excessive requirements.

The reforms of the prudential framework carried out to date have helped bolster the solvency of the banking system, as borne out during the pandemic, in which bank lending continued unabated, thanks also to the specific measures set in place. Nonetheless, a further modification of the rules is needed to implement the latest Basel III changes in the EU and to continue improving the capitalisation levels of the banking system. This time round, the main aim of the reforms is to restore the credibility of RWAs, reducing the excessive variability of internal models and developing more robust standard models. Their implementation is set for 1 January 2023, which is why the European Commission recently published a legislative proposal to amend the CRR and the CRD.⁷¹ The BCBS and the G20, together with the vast majority of the EU's central banks and supervisors,⁷² have argued in favour of the full, timely and consistent implementation of the Basel III reforms, with minimal deviations, to help shore up all of the banking systems (which have proven so

71 For further details, see "Banking Package 2021: new EU rules to strengthen banks' resilience and better prepare for the future", European Commission press release of 27 October 2021.

72 The Banco de España and another 24 central banks and supervisory authorities have requested from the European Commission a full, timely and consistent implementation of Basel III (Various authors (2021b)). See also the ECB and the EBA (2021).

interdependent), while also offering greater support to the real economy in times of crisis.

As for the review of the resolution framework, experience has shown that an absence of effective solutions for certain categories of institutions within the banking crisis management framework has been addressed in various ways, depending on the domestic regime in place, thus raising doubts as to their consistency and suggesting the need for improvement. The restrictive approach to assessments of public interest as a prerequisite for resolution and the difficulties in accessing funding encourage the use of parallel instruments and government support outside of resolution. The existence of different national insolvency proceedings generates discrepancies in the outcomes for shareholders and creditors across Member States. There are also differences as regards the possibility of using deposit guarantee schemes for such purposes, as well as in the scope of depositor protection. The upshot is an uneven playing field among the different countries, and the risk of exposing taxpayers to the cost of a winding-up process. Therefore, a reform of the framework is needed to press forward with the banking union, bolster financial stability, mitigate taxpayer exposure and provide appropriate, proportionate solutions for managing and financing the failure of institutions.

Elsewhere, mechanisms must be set in place to ensure institutions are able to access liquidity post-resolution, thus enabling them to operate as normal, since the capacity of the SRF (even with the backstop) is limited.

Lastly, while this aspect is not expected to form part of the forthcoming reform, resolvability is not simply a matter of ensuring institutions maintain high levels of TLAC/MREL. A group structure based on subsidiaries with operational and financial independence reduces the risk of contagion and facilitates resolution. MPE structures must therefore be afforded non-discriminatory treatment, eliminating any incentives for increasing interconnections in cross-border groups. This aspect could be addressed in a future modification of the CRR.

12.11.2021.

REFERENCES

- Amamou, R., A. Baumann, D. Chalamandaris, L. Parisi and P. Torstensson (2020). *Liquidity in resolution: estimating possible liquidity gaps for specific banks in resolution and in a systemic crisis*, Occasional Paper No 250, European Central Bank.
- Anguren, R., L. Gutiérrez de Rozas, E. Palomeque and C. J. Rodríguez García (2020). "The regulatory and supervisory response to the COVID-19 crisis", *Financial Stability Review* No 39, November, Banco de España.
- Basel Committee on Banking Supervision (BCBS) (2014). *Supervisory framework for measuring and controlling large exposures*.
- Basel Committee on Banking Supervision (2017). *Basel III: Finalising post-crisis reforms*.
- Ecofin (2010). *Council conclusions on crisis prevention, management and resolution*, Meeting 3054 of the Economic and Financial Affairs Council, Brussels, 7 December.
- European Banking Authority (EBA) (2019). *EBA advises the European Commission on the implementation of the final Basel III framework*, press release of 5 August.
- European Banking Authority (2020). *EBA Quantitative MREL Report*, 17 February.
- European Central Bank (ECB) (2016-2021). *Macroprudential Bulletin*.
- European Central Bank and European Banking Authority (2021). "EU implementation of outstanding Basel III reforms", letter of 7 September 2021 co-signed by the Chairperson of the EBA, the Vice President of the ECB and the Chair of the Supervisory Board of the ECB.
- European Commission (2015). "Towards the completion of the banking union", Communication from the Commission to the European Parliament, the Council, the European Central Bank, the European Economic and Social Committee and the Committee of the Regions, 24 November.
- European Commission (2019a). *Adoption of the banking package: revised rules on capital requirements (CRR II / CRD V) and resolution (BRRD / SRM)*.
- European Commission (2019b). *Report from the Commission to the European Parliament and the Council on the application and review of Directive 2014/59/EU (Bank Recovery and Resolution Directive) and Regulation 806/2014 (Single Resolution Mechanism Regulation)*, 30 April.
- European Commission (2020). *Combined evaluation roadmap/inception impact assessment*, 10 November.
- European Systemic Risk Board (ESRB) (2020). *A Review of Macroprudential Policy in the EU in 2019, Special Feature A: The ESRB as a coordination and notification hub under CRD V and CRR II*.
- Ferreira, E. (2019). *Banking Union: Crossing an Unstable Bridge*, speech delivered at the CIRSIF Annual International Conference, Lisbon, 4 July.
- Hernández de Cos, P. (2021). *Basel III implementation in the European Union*, speech delivered on a Eurofi panel, Ljubljana, 10 September.
- Ibáñez, J. and B. Domingo (2013). "La transposición de Basilea III a la legislación europea", *Financial Stability Review* No 25, November, Banco de España.
- Restoy, F. (2018). *Bail-in in the new bank resolution framework: is there an issue with the middle class?*, speech at the IADI-ERC International Conference, Resolution and deposit guarantee schemes in Europe: incomplete processes and uncertain outcomes, Naples, 23 March.
- Restoy, F. R. Vrbaski and R. Walters (2020). "Bank failure management in the European banking union: What's wrong and how to fix it", Occasional Paper No 15, Financial Stability Institute.
- Sotelo, F. (2021). "A proposal to funding crisis management in deposit taking institutions", seminar organised by the Banca d'Italia, "The crisis management framework for banks in the EU. How can we deal with the crisis of small and medium-sized banks?" 15 January.
- Various authors (2021a). "Macroprudential policy in Spain; institutions and instruments", *Información Comercial Española* No 918, 26 February.
- Various authors (2021b). *The EU should stick to the Basel III agreement*, letter of 7 September signed by the central banks and banking supervisory authorities of Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Estonia, Greece, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.

- [CRR II] Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements, and Regulation (EU) No 648/2012.
- [CRD V] Directive (EU) 2019/878 of the European Parliament and of the Council of 20 May 2019 amending Directive 2013/36/EU as regards exempted entities, financial holding companies, mixed financial holding companies, remuneration, supervisory measures and powers and capital conservation measures.
- [BRRD II] Directive (EU) 2019/879 of the European Parliament and of the Council of 20 May 2019 amending Directive 2014/59/EU as regards the loss-absorbing and recapitalisation capacity of credit institutions and investment firms and Directive 98/26/EC.

Programme of the third Conference on Financial Stability
of the Banco de España and CEMFI

PROGRAMME OF THE THIRD CONFERENCE ON FINANCIAL STABILITY OF THE BANCO DE ESPAÑA AND CEMFI

The third biennial Conference on Financial Stability, organised by the Banco de España in cooperation with the Centro de Estudios Monetarios y Financieros (CEMFI), took place on 18-19 October 2021 with the aim of promoting the research and discussion of topics relating to financial stability and macroprudential policy among academics, practitioners, and policy-makers.

The conference provided a forum to discuss a variety of issues, including the impact of the COVID-19 pandemic and the financial stability implications of the development of central bank digital currencies. The keynote speaker was Randal K. Quarles, member of the Board of Governors of the Federal Reserve System, in his capacity as chair of the Financial Stability Board (FSB).

In contrast with previous conferences, on this occasion the event was held with a hybrid format; most speakers participated in-person at the premises of the Banco de España in Madrid, while the majority of the audience (around 250) followed the event online.

The full programme of the conference is set out below, with links to the research papers discussed (presenting authors are marked in italics) and to the videos of the sessions uploaded by the Banco de España to its website.

[Link to the video recording of the first day of the conference \(18/10/2021\)](#)

[Link to the video recording of the second day of the conference \(19/10/2021\)](#)

18 October 2021

Opening and keynote (11:00 - 12:20)

Identifying lessons from the current crisis on the prudential framework for the banking system

Pablo Hernández de Cos, Banco de España

Financial stability and coordination in times of crisis

Randal K. Quarles, Federal Reserve Board

Session 1 (14:00 - 16:00)

Chair: *Rafael Repullo*, CEMFI

Liquidity insurance vs. credit provision: Evidence from the COVID-19 crisis

Tumer Kapan, International Monetary Fund

Camelia Minoiu, Federal Reserve Board

Discussant: *Daniel Paravisini*, London School of Economics

Pandemic lending: The unintended effects of model-based regulation

Franco Fiordelisi, University of Essex

Giulia Fusi, European Stability Mechanism

Angela Maddaloni, European Central Bank

David Marqués-Ibáñez, European Central Bank

Discussant: *Saleem Bahaj*, University College London

Unused bank capital buffers and credit supply shocks at SMEs during the pandemic

Jose Berrospide, Federal Reserve Board

Arun Gupta, Federal Reserve Board

Matthew P. Seay, Federal Reserve Board

Discussant: *Andrea Polo*, Luiss University

Panel on “Central bank digital currencies and financial stability” (16:30 - 18:30)

Chair: *Margarita Delgado*, Banco de España

Markus Brunnermeier, Princeton University

Jon Cunliffe, Bank of England

Jean-Pierre Landau, Sciences Po

19 October 2021

Session 2 (09:00 - 11:00)

Chair: *Ángel Estrada*, Banco de España

The rise of bond financing in Europe

Olivier Darmouni, Columbia Business School

Melina Papoutsj, European Central Bank

Discussant: *Jan-Pieter Krahen*, University of Frankfurt

The value of “new” and “old” intermediation in online debt crowdfunding

Fabio Braggion, Tilburg University

Alberto Manconi, Bocconi University

Nicola Pavanini, Tilburg University

Haikun Zhu, Erasmus School of Economics Rotterdam

Discussant: *Dmitry Arkhangelski*, CEMFI

Who truly bears (bank) taxes? Evidence from only shifting statutory incidence

Gabriel Jiménez, Banco de España

David Martínez-Miera, Universidad Carlos III de Madrid

José-Luis Peydró, Universitat Pompeu Fabra

Discussant: *Ernst-Ludwig von Thadden*, University of Mannheim

Session 3 (11:30 - 13:30)

Chair: *Olympia Bover*, Banco de España

Multiple credit constraints and time-varying macroeconomic dynamics

Marcus Mølbak Ingholt, Danmarks Nationalbank

Discussant: *Galo Nuño*, Banco de España

Credit allocation and macroeconomic fluctuations

Karsten Müller, NUS Business School

Emil Verner, MIT Sloan School of Management

Discussant: *Veronica Rappoport*, London School of Economics

Ownership concentration and performance of deteriorating syndicated loans

Mariassunta Giannetti, Stockholm School of Economics

Ralf R. Meisenzahl, Federal Reserve Board

Discussant: *Ansgar Walther*, Imperial College London

Session 4 (14:30 - 16:30)

Chair: *Javier Suárez*, CEMFI

Macrofinancial feedback, bank stress testing and capital surcharges

Tobias Adrian, International Monetary Fund

Jose Berrospide, Federal Reserve Board

Romain Lafarguette, International Monetary Fund

Discussant: *Loriana Pelizzon*, University of Frankfurt

Separating retail and investment banking: Evidence from the UK

Matthieu Chavaz, Bank of England

David Elliott, Bank of England

Discussant: *Giovanna Nicodano*, University of Turin

Financial stability governance and central bank communications

Juan M. Londono, Federal Reserve Board

Stijn Claessens, Bank for International Settlements

Ricardo Correa, Federal Reserve Board

Discussant: *Oren Sussman*, University of Oxford

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Carmen Alonso Ledesma

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Álvaro Menéndez and Maristela Mulino

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Pedro Duarte Neves

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Richard Herring

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