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FinTech: From Systemic Risk to SupTech Application Initiatives. What are the obstacles for BRICS Countries?

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“A chi sta ancora cercando la storia che ha dentro”

Alla Donna che sono,
che cerca sempre di migliorarsi e che non smette mai di sognare.
Alle mie vittorie e alle mie sconfitte.
Alla bambina che sono e sarò sempre,
con le favole nel cuore e mille sogni dentro gli occhi

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ABSTRACT

Digitalization has made us change the way we look at things, we can think of a new Industrial Revolution, which has given life to the digital economy, that is, a change in social and economic relations which has required, for some years now, to rethink the traditional approaches. The banking-financial world is no stranger to such changes as it finds itself facing radical situations of modernization, think of the transition from branches to ATMs and internet banking, innovations which have affected the economy by upsetting the economic, social and financial markets, leading consumer habits to change as quickly as possible to keep up.

Fintech was first discussed in 2009, when traditional banks were facing an economic and financial crisis. The subprime mortgage crisis in the United States led to a decline in income and employment, forcing lenders to impose restrictions on bank credit to families and businesses.

The fintech phenomenon distorts the economy, the banking and financial sectors, also changing the role of credit institutions and intermediaries, calling into question a system that has been well solidified to date.
But what is actually meant by the term Fintech and what innovations does it bring to the banking and financial system? In practice, can the Fintech system be considered an asset or a threat to the economy? Are there innovations capable of overcoming the main risks that this new digital era entails?

The arrival of this phenomenon is certainly not a surprise for the more modernized countries that manage to keep up almost effortlessly, but on the other hand we must also keep in mind those geographical areas that are developing and that are slowly emerging , so in this case, what would be the obstacles for developing countries considering these changes in banking and financial systems?

This essay seeks to respond to all of this, providing a general picture of the Fintech phenomenon and a more detailed focus on the risks and innovations that can help us reduce the latter; finally analyzing the behavior of BRICS countries towards these new innovations.

The first part of the thesis (chapter I) will be an introductory historical overview starting from the birth of the bank and its evolution, going through the transformation of payment methods that will lead to today's Fintech bank, analyzing the main financing methods that have given rise to this new prototype of banking and finance.

The second chapter will propose an analysis of the main risk deriving from FinTech, i.e. "systemic risk", specifying its characteristics, methods of diffusion and concluding with the regulatory initiatives currently present in Italy and Europe.

In the third chapter we will specifically analyze one of the emerging innovations to try to cope with systemic risk, covered in the previous chapter. We will therefore understand what the main SupTech Innovation tools are, the current application and the main legal and operational problems that could be encountered.

To conclude (chapter IV) a general framework will be proposed on the BRICS countries and we will analyze how these emerging economies deal with the introduction of this new technology, trying to understand how the perspectives change between Western and Eastern countries. and what the main forms of supervision could be in this type of country.

CHAPTER 1

THE FINTECH PHENOMENA: FINANCIAL TECHNOLOGY BANK

1.1 The Banking System and its evolution

The 2008 financial crisis brought dramatic changes to the way finance is regulated. The Dodd-Frank Act[1] imposed comprehensive and systematic regulation of the industry on a scale not seen since the New Deal[2]. However, financial regulatory reforms implemented since the crisis are based on outdated ideas about what financial services are and how they are provided. The regulation did not take into account the rise of financial technology (or "fintech") companies and the fundamental changes they have ushered in a variety of aspects, from how the banking sector operates to how it raises and raises capital. These changes require a far-reaching reconceptualization of financial regulation in the age of technology-enabled finance[3].

When we talk about technological revolutions we are referring to a historical framework characterized by a series of new technologies that have brought changes to the economic and financial systems, especially on a global scale, eliminating the constituent elements that had been used previously. Although we have witnessed several revolutions, they have all had an impact on society, albeit with different generations, characteristics and participants. In this case, the problem is that technology distorts the system "like a tide" and the only option for humans and businesses is to adapt to it by changing their lifestyles and radically changing their habits. To do this, we consider historical moments of strong influence, such as the first British industrial revolution (late 18th and early 19th centuries), which transformed sectors such as agriculture, transport, technological

[1] Dodd-Frank Act is a federal statute in force in the United States, converted into law with the signature of President B. Obama in July 2010 and considered the response of the American regulator to the financial crisis that began in 2007. It is believed that the content of this law, which takes its name from its creators B. Frank and C. Dodd, resulted in the most innovative and revolutionary change in financial regulation in the United States since the Great Depression of 1929. The D.-F. A. defined the criteria to identify those credit institutions whose failure could jeopardize the entire US financial system (the so-called 'systemically important' banks). See more, FTA Online News, "Dodd Frank Act, L'ambiziosa riforma di wall street", Borsa Italiana, 2013

[2] The New Deal ("new course" or literally "new pact") refers to the economic and social reform plan promoted by US President Franklin Delano Roosevelt between 1933 and 1943 with the aim of reviving the country from the great depression that had overwhelmed the United States of America since 1929 ('Black Thursday'). See more, Treccani, "New Deal", Dizionario di Storia 2010.

[3] W. Magnuson, "Regulating Fintech" in Vanderbilt Law Review, Volume 71, 2018

innovation, banking and finance or the creation of the first computer in 1941[4]. It is precisely from the invention of computers that we must start our research as it has made every tool previously used obsolete. It is with the development of the Internet and the world of e-commerce that a digital revolution known as Industry 4.0 or "industrial digital transformation" has made physical relationships obsolete. This revolution spread primarily in America in the early 2000s with the Bank of America which saw the arrival of new users, it later spread to Europe, in particular in Great Britain considered at the time as the banking and financial system more reliable, to then arrive in Italy[5]. The phenomenon of change was felt between the end of the 1990s and the first decade of the 21st century when the operations of banks began to move towards an online reality[6]. This did not mean abandoning the traditional channel, which will remain the basis of every bank-customer-company relationship, but giving added value to it. Following the COVID-19 pandemic, the online channel has become increasingly prevalent; since 2020, with the health emergency, every type of physical interaction has been reduced, leaving room for the virtual one which is currently chosen by the greatest number of banking customers.

Home banking, mobile banking and in general all banking apps represent the means by which to easily get in touch with customers, making it easier to move around the bank.

This is the basis of the evolution of the banking system and represents a new business model on which to base the relationship with customers and exploiting technologies, breaking down barriers and regulatory and organizational constraints.

[4] Investopedia, The Evolution of Banking over time, written by Andrew Beattie, March 2023: https://www.investopedia.com/articles/07/banking.asp

[5] Il Sole 24 Ore, Perché si parla tanto di industria 4.0: che cos'è e quanti lavori può creare, di Alberto Magnani, Ottobre 2017: https://www.ilsole24ore.com/art/perche-si-parla-tanto-industria-40-che-cos-e-e-quanti-lavori-puo-creare-AEZYmnlC

[6] Profinch, History of Banking: https://profinch.com/history-of-banking/

1.1.1 From the Bank ATM to Digital Transformation

For several years we have been witnessing a profound transformation of the banking sector at a global level, the consequence of which is an ever greater attention by financial operators towards more innovative solutions and approaches to the customer that embrace technological innovation and the most advanced tools[7]. It is clear that innovation is necessary to achieve company objectives. This is a universal concept used both by companies and by banks and other financial intermediaries.

Figure 1 below briefly represents what we want to highlight, i.e. the evolution of the way of banking over the years[8].

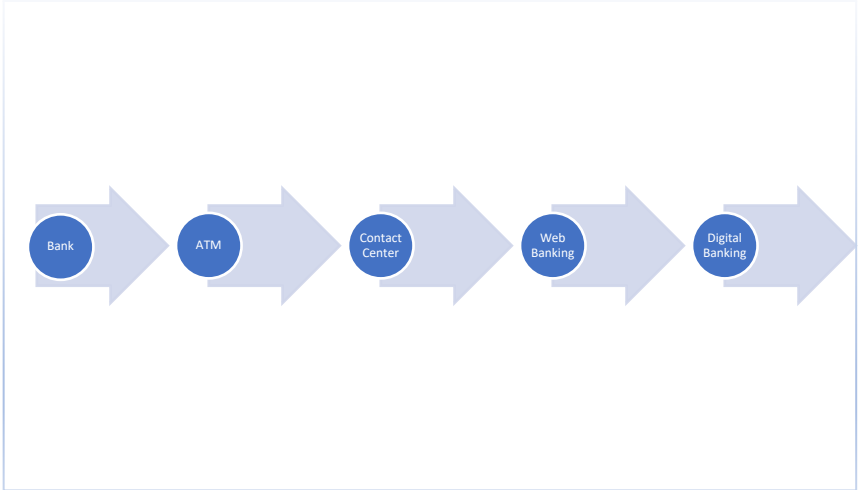

Fig. 1: Personal editing

Banks and credit institutions were created as systems for deposits and money transfers but also for granting loans for both individuals and companies[9]. It was the traditional banking model, based on the offering of cutting-edge services thanks to the network of branches present in the area and with a degree of vertical integration. The common

[7] Il Sole 24 Ore, Trasformazione digitale nel settore bancario: strategie innovative per un nuovo presidio territoriale, di Vicenzo Fiore, 4 dicembre 2023: https://www.ilsole24ore.com/art/trasformazione-digitale-settore-bancario-strategie-innovative-un-nuovo-presidio-territoriale-AFbRduuB

[8] Intesa, Come cambiano le modalità di interazione tra banca e cliente retail, *www.intesa.it*

[9] it is a concept that has been present since ancient times, just think of the time of the Babylonians or the ancient Greeks as they used the times as a place for lending and exchanging money. Le prime forme di attività bancaria: https://it.wikipedia.org/wiki/Storia_del_settore_bancario

objectives of the banks were linked to standardization, compliance with current banking, economic and financial regulations and the internal industrialization of processes. In the Italian banking system, the branch network has developed in a large number (56 branches per 100.000 inhabitants) compared to the European average (45 branches), also thanks to the concentrations of different market players[10].

The habits of banking customers have changed radically. Technology began to be used to obtain advantages in terms of efficiency and in the 1970s cash dispensers were introduced, today known as automatic teller machines or ATMs, initially placed inside the branches and over time distributed throughout the territory. Immediately afterwards, POS (Point of Sale) were created which had the function of transferring transactions from bank staff to customers. The advantages were seen in the efficiency of not wasting time and resources and in the reduction of costs while maintaining high quality standards of the products. processes and products offered.

The call center service was subsequently created, i.e. a new remote branch which required a new operational structure where customer data and information were received by the branch itself but which at the same time managed to satisfy remote needs.

Starting from the 1980s, first in the United States and then in the rest of the world, the concept of electronic banking was established which changed the processes and methods of execution by combining traditional models with the search for the efficiency and effectiveness of innovative services . We are starting to talk about Remote Banking, i.e. those automated services that allowed users to connect via transportable interactive terminals or while staying in offices or homes[11].

This new phenomenon, however, could not allow the traditional banking to be set aside but rather favored cooperation and adaptation.

[10] KPMG, Advisory: Sportelli bancari e nuovi modelli distributivi, Febbraio 2017: https://assets.kpmg.com/content/dam/kpmg/it/pdf/2017/02/KPMGSportellibancarinuovimodellidistributivi.pdf

[11] Intesa, Come cambiano le modalità di interazione tra banche e clienti retail: www.intesa.it

In the early 2000s, social media, cutting-edge communication services and the cloud were developed, which resulted in the change in the needs of customers who need to receive the same service elsewhere or outside branch hours. From this moment on, banking institutions had to review their strategy using an approach focused on attracting customers through "home banking10" which is free and easily accessible thanks to mobility. Simultaneously with the period there is the spread of electronic payment systems which over the years is reducing the circulation of cash especially among the younger population. it is highlighted that from 2005 to 2011 the number of users using credit, debit and prepaid cards increased by 35%, going from 50 million to 67 million. This trending increase goes hand in hand with the creation of ATMs, Automatic Teller Machines, and POS (Point Of Sale) stations at participating merchants[12]. The Government's maneuvers have contributed to the spread of digital payments and internet banking on the one hand with the Economic Development decree of January 2014 which required, by June 2014, commercial establishments to equip themselves with a POS for payments with credit cards debit, credit and prepaid. Furthermore, to encourage this payment system and to reduce tax evasion, it imposed the limitation of cash initially with a ceiling of 3,000 euros and from July 2020 raised to 2,000[13]. On the other hand, we have witnessed the entry of new financial operators who have expanded the "basic" payment instruments. Just think of PayPal, or rather an online payment service that allows companies and consumers to send and receive money easily thanks to their device, email address or Google Wallet without a credit card. The entry of new operators has expanded the range of advanced payment instruments currently on the market.

There have been two evolutionary phases of virtual banking:

• the first until the mid-1990s involves the transition from traditional banking to online banking. During this phase, banks began to offer basic services online, such as viewing

[12] KPMG, Digital Banking Report, 2018:
https://assets.kpmg.com/content/dam/kpmg/it/pdf/2018/07/KPMG-Digital-Banking-2018.pdf

[13] Ministero dello sviluppo economico, Decreto 24 Gennaio 2014, Definizioni e ambito di applicazione dei pagamenti mediante carte di debito. (14A00618) (GU Serie Generale n.21 del 27-01-2014):
https://www.gazzettaufficiale.it/eli/id/2014/01/27/14A00618/sg

balances, viewing transactions, bank transfers and bill payments. Customers could access these services via a computer connected to the Internet by entering their login credentials.

• The second evolutionary phase saw the development and diffusion of mobile banking apps. Mobile banking apps have made banking services even more accessible by allowing customers to manage their accounts directly from their mobile devices. In addition to the basic services available at online banking, mobile banking apps often offer additional features such as photo check deposit, biometric authentication, and personalized push notifications.

These phases marked a significant transformation in the banking sector, reducing dependence on physical branches and offering customers greater flexibility and convenience in accessing banking services. The continued evolution of virtual banking also includes the development of new technologies, such as artificial intelligence and blockchain, to further improve the customer experience and operational efficiency of banks[14].

1.2 The Pre-Fintech Period

The term Fintech arises from the contraction of the words "finance" and "technology" and can be translated into the generic formulation “technology applied to finance” (European Central Bank, 2017). There is, however, no single definition of “Fintech” recognized globally; therefore, all digital innovations in the financial sector are considered Fintech, regardless of which actor develops and provides the product or service.

The pre-fintech period refers to the period before the explosion of fintech companies, i.e. those companies that use technology to offer innovative financial services. This period is characterized by the predominance of traditional financial institutions, such as banks and

[14] Internet e il settore bancario. Introduzione ai servizi bancari evoluti. Virtual Banking: una definizione di banca virtuale: www.performancetrading.it

credit unions, which offered financial services through traditional channels such as bank branches, ATMs and telephone services.

During the pre-fintech period it is possible to observe:

Domination of traditional financial institutions: Traditional banks and financial institutions dominated the financial sector, offering a full range of banking, insurance and investment services. These institutions were often characterized by complex structures, bureaucratic processes and relatively long response times.

Limited service options: Customers had access to a limited number of service options, primarily through bank branches and automated teller machines (ATMs). The availability of banking services was limited to branch opening hours and often required the physical presence of the customer.

Manual Processes and Paper Money: Banking processes were largely manual and based on paper money. Customers had to fill out paper forms to open an account, apply for a loan or make a transfer. Financial transactions were often based on paper checks or cash.

Security and Regulation: The security of financial transactions was primarily managed through physical security controls and traditional banking regulations. Regulatory compliance was important, but monitoring and verification processes were largely manual.

Limited technological innovation: Although there were technological developments in the financial sector, such as the introduction of ATMs and electronic payment systems, technological innovation was limited and largely driven by traditional financial institutions.

The pre-fintech period was characterized by relative stagnation and resistance to innovation in the financial sector. However, the emergence of fintech has revolutionized this landscape, introducing a wide range of digital, agile, and customer-focused financial services that have fundamentally changed the way people access and manage their money.

Years after the financial economic crisis, the banking sector re-emerged in the market thanks to the adoption of new technologies and above all for having tried to manage the

risks due to evolution and new innovations introduced. The fintech sector has seen tremendous growth in recent years. In 2015, investors invested more than $19 billion in this sector. This is a 106% increase over the amount invested in 2014[15]. In 2015, venture capital-backed fintech companies received $13.8 billion in investments. This is six times more than in 2011. In 2016, Nasdaq also launched the Financial Technology Index, which tracks the performance of companies specializing in financial technology[16]. It is becoming increasingly clear that fintech is now an integral part of the financial landscape.

In this regard, banks had to try to remain competitive in the long term by adopting improved services, reducing costs, coming into contact with new possible investors but above all they had to be able to mitigate counterparty risks as well. The Fintech sector has had the opportunity to consolidate further following the loss of customer trust with banks, think for example of the bankruptcy of Veneto Banca in 2017[17], as in those years consumers began to look for the need for a new reality that it had been able to offer innovative solutions for the provision of financial services, for the management of personal assets but especially in those who place trust again. Since 2019 we started talking about FinTech 3.0, which is one of the most promising markets for private individuals, businesses, start-ups and investors worldwide but also in Italy. This trend in the banking-technology sector is only a framework compared to the current reality as today we hear more and more talk in newspapers of a real Fintech revolution or rather of a system of Fintegration[18] which is finally becoming a reality.

[15] KPMG & CB, "The Pulse of Fintech" in Review, Insight 11, 2016

[16] See T. Demos, "What's Fintech? Nasdaq and KBW Offer an answer with a new index", Wall St. J., 2016

[17] On Friday 23 June 2017, the European Central Bank (ECB) declared the two Veneto banks "failing or likely to fail". On the same day the Single Resolution Board (SRB) assessed that the conditions for resolution as per BRRD were not met. As a consequence, the two Veneto banks had to be wound down under normal insolvency proceedings at national level, under the responsibility of Banca d'Italia. On 25 June 2017 the two banks were wound down with the transfer of the performing business to Intesa San Paolo. European Parliament, The orderly liquidation of Veneto Banca and Banca Popolare di Vicenza, 23 June 2017:
https://www.europarl.europa.eu/RegData/etudes/BRIE/2017/602094/IPOL_BRI(2017)602094_EN.pdf

[18] La Fintegration è Finalmente realtà, Borsa del Credito, 23 dicembre 2020: www.lamiaFinanza.it

1.3 Definition and Sector's Characteristics

The fintech sector, short for "financial technology," refers to an industry made up of companies that use technology to innovate and improve traditional financial services. Fintech is fundamentally changing finance, from investment management to financing to forms of currency. In each of these areas, fintech innovations have reduced barriers to entry, expanded access to financial services, and challenged traditional notions of how finance works[19].

Key features of the fintech sector include:

Technological innovation: Fintech companies distinguish themselves by adopting cutting-edge technologies, such as artificial intelligence, blockchain, big data analytics and process automation. These technologies enable fintech to develop innovative solutions that improve operational efficiency and optimize the customer experience.

Focus on customer experience: Fintech put customer experience at the center of attention, designing user-friendly and intuitive solutions. Fintech platforms are often characterized by a simple user interface and streamlined processes, which minimize friction and improve customer satisfaction.

Agility and flexibility: Fintech companies are known for their agility and flexibility in adapting to market changes and customer needs. Unlike traditional financial institutions, which can be constrained by complex organizational structures and slow decision-making processes, fintech are able to respond quickly to emerging opportunities and technological developments.

Access to Financial Services: Fintech aim to democratize access to financial services, offering solutions that are more convenient, accessible and inclusive than traditional

[19] In response to these challengers, some traditional banks have attempted to acquire fintech companies or develop them in-house. In 2016 , for example, Goldman Sachs acquired Honest Dollar, an online retirement savings start-up, while JPMorgan created a program to "adopt" fintech start-ups, allowing them access to JPMorgan's facilities and expertise. See M. Mittelman, "JPMorganto Adopt Fintech Startupswith In-House Incubator",BLOOMBERG, 2016

options. This can include services such as digital payments, peer-to-peer lending, automated investing and microfinance.

Security and regulatory compliance: Despite the emphasis on innovation and technology, fintech pay particular attention to data security and regulatory compliance. Fintech companies must comply with rigorous data security and privacy standards, as well as financial regulations and regulations specific to the industry in which they operate.

Collaboration and partnerships: Fintech often collaborate with other companies, including traditional financial institutions, technology companies and financial services providers, to exploit synergies and access new market opportunities. Partnerships can enable fintech to broaden their service offerings, reach new customer segments and accelerate business growth.

A 2022 Gartner study highlighted and categorized Fintech companies based on the role played by the Fintech service in relation to incumbent financial services companies, dividing them into: complementor, catalyst and competitor[20].

Complementors are new services that work alongside those of incumbent financial services companies. They can only be used by the customer in conjunction with a traditional financial service and cannot be used alone. Examples of complementors are personal financial management companies, which aggregate customer account data from multiple financial institutions.

Catalysts are technology and service providers that help financial services companies compete in new markets or against new Fintech companies that are invading their business.

Finally, competitors compete for the same business as incumbent companies, and represent a threat and risk of permanent loss of business for incumbent operators. Competitors offer substitutes to traditional financial services that may vary in attributes, usage, back-end operations or distribution.

[20] Gartner, Understanding and Assessing Fintech Companies, 2021

Fintech companies can, however, not limit themselves to one of the three categories, in fact, as befits an emerging market, they can move or expand into other categories. For this reason, banks and traditional and consolidated banking networks are therefore forced to rethink their structure, organization and role, and to review their business models, as the innovations brought by Fintech have marked a increasingly glaring discontinuity with traditional finance, emerging as a disruptive factor for the latter. Furthermore, the applications of new technologies have been able to create products, services and business models that have significantly changed the financial ecosystem[21]. As you can see from figure 2 below, these innovations include both financial services and information technologies, affecting all sectors of banking and financial intermediation.

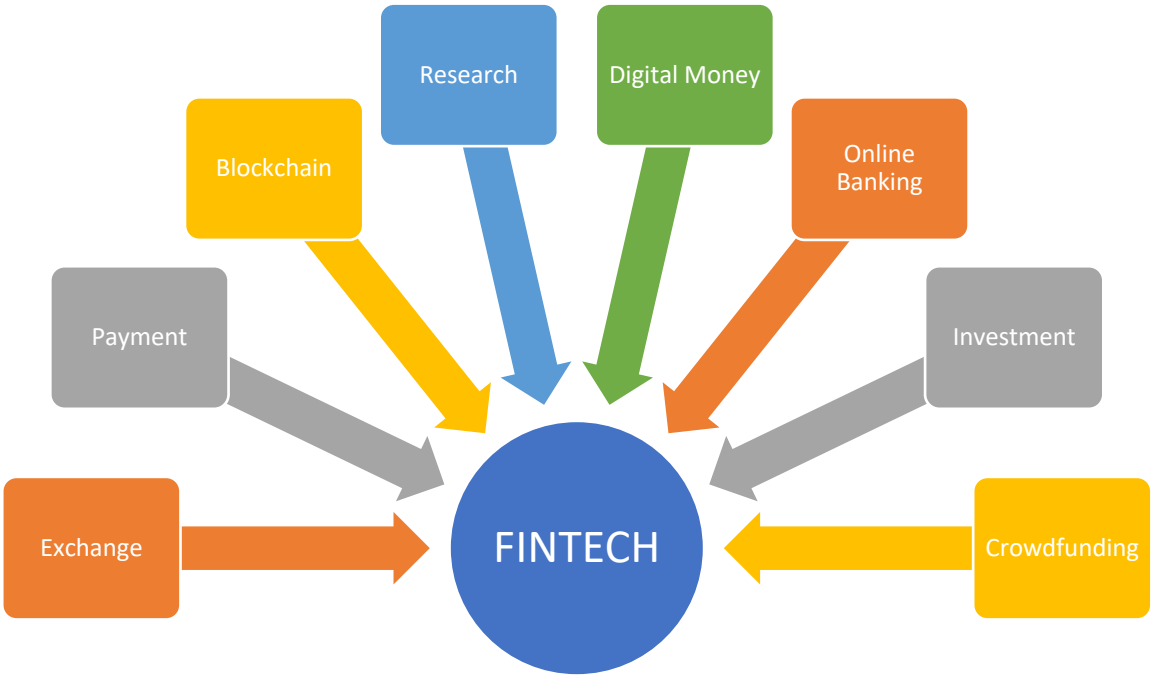

Fig.2. Personal editing

In other words, the way financial transactions are processed and the way interactions between participants in virtual financial markets take place will depend on established, or ongoing, technological and digital changes. Much depends on promoting the innovation that characterizes technology. Financial products based on technological phenomena such as artificial intelligence (AI), cloud computing, big data analytics or technological tools such as cryptoassets or smart contracts based on distributed ledger technology (DLT)

[21] Roberto Ferrari, 2016, L'Era del Fintech, La rivoluzione digitale nei servizi finanziari

make all this a reality[22]. This is often perceived as the FinTech revolution[23]; if you want to understand the existing situation, you can try to identify the current thinking of technology finance. This is related to the process of gradual digitalization of reality and dating of reality. that is, The generation, collection and processing of data generated by the realities that characterize today's society and more specifically modern finance (in other words, user access to digital technologies)[24]. These are phenomena that offer great potential in terms of economies of scale and network effects[25].

1.3.1 Digital Banking

Digital banking refers to the provision of banking services via digital channels such as websites, mobile apps, chatbots and automated telephone services. It is a key component of digital transformation in banking and offers customers fast, convenient and personalized access to financial services, without the need to visit a physical branch. Digital Banking is defined as the "sum" of online banking and mobile banking: Online Banking + Mobile Banking = Digital Banking[26].
Features of digital banking include:

Online access to bank accounts: Customers can access their bank accounts via an online portal or mobile app. They can check their balance, view transactions, monitor account activity and download statements.

Financial Transaction Management: Customers can perform a variety of financial transactions online, including bank transfers, bill payments, prepaid card top-ups, and account transfers.

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[22] V. Bevivino, “Il rischio sistematico generato dalla FinTech” in Il Nuovo Diritto delle Società, Fascicolo 3, 2023
[23] V. Cortina-Schmukler, “The FinTech revolution: a threat to global banking” in World Bank: Washington DC, 2028
[24] Buckley, Arner, Zetzsche, Selga, “Techrisk” in Singapore Journal of Legal Studies, 2020
[25] V. Bevivino, “Il rischio sistematico generato dalla FinTech” in Il Nuovo Diritto delle Società, Fascicolo 3, 2023

[26] E. Napoletano, Daphne Foreman, “What Is Digital Banking?” Forbes, 2021: https://www.forbes.com/advisor/banking/what-is-digital-banking/

Digital Payment Services: Digital banking allows customers to make digital payments in several ways, such as P2P (person-to-person) transfers, e-commerce payments, bill payments, and in-app purchases.

Mobile check deposit: Some digital banking platforms offer photo check deposit functionality, allowing customers to deposit a paper check using their mobile device's camera.

Digital customer support: Digital banking platforms often include digital customer support features, such as chatbots and virtual assistants, that provide immediate answers to customer questions and real-time assistance.

Advanced Security: Digital banking platforms integrate advanced security measures, such as two-factor authentication, biometric identification and suspicious transaction monitoring, to protect data and prevent fraud.

Personalization of the user experience: Digital banking platforms use data analytics to personalize the user experience, offering personalized suggestions, targeted promotions and financial advice based on customer behavior and preferences.

Integration with other fintech solutions: Digital banking platforms can integrate third-party services, such as personal financial management apps, automated investment platforms (robo-advisors) and mobile payment services, to broaden the service offering and improve the overall customer experience.

One of the main trends inherent in Digital Banking, which is dominating the Fintech sector today, is Buy Now, Pay Later: a service that allows users to purchase products available on e-commerce sites in installments. Specifically, the service is made available to users by specialized companies that manage operations on behalf of merchants (both online and physical), in order to incentivize the conversion rate and average customer cart. In fact, the advantage linked to Buy Now Pay Later is precisely that of minimizing

cart abandonments as well as increasing customer loyalty, and represents one of the fastest growing Fintech services of the moment[27].

1.3.2 Crowdfunding

Efficient capital allocation allows markets to function properly and directs funds and resources to the most valuable companies and entrepreneurs[28]. Therefore, the power to control the allocation process itself has fundamental implications for the economy as a whole[29]. This process has traditionally been led by large banks. They are the only company with the financial strength and market knowledge to successfully manage large-scale bond issues, IPOs and more[30]. However, fintech is starting to disrupt the fundraising business. This broke the banks' monopoly on both debt and equity financing and opened up new avenues for consumers and businesses to access capital. The most important innovation that fintechs have developed in fundraising is the precursor of crowdfunding.

Crowdfunding is a financing model that is based on the collection of funds from a large number of people, often via dedicated online platforms. This approach allows entrepreneurs, artists, non-profit organizations and individuals to raise funds for specific projects, initiatives or causes without having to resort to traditional financing channels, such as banks or private investors. The main features of crowdfunding include[31]:

Participation of a large network of people: Crowdfunding involves a large network of individuals, or "founders", who contribute financially to the project or initiative. These

[27] KPMG, Pulse of Fintech H2'21, January 2022: https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2022/03/pulse-of-fintech-h2-21.pdf

[28] B. S. Black, "The Legal and Institutional Preconditions for Strong Securities Markets", 48 UCLA L. REV. 781 (2001)

[29] F. Allen, "Stock Markets and Resource Allocation", in CAPITAL MARKETS AND FINANCIAL INTERMEDIATION 81, 95-97 (Colin Mayer & Xavier Vives eds., 1993) (explaining the relationship between market valuation and resource allocation)

[30] R. S. Thomas, S. J. Schwab & R. G. Hansen, "Megafirms", 80 N.C. L. REV. 115, 180-86 (2001) (describing the increasing market power in debt offerings and initial public offerings of a few investment banks)

[31] Banca D'Italia Eurosistema, Crowdfunding: https://economiapertutti.bancaditalia.it/chiedere-prestito/crowdfunding/

"founders" can be friends, family, supporters of the cause or simply individuals interested in the project.

Dedicated online platforms: Crowdfunding is often facilitated by specialized online platforms, where project promoters can create a crowdfunding campaign, describing the project, setting a funding goal and offering rewards or incentives for donations.

Different crowdfunding models: There are different crowdfunding models, including:

- Reward-based crowdfunding: Backers receive a reward or incentive in exchange for their donation. Rewards can be products, services, special recognition or exclusive benefits related to the project.
- Equity crowdfunding: Investors receive an ownership stake or shares in the company in exchange for their investment. This model is mostly used by startups to raise venture capital.

Debt-based crowdfunding: Investors provide financing in the form of a loan, which must be repaid with interest over time.

Transparency and accountability: Crowdfunding platforms promote transparency and accountability, allowing project promoters to communicate with supporters, update them on the status of the project and share the results achieved.

Diversification of funding sources: Crowdfunding offers project promoters an alternative way to raise funds, allowing them to diversify funding sources and reduce dependence on traditional investors or financial institutions.

Crowdfunding has revolutionized the way people can get funding for their projects, democratizing access to capital and allowing a wide range of ideas and initiatives to find support and financial sustenance from the online community.

1.3.3 Cryptocurrencies

Fintech has also innovated in an even more fundamental facet of finance-that is, the structure of currency itself. As Niall Ferguson said: “The rise of money was essential to the rise of man”[32]. Until now, the process of creating and distributing money was the responsibility of governments[33]. Fintech is starting to challenge this system, particularly through the invention of “cryptocurrency”.

Cryptocurrencies, or digital currencies, are decentralized digital currencies created on the internet and untied from common legal tender currencies such as the euro or the dollar. These are therefore "digital representations of value" not subject to issuance, guarantee or control by central banks or public authorities. They are generally issued by private issuers that use highly specialized software and, generally, blockchain technologies. They are stored within virtual wallets called e-wallets, and can be used as a means of exchange or held for investment purposes. When there is the consent of the participants in the transaction, they can be exchanged in peer-to-peer mode, that is, directly, without intermediaries, to purchase goods and services, as if it were a full-fledged currency. The cryptocurrency can be closed, one-way or two-way depending on whether or not it can be exchanged with an 'official' currency; for example, Bitcoin is a bidirectional virtual currency because it can be converted with the main official currencies and vice versa. Cryptocurrencies do not have commissions, offer greater speed and efficiency in payments and foreign remittances, and can be issued by anyone; therefore, it is possible to find thousands of virtual coins in circulation at the same time. According to Statista, there are currently around 6 thousand of them, the most widespread of which are: Bitcoin, Etherum and Litcoin[34].

The explosion of virtual currencies in recent years has drawn attention from regulators, who have concerns about the systemic implications of virtual currencies on the wider economy. But regardless of the eventual response of regulators to virtual currency, fintech

[32] N. Ferguson, “The ascent of money: A financial history of the world”, 2008

[33] An important exception can be found in the private bank notes issued during the so-called Free Banking Era in the United States from 1837 to 1863, during which individual banks would print notes that entitled holders to payment from the bank in gold or silver. See H. Rockoff, “The free banking era”, 1975

[34] La Nazione, Criptovalute cosa sono, vantaggi e rischi, 14 Dicembre 2021: https://www.lanazione.it/economia/criptovalute-cosa-sono-80d9d017

has already demonstrated the feasibility of decentralized, peer-to-peer online networks to disrupt fundamental features of the financial system, in this case currency itself. It suggests that fintech will continue to challenge many of the assumptions about the respective roles of banks, governments, and individuals in finance.

1.3.4 SupTech

SupTech is short for “supervisory technology,” a term that refers to the use of advanced technologies by financial regulators to improve oversight and compliance in the financial industry. Here are some of the features and applications of SupTech:

Automation of surveillance processes: SupTech uses technologies such as artificial intelligence, machine learning and big data analytics to automate the processes of collecting, processing and analyzing financial data. This allows regulators to more easily identify financial risks and monitor the activities of market participants in real time.

Data analytics and predictive models: Regulators use SupTech tools to analyze large amounts of financial data and identify patterns and anomalies that could indicate systemic risks or fraudulent behavior. Machine learning and predictive analytics help you spot trends and predict potential problems before they happen.

Compliance Monitoring: SupTech helps regulators monitor and ensure financial institutions' compliance with regulations and regulatory requirements. Automated monitoring technologies help identify violations and irregularities more quickly and efficiently, reducing the risk of fraud and abuse.

Reduce costs and response times: Automating supervisory processes through SupTech can reduce regulators' operational costs and speed up response times to financial emergencies. Advanced technologies enable more effective oversight and better allocation of resources.

Collaboration and data sharing: SupTech facilitates collaboration and data exchange between regulators, enabling more coordinated and synergistic oversight of the financial

sector. Data sharing platforms allow regulators to access crucial information in real time and cooperate in addressing common challenges.

A more detailed analysis about the SupTech Innovation will be held in chapter three.

1.3.5 Cybersecurity

The financial services sector is one of the sectors most exposed to cybersecurity risks due to increasingly stringent regulations and increasingly sophisticated threats. Therefore, it is important to adopt best practices to ensure the security of software that handles sensitive data and operations. FinTech firms, which provide digital financial services ranging from payments and lending to investment management and insurance, are attractive targets for cybercriminals[35] seeking to exploit vulnerabilities and gain unauthorized access to sensitive information. Fintech companies must implement robust measures to protect customer data, including encryption, access controls, and secure data storage practices. Compliance with data protection regulations such as GDPR (General Data Protection Regulation) is essential for handling personal data securely.

Firms should invest in secure IT infrastructure, including firewalls, intrusion detection/prevention systems, and secure network protocols, to defend against cyber threats such as malware, ransomware, and denial-of-service attacks.

Strong authentication mechanisms, such as multi-factor authentication (MFA) and biometric authentication, help verify the identities of users and prevent unauthorized access to accounts and financial services. Role-based access controls ensure that users have appropriate permissions and privileges based on their roles within the organization.

Fintech companies should follow secure software development practices, conduct regular code reviews, and perform vulnerability assessments to identify and address security flaws in applications and software platforms.

Developing and regularly testing incident response plans is crucial for fintech firms to detect, respond to, and recover from cybersecurity incidents effectively. This includes establishing communication protocols, coordinating with relevant stakeholders, and implementing measures to minimize the impact of security breaches.

[35] Skinner, "Cybercrime in the Securities Market: Is U.C.C. Article 8 Prepared?" in N.C. Law Review Addendum, 2012

Fintech companies operating in the financial sector must comply with industry-specific regulations and standards governing cybersecurity and data protection, such as PCI DSS (Payment Card Industry Data Security Standard) and FFIEC (Federal Financial Institutions Examination Council) guidelines. Compliance demonstrates a commitment to safeguarding customer information and maintaining the trust of stakeholders.
Human error remains a significant cybersecurity risk, so providing regular training and awareness programs to employees helps reinforce security best practices and promote a culture of cybersecurity awareness throughout the organization.
Fintech firms often rely on third-party vendors and service providers for various functions, such as cloud hosting, payment processing, and customer support. It's essential to assess and manage the cybersecurity risks associated with these third-party relationships through due diligence, contractually defined security requirements, and ongoing monitoring.

Veracode[36], a leader in intelligent software security solutions, has conducted research that shows the factors that influence cybersecurity in the fintech sector. It was shown that compared to the year 2022, the financial sector has the lowest percentage of applications with security flaws (72%). This is a decreasing percentage, but higher than the average for other sectors.

In summary, Veracode research shows that the financial services industry is leading the way in software security by adopting effective and innovative techniques. Automation, training and artificial intelligence are the three pillars of this strategy and reduce the risk of errors. However, with the advent of digitalization and datafication, technological risks, including those related to cybersecurity and data protection, can be considered a separate form of risk, beyond the traditional classification of operational risks[37].

[36] Veracode, "Report reveals automation and training are key drivers of software security for financial services", 2023: https://www.veracode.com/press-release/veracode-reveals-automation-and-training-are-key-drivers-software-security-financial
[37] V. Bevivino, "Il rischio sistematico generato dalla FinTech" in Il Nuovo Diritto delle Società, Fascicolo 3, 2023

1.4 The Risks of the New Technological Finance

Fintech has brought a wave of innovation and change to the financial sector. These changes are impacting nearly every financial sector, from asset management to capital raising to the form of money itself. However, this change also requires an overall reassessment of the adequacy of current financial regulation.

The new technological finance, or fintech, brings with it a series of risks, both for users and for the financial system as a whole. Here are some of the main risks associated with fintech[38]:

Data security: Since fintech relies heavily on the internet and digital platforms, there is a risk of data security breaches. Users' personal and financial information may be vulnerable to hacking, identity theft and other forms of cybercrime.

Fraud and manipulation: The use of advanced technologies such as artificial intelligence and blockchain has made it more difficult to detect and prevent financial fraud. However, there are still risks of fraud and manipulation, especially in cryptocurrencies and decentralized financial markets.

Insufficient regulation: The rapid growth of fintech has often outpaced regulators' ability to keep pace with innovation. This has created a fragmented and uncertain regulatory environment, which can expose users to consumer protection and financial stability risks.

Financial Exclusion: While fintech has the potential to democratize access to financial services, there is a risk that certain segments of the population may be excluded or disadvantaged from adopting advanced financial technologies. This can exacerbate economic and social inequalities.

Unsecured Deposits: Many fintech services, such as digital wallets and investment platforms, may not be subject to the same guarantees and deposit protections offered by

[38] Studio Balestreri, Quali rischi per la Fintech?, 10 Marzo 2018: https://www.studiobalestreri.it/articles/quali-rischi-per-lefintech/#/:~:text=Rischi%20connessi%20con%20parti%20terze,e%20volatilità%20della%20raccolta%20bancaria

traditional financial institutions. This means that users may be at greater risk of losing their funds in the event of business failure or data loss.

Lack of standardized rules: Because fintech is a relatively new and rapidly evolving industry, global rules and standardizations for consumer protection, data security and financial stability are often lacking. This can create confusion and uncertainty for users and companies operating in the sector.

Market Instability and Systemic Risk: Some forms of fintech, such as cryptocurrencies and decentralized financial markets, can be subject to extreme price fluctuations and instability. This can cause significant financial losses for investors and threaten the stability of the financial system as a whole.

Effectively addressing these risks requires a balance between technological innovation and the protection of users and the financial system as a whole. Regulators, fintech companies and users must work together to develop policies, procedures and technology solutions that mitigate risks and promote safe, inclusive and responsible fintech. The risks of new technological finance can have widespread impacts on a variety of actors within the financial system and beyond[39]. Among the main affected actors we can distinguish: End users, including consumers and businesses, who may be affected by risks such as data security breaches, financial fraud, loss of funds due to risky investments or failures of fintech platforms, and financial exclusion resulting from limited access to services fintech; Regulators may be challenged by the rapid evolution of fintech and the emergence of new financial technologies that may not be adequately covered by existing regulations. They may be faced with the task of protecting consumers and financial stability while promoting innovation; Traditional financial institutions may come under pressure from growing competition from fintech, risking losing customers to more agile and innovative fintech platforms. They may also be exposed to cybersecurity risks and adaptation to new business models; Investors may be exposed to risks arising from fintech market volatility, price manipulation, fraud and investment losses in fintech products or platforms that are not adequately regulated or managed; Risks arising from new technological finance can have impacts on the global economy, including financial

[39] ODCEC Roma, Fintech: l'evoluzione della finanza tra opportunità e rischi, a cura di Carlo Di Salvo, Dicembre 2018:
https://www.odcec.roma.it/index.php?option=com_wbmfm&format=raw&cod=MjQ4NTk=

stability and consumer confidence in financial markets. Financial crises or frauds in the fintech sector can have repercussions on the entire global financial system (Systemic Risk); The risks of new technological finance can have a broader impact on society and communities, including exacerbating economic and social inequalities due to financial exclusion or limited access to innovative financial services[40].

Therefore, as already mentioned, FinTech encompasses that phenomenon of innovation and change in the financial sector which affects almost all areas of finance, from asset management to capital raising up to the form of money itself, and which promises to bring significant benefits to the system technological and to society, facilitating the development of financial services and reducing their costs.

By highlighting these aspects, the positive and negative effects of a particular technological progress are highlighted. These are considered primarily, if not entirely, for the impact they may have on the cost, convenience or market access of the counterparties executing the transaction. This perspective necessarily overlooks the systemic importance of fintech as a potentially disruptive factor in the political structures underlying the functioning of today's financial system. This change therefore also requires an overall reassessment of the adequacy of current financial regulation. To do this it is necessary to identify the systemic risks with which the underlying system of technological phenomena is associated by their nature[41].

[40] CONSOB, Quaderni Fintech – La portabilità dei dati in ambito finanziario, a cura di A. Genovese e V. Falce, Aprile 2021: https://www.consob.it/documents/1912911/1933915/Fintech_8.pdf/8321ac83-ee16-dfb7-3f24-fa58ebc580d3

[41] V. Bevivino, "Too small to care: troppo piccolo per curarsene? L'individuazione del rischio sistematico generato dalla FinTech" in Il Mulino Rivisteweb, Fascicolo 1, Aprile 2023

CHAPTER 2

THE SYSTEMIC RISK

2.1 Definition of Systemic Risk

Although the financial system has grown in size and complexity over the years, its primary purpose has always been simple: to mediate between providers of capital and users of capital[42]. Efficient capital allocation is critical to the functioning of modern economies, and the health of the financial system is generally closely linked to economic growth[43]. However, like any market, the financial system does not always function correctly. Individual financial institutions pursuing their own private interests may impose costs on the public, perhaps due to underproduction of public goods, lack of relevant information, or the development of monopolies. In these cases, governments have an interest in intervening to correct inefficient behavior[44]. Financial regulation therefore aims to improve the functioning of the financial system, inter alia by correcting market failures, limiting externalities and protecting vulnerable parties. Given the centrality of the financial sector to economic growth, it is perhaps not surprising that financial regulation has long been characterized by a focus on systemic risk[45]. After all, much of the country's economic crisis was caused by the financial sector crisis. When a bank finds itself in financial difficulty, the problem affects the entire economy. This type of externality is a typical reason for government regulation, and as a result, financial regulation has been structured to minimize systemic risk.

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[42] Discussing the underlying policies and principles of financial regulation. See J. Armour, D. Awrey, P. Davies, L. Enriques, J. Gordon, C. Mayer & J. Payne, "Principles of financial regulation", 2016

[43] W. J. Magnuson, "Regulating Fintech" in Vanderbilt Law Review, Volume 71, 2018

[44] Discussing in more details the four main reasons for financial regulations. See A. S. Binder, "It's broke, Let's fix it: Rethinking Financial Regulation", 6 INT'L J. CENT. Banking 277, 2010

[45] See I. Anabtawi & S. L. Schwarcz, "Regulating Ex Post: How Law Can Address the Inevitability of Financial Failure", 92 TEX. L. REV. 75 (2013) (analyzing the implications of ex ante and ex post approaches to reducing financial systemic risk); R. C. Clark, "The Soundness of Financial Intermediaries",86 YALE L.J. 1 (1976) (describing the rationales underlying the regulation of risk at financial companies); C. K. Whitehead, "Reframing Financial Regulation", 90 B.U. L. REV. 1 (2010) (arguing that the principal issues that financial regulation is intended to address are market stability and risk-taking)

So, as we said, following the numerous crises that have hit the world economy in recent decades, but above all considering their intensity and persistence, scholars and supervisory authorities have focused their attention on a factor called systemic risk, which emerged rather recently, but of considerable importance for defining an effective crisis intervention and prevention policy. To fully understand systemic risk, its original causes, the ways in which it propagates and the consequences it draws, it is appropriate to try to give it a general definition.

The term "systemic risk" is a widely used but poorly understood concept. Systemic risk is generally understood as the possibility that an economic shock in one part of the financial system will cause a shock in other parts of that system. In other words, systemic risk, also known as market risk or non-diversifiable risk, refers to the inherent risk associated with the entire market or a particular market segment. It is the risk that cannot be diversified away through the process of portfolio diversification because it affects the entire market or a specific segment of it[46]. The ECB itself defines it as a risk of financial instability so widespread as to compromise the functioning of the financial system to the point where the real economy is concretely affected. Usually, when we talk about risk propagation, we mainly refer to the banking sector, as the banking system itself is an important channel in the spread of shocks to the entire economy, but other channels should not be overlooked either, such as insurance and hedge funds[47]. The idea that emerges is therefore the possibility that a "triggering event"[48] affects a part of the financial complex, and subsequently negatively extends to the entire system. For example, large banks are considered more exposed to systemic risk because their failure could have negative repercussions on other banks and financial institutions. Such institutions could then experience economic shocks of their own, leading to a decline in overall activity in

[46] According to the Capital Asset Pricing Model, in equilibrium two assets with the same expected return must also have the same systematic risk (measured by beta), although the overall risk (measured by standard deviation) of the two assets may be different. The reason for the possible difference between overall risk (the standard deviation) and systematic risk (beta) is that a portion of the overall risk of the business can be eliminated through diversification. The part of risk that can be eliminated through diversification is called diversifiable risk (or specific risk) and represents the peculiar risk of a specific company. On the contrary, there is a portion of risk that cannot be eliminated no matter how much investors diversify their portfolio, this risk is systematic risk. Approfondimento da parte di Borsa Italiana: https://www.borsaitaliana.it/borsa/glossario/rischio-sistematico.html

[47] N. Chany, M. Getmansky, S. Haas, and W. Lo., Systemic risk and hedge funds. MIT Sloan School of Management, 4535, 2005

[48] By "triggering event" we mean an event or a series of events that trigger or give rise to a financial crisis.

the economy, possibly a slowdown in macroeconomic growth and even a recession[49]. In defining the concept of systemic risk, we can refer to a sentence by Sheldon and Maurer in Interbank lending and Systemic Risk: an Empirical Analysis for Switzerland (1998), later taken up by De Bandt and Hartmann[50], which says: “Systemic risk are for financial market participants what Nessie, the monster of Loch Ness, is for the Scots: everyone knows and is aware of the danger. Everyone can accurately describe the threat. Nessie, like systemic risk, is omnipresent, but nobody knows when and where it might strike. There is no proof that anyone has really encountered it, but there is no doubt that it exist”.

When talking about systemic risk it is right to underline that there are different schools of thought and different interpretations. To better understand the various interpretations, I would like, on the one hand, to explain the concept of systemic risk developed by Professor Schwartz, the professor's definition is the one on which this paper is based, on the other hand I would like to explain a recent elaboration of systemic risk in context of artificial intelligence by the European Parliament.

The Council of the EU announces that it has approved, on 21 May 2024, the Artificial Intelligence (AI) Act[51], the so-called law on artificial intelligence, aimed at harmonizing the rules on artificial intelligence with a "risk-based" approach, meaning that the greater the risk of causing harm to society, the stricter the rules will be. It is the first of its kind in the world. Given the significant impact of AI on society and the need to build greater trust, it is essential to develop AI and its regulatory framework in accordance with the Union values enshrined in Article 2 of the Treaty on European Union (TEU) . Fundamental rights and freedoms enshrined in treaties and charters, pursuant to Article 6 TEU. The premise is that AI must be a human-centric technology. It is intended to serve as a tool for people, with the ultimate goal of improving their well-being. In order to ensure a high and continuous level of protection of the public interest in terms of health, safety and fundamental rights, it is appropriate to establish common rules for high-risk

[49] F. Allen & D. Gale, “Financial Contagion”, 108 J. POL. ECON. 1, 2000. (“One theory is that small shocks, which initially affect only a few institutions or a particular region of the economy, spread by contagion to the rest of the financial sector and the infect the larger economy”)
[50] O. De Bandt and H.P, Systemic risk: a survey. European Central Bank, 35, 2000

[51] REGOLAMENTO DEL PARLAMENTO EUROPEO E DEL CONSIGLIO che stabilisce regole armonizzate sull'intelligenza artificiale e modifica i regolamenti (CE) n. 300/2008, (UE) n. 167/2013, (UE) n. 168/2013, (UE) 2018/858, (UE) 2018/1139 e (UE) 2019/2144 e le direttive 2014/90/UE, (UE) 2016/797 e (UE) 2020/1828 (regolamento sull'intelligenza artificiale)

AI systems. These rules must be consistent with the Charter, non-discriminatory and consistent with the EU's international trade obligations. They should also take into account the European Declaration on Digital Rights and the principles of the Digital Decade, as well as the ethical guidelines for trustworthy AI from the High Level Expert Group on Artificial Intelligence (AI HLEG)[52]. The term "AI system" in this Regulation is clearly defined to ensure legal certainty, promote international convergence and widespread adoption and provide the necessary flexibility for rapid implementation, it is necessary to closely cooperate with the activities of international organizations that they deal with AI. technological development in this field. Furthermore, the definition should be based on the key characteristics of AI systems that distinguish them from traditional software systems or simpler programming approaches, and systems based on rules established exclusively by natural persons to perform operations automatically should not be included. A fundamental characteristic of artificial intelligence systems is the ability to reason. This inference capability is the process of obtaining outcomes such as predictions, content, recommendations, and decisions that can impact physical and virtual environments and deriving models and/or algorithms from inputs or data. Refers to the functionality of an artificial intelligence system. Techniques that enable inference when building AI systems include machine learning approaches that learn from data how to achieve a specific goal, and logic that draws inferences from encoded knowledge or symbolic representations of the task to be solved, and knowledge-based approaches. The inference capabilities of AI systems go beyond basic data processing by enabling learning, inference or modeling. The term “automation” refers to the fact that the operation of artificial intelligence systems requires the use of machines. The reference to explicit or implicit goals emphasizes that AI systems can operate according to defined explicit or implicit goals. The goals of an AI system may differ from the intended purpose of the AI system in certain situations. For the purposes of this rule, environment means the context in which an AI system operates, while the results produced by an AI system

[52] The European AI Alliance is an initiative of the European Commission to establish an open political dialogue on artificial intelligence. Since its launch in 2018, the AI Alliance has engaged around 6,000 stakeholders through regular events, public consultations and online forum exchanges. The AI Alliance was initially created to lead the work of the High-Level Expert Group on Artificial Intelligence (AI HLEG). The group's ethical guidelines and its policy and investment recommendations were important documents that shaped the concept of trustworthy AI, contributing to the Commission's approach to AI. This work relied on a mix of expert input and community-driven feedback.
Following the close of the AI HLEG mandate, the AI Alliance community continues to advance trustworthy AI by sharing best practices among members and helping AI developers and other stakeholders apply key requirements, through the ALTAI tool — a practical Trustworthy AI evaluation list. See more at Commissione Europea, “L’Alleanza Europea per l’IA” 2023

reflect the various functions performed by the AI system and include predictions, content, recommendations or decisions included. AI systems are designed to operate with varying degrees of autonomy. This means that AI systems have a certain degree of autonomy to operate through human intervention and can function even without human intervention. The adaptability that an AI system can exhibit after implementation refers to the self-learning ability that allows the system to change during use. An AI system can be used as an independent element (stand-alone), regardless of whether the system is physically integrated into the product (integrated) or supports the functionality of the product without being integrated (non-integrated or as a component of the product). Implementing a proportionate and effective framework for AI systems requires using a clearly defined risk-based approach. This approach aims to adapt the nature and content of these rules to the intensity and extent of the risks that AI systems may pose. Therefore, some unacceptable AI practices should be prohibited, requirements for high-risk AI systems and obligations for associated operators should be established, as well as transparency obligations for certain AI systems. A risk-based approach forms the basis for a proportionate and effective set of binding rules, it is important to remember the 2019 Ethical Guidelines for Trustworthy Artificial Intelligence, developed by the independent AI HLEG appointed by the European Commission. Within these guidelines, KI-HLEG has developed seven non-binding ethical principles regarding AI. These principles aim to ensure that AI is trustworthy and ethically valid. The seven principles include human intervention and surveillance, technical robustness and security, privacy and data governance, transparency, diversity, non-discrimination and fairness, as well as well-being and social and environmental responsibility . Without prejudice to the legally binding requirements of this Regulation and any other applicable provisions of Union law, those guidelines aim to support the development of coherent, trustworthy and human-centred AI, in accordance with the Charter and its values underlying development. According to the AI-HLEG guidelines, “human intervention and monitoring” means that artificial intelligence systems are developed and used as tools to serve human beings, respect human dignity and individual autonomy, and ensure that they are adequately monitored.

So, in summary, the new law aims to facilitate the development and implementation of safe and reliable AI systems in the EU internal market by both the public and private sectors. At the same time, respect for the fundamental rights of EU citizens should be

guaranteed and investment and innovation in the field of artificial intelligence in Europe should be encouraged. The AI Law applies only to areas covered by EU law, with exceptions, such as for systems used exclusively for military and defense purposes or for research purposes. The new law classifies different types of artificial intelligence based on risk. AI systems involving only limited risks are subject to very low transparency obligations, while high-risk AI systems are permitted but subject to different requirements and obligations to gain access to the EU market. Artificial intelligence systems such as cognitive behavioral manipulation and social scoring will be banned from the EU as their risks are deemed unacceptable. The law also prohibits the use of artificial intelligence in predictive policies based on profiling or in systems that use biometric data to classify people according to specific categories such as race, religion or sexual orientation. The Artificial Intelligence Law also addresses the use of general purpose artificial intelligence (GPAI) models. GPAI models that do not pose systemic risks are subject to some limited requirements, such as those regarding transparency, while models that pose systemic risks must comply with more stringent rules. These are systems that can be used for a variety of tasks. Some of them can cause system problems if used extensively. Systemic risks are threats to the proper functioning of European markets and the potential damage to values such as health, public safety and fundamental rights. These systems have special requirements: Creation of the technical documentation of the machine, its training process and evaluation of its results; Compliance with copyright law; Create and publish datasets used to train machines. The European Commission considers state-of-the-art AI models trained with more than 10^25 FLOPS of aggregate computational power to pose a systemic risk. This threshold is subject to change depending on technological developments in this field[53]. Once signed by the European Parliament and the President of the European Council, the legislation will be published in the Official Journal of the EU within a few days and will enter into force 20 days after publication. The new rules will apply for two years from their entry into force, with the exception of some provisions.

In this thesis, however, we will adopt the definition of systemic risk proposed by Professor Steven L. Schwarcz[54]. What the various definitions of systemic risk have in common is that a triggering event, such as an economic shock or systemic failure, triggers

[53] Di Redazione, "A.I Act: il orimo provvedimento normativo sul'Intelligenza Artificiale è Europeo" in Giurdanella, rivista giuridica, Marzo 2024
[54] Steven L. Schwarcz, "Systemic Risk", 97 *Georgetown Law Journal* 193-249 (2008)

a downward economic chain, also known as a domino effect. These consequences may include (chains of) financial institutions and market failures. Although less dramatic, these consequences can result in significant (series) losses for financial institutions or significant price fluctuations in financial markets. In both cases, the results affect financial institutions, markets, or both. Banks and other financial institutions (collectively, "Institutions") are an important source of capital. Therefore, it can deprive companies of capital and increase costs, especially if a large number of companies fail. The increase in the cost of capital or the decrease in the availability of capital are the most serious direct effects of system failure[55]. A bank's inability to meet withdrawal requests causes it to fail, which in turn causes other banks and their creditors to fail. The first failure occurs when depositors panic and the bank agrees to give them money. Because banks hold only a small portion of their deposits in cash reserves, they may not have enough liquidity to meet all withdrawal requests and may default and eventually go bankrupt[56]. Banks are closely intertwined financially, which could lead to further cascades of failures. They lend and borrow money from each other, hold deposits with each other, and make payments through the interbank clearing system (however, banks whose capital and deposit accounts exceed their debts must pay these debts to other banks that want to increase their loans. Surplus funds can be provided). Because of this interconnectedness, the failure of one bank to fulfill its obligations to another bank can negatively impact the ability of other banks to fulfill their obligations to other banks, both within and outside the banking chain[57]. While the series of bank failures remains an important symbol of systemic risk and disintermediation, which allows companies to bypass banks and other financial intermediaries and access capital markets as an ultimate

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[55] William J. McDonough, President, Fed. Reserve Bank of N.Y., Statement Before the United States House of Representatives Committee on Banking and Financial Services (Oct. 1, 1998), *in* FED. RES. BULL., Dec. 1998, *available at* http://newyorkfed.org/newsevents/speeches/1998/mcd981001.html (stating that the most important direct consequence of systemic risk brought on by a failure of Long- Term Capital Management would have been "increases in the cost of capital to American businesses"); *see also* E.P. DAVIS, DEBT, FINANCIAL FRAGILITY, AND SYSTEMIC RISK 117 (1992) (describing the worst consequence of systemic risk as "disrupt[ing] the payments mechanism and capacity of the system to allocate capital")

[56] R.W. HAFER, THE FEDERAL RESERVE SYSTEM 145 (2005) (observing that a bank's cash reserves are often less than five percent of its deposits)

[57] Kaufman, *supra* note 9, at 20; *see also* Ju¨rgen Eichberger & Martin Summer, *Bank Capital, Liquidity and Systemic Risk* 14 (Oesterreichische Nationalbank, Working Paper No. 87, 2004)

source of financing, continuing trends make these failures even more difficult Compared to the past[58]. Today, companies can obtain most financing through capital markets without the help of intermediaries. As a result, financial markets themselves have become the focus of systemic risk research. Systemic disruptions can occur outside the international banking system and spread through the linkages between banking relationships and capital markets[59]. Therefore, institutional systemic risk and market system risk should not be considered separately. In both cases, institutions and markets may be involved. Perhaps a better way to think about systemic risk is to focus on important financial intermediaries, such as banks, which are sometimes essential for lending to companies, and sometimes hedge funds, which are not financial intermediaries, or at least they are not on markets and institutions such as. Important financial intermediaries. This integrated perspective is useful because a series of failures at a key financial intermediary, by definition, has a significant impact on the availability and cost of capital. These failures are therefore implicit indicators of market impact. In contrast, a series of failures of financial institutions that are not significant financial intermediaries will have a significant impact on the availability and cost of capital only if the failure is large enough to threaten the sustainability of capital markets. Therefore, as disintermediation increases, systemic risk should increasingly be considered in terms of its impact on markets, rather than on financial institutions themselves.

At this point we can say with certainty that a characterizing factor of systemic risk is the extent of the shock, which to be defined as systemic must entail negative consequences on a good part of the financial system. Some common sources of systemic risk include: Changes in interest rates, inflation, economic recessions or expansions, political instability, changes in investor sentiment, natural disasters, global pandemics. In any case, whatever the initial event is, the spread of disruption between different institutions or markets requires close ties between them. Therefore, the second fundamental factor of

[58] Kaufman, *supra* note 9, at 20; *see also* Ju¨rgen Eichberger & Martin Summer, *Bank Capital, Liquidity and Systemic Risk* 14 (Oesterreichische Nationalbank, Working Paper No. 87, 2004)

[59] WESLEY B. TRUITT, THE CORPORATION 107–09 (2006). Firms often use capital markets to turn illiquid assets into cash. For instance, through securitization, banks can turn long-term mortgages into easily tradable securities. MEIR KOHN, FINANCIAL INSTITUTIONS AND MARKETS 381 (2d ed. 2004). Firms can also borrow more cheaply through bonds and commercial paper than they can from banks. *See id.* at 145

systemic risk can be defined as the "capacity"[60] of systemic risk to spread throughout the financial system through various transmission mechanisms (e.g. through information channels), thus causing a crisis of confidence in the system. For that reason, according to the Bank of International Settlements (one of the most important international financial organizations, the BIS, which aims to promote cooperation between central banks and other agencies in order to guarantee stability), systemic risk presents itself as a disorder that affects the mechanisms of the financial world causing its collapse and could potentially lead to a crisis through chain reactions that amplify friction and difficulties.

An important distinction to make is the difference between systemic risk and systematic risk. Systemic risk and systematic risk are both important concepts in finance, but they refer to different types of risk affecting financial markets and institutions. Here are the main distinctions between the two:

As said previously, Systemic risk refers to the risk of collapse of an entire financial system or entire market, potentially leading to a financial crisis. It is the risk that the failure of a single entity or group of entities could cause a domino effect, leading to widespread financial instability. Systemic risk affects the entire financial system or a large part of it, including banks, financial markets, and other financial institutions. Causes can include the failure of a major financial institution (e.g., Lehman Brothers in 2008), widespread defaults on loans, or major economic disruptions that lead to a loss of confidence in financial institutions. The 2008 financial crisis is a prime example of systemic risk, where the collapse of major financial institutions led to a global economic downturn. Mitigating systemic risk often involves regulatory measures such as stricter capital requirements for banks, improved risk management practices, and the creation of financial safety nets like government bailouts or guarantees.

On the other hand, Systematic risk, also known as market risk or non-diversifiable risk, refers to the inherent risk that affects the entire market or a large segment of the market. It is the risk of a loss due to factors that affect the overall performance of the financial markets. Systematic risk impacts all investments across the board, such as stocks, bonds, and other securities, and cannot be avoided through diversification. Causes include

[60] Faster Capital, Rischio sistemico quando i domino cadono – rischio sistemico e mercati finanziari, 12 Dicembre 2023: https://fastercapital.com/it/contenuto/Rischio-sistemico--quando-i-domino-cadono--rischio-sistemico-e-mercati-finanziari.html

macroeconomic factors such as changes in interest rates, inflation, recessions, political instability, and natural disasters. An example of systematic risk is the impact of a major economic recession on the stock market, where nearly all stocks might decline in value regardless of the individual performance of companies. Systematic risk cannot be eliminated through diversification, but it can be managed through various strategies such as asset allocation, hedging, and investing in securities with different risk profiles.

Understanding these distinctions is crucial for both investors and policymakers in managing and mitigating risks within financial systems and markets[61].

At this point, it seems useful to consider the importance of systemic risk in the context of technological financial activities. The issue of systemic risk posed by FinTech activities concerns the overall impact on financial stability determined by the activities themselves[62]. Some key sources of systemic risk in the fintech sector include:

Macroeconomic Factors[63]: Economic indicators such as interest rates, inflation, GDP growth, and unemployment rates can impact the fintech industry. For example, a recession or economic downturn may reduce consumer spending and investment, affecting fintech companies' revenue and growth prospects.

Regulatory Environment: Changes in regulatory policies and compliance requirements can have a significant impact on fintech firms. For instance, stricter regulations related to data privacy, financial transactions, or consumer protection may increase compliance costs and limit the ability of fintech companies to operate or expand their services[64].

Technological Disruption: While fintech companies thrive on innovation and technological advancements, they are also exposed to systematic risk arising from rapid changes in technology. Disruptive technologies, cybersecurity threats, or infrastructure failures can impact the entire fintech ecosystem and undermine trust in digital financial services.

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[61] L.P. Hansen, Challenges in Identifying and Measuring Systemic Risk, November 2012: https://www.nber.org/system/files/working_papers/w18505/w18505.pdf
[62] V. Bevivino, Il Rischio Sistematico generato dalla FinTech, fascicolo 3|2023
[63] L.P. Hansen, Challenges in Identifying and Measuring Systemic Risk, November 2012: https://www.nber.org/system/files/working_papers/w18505/w18505.pdf
[64] V. Bevivino, Il Rischio Sistematico generato dalla FinTech, fascicolo 3|2023

Global Events and Geopolitical Risks: Fintech companies operating on a global scale are susceptible to geopolitical tensions, trade disputes, and international conflicts. Events such as trade wars, Brexit, or geopolitical instability in key markets can create uncertainty and volatility, affecting fintech firms' operations, partnerships, and expansion plans[65].

Systemic Financial Risks: Fintech companies that provide payment processing, lending, or investment services may be exposed to systemic risks within the broader financial system. These risks include market liquidity, credit risk, counterparty risk, and systemic financial crises that can impact the stability and functioning of the fintech sector[66].

Overall, while FinTech offers opportunities for innovation and growth, investors and stakeholders need to be aware of the systematic risks inherent in the industry and implement risk management strategies to mitigate their impact on fintech businesses and investments.

2.2 The Origin of Systemic Risk

After having provided a general framework for the various definitions of systemic risk, we will now delve deeper into the concept by analyzing the two main phases: mechanisms of initiation and diffusion of the shock.

To understand how systemic crises emerge and develop, it is necessary to focus on the key factors typically defined as the four Ls of financial crises: liquidity, leverage, losses and linkages[67]. These characteristics must be considered from the point of view of both the individual institution and, more generally, the system itself. Before considering the factors that characterize the development of a systemic crisis, it is necessary to distinguish between situations of financial "instability" and situations of financial "suffering". According to a 2009 study by Borio and Drehmann, the latter can be defined as an event

[65] Baomin Chen & Xinyun Yang & Zhenzhong Ma, 2022. "Fintech and Financial Risks of Systemically Important Commercial Banks in China: An Inverted U-Shaped Relationship," Sustainability, MDPI, vol. 14(10), May 2022

[66] BCE Banca Centrale Europea, via Financial Stability Review, The Concept of Systematic Risk, December 2009: https://www.ecb.europa.eu/pub/pdf/fsr/art/ecb.fsrart200912_02.en.pdf

[67] C. Aymanns, J.D. Farmer, A.M. Kleinnijenhuis, T. Wetzer, Book of Computational Economics, Chapter 6 – Models of financial stability and their application in stress tests, 2018: https://www.oecd.org/naec/new-economic-policymaking/models_of_financial_stability_and_their_application_Farmer.pdf

in which the failure of multiple financial institutions, or in any case a situation of significant hardship, can have a serious impact on the real economy. Financial instability, on the other hand, can be described as a situation where the entire system is vulnerable. Therefore, a financial shock of normal intensity is sufficient to cause a crisis of considerable size[68]. For this reason, system stability is globally considered a fundamental objective on which to base the macroprudential policy of the financial complex.

2.2.1 Interconnections – Linkages

As explained previously, the financial market is made up of numerous and complex interconnections which create an intense network of links between the various institutions, which by operating efficiently can establish a virtuous circle of liquidity and information, which guarantees the smooth functioning of the system.

However, we also mentioned that, in periods of financial imbalance, these links can put the entire system at risk, since they act as a conduit for the spread of the systemic crisis and the consequent negative effects. Some research[69] on the relationship between financial network structure and systemic risk suggests that there is a critical threshold that represents the magnitude of negative shocks affecting financial institutions and that, as interbank liability structures become more diversified, financial institutions have greater system stability. However, as mentioned above, beyond this threshold the denser network of connections acts as a shock propagation mechanism, making the system more vulnerable.

Correlations between financial institutions can arise from both balance sheet assets and balance sheet liabilities. Links within assets can arise, for example, from credit agreements on the interbank market or from holding positions with similar portfolio exposures. However, when it comes to debts, relationships often arise because they are shared by the same depositors.

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[68] C. Borio, M. Drehmann, Assessing the risk of banking crises – revisited, BIS Quarterly Review (2009)

[69] D.MAcemoglu, A. Ozdaglar, A. Tahbaz-Salehi, Systemic risk and stability in financial markets in "America Economic Review", 2015

To give an overview of what has been explained, one can think of the phenomenon of the so-called "Bank run". Bank run[70] is a phenomenon that occurs when multiple bank customers go to a financial institution at the same time to withdraw the money they have deposited. This phenomenon is typical of many financial crises and arises from the fear that the bank in question will go bankrupt. We can therefore say that it is a reaction that arises from mistrust in the health of the organization.

The real danger of a Bank Run arises from the fact that banks often lack liquidity due to rapid withdrawals of sums deposited by customers, which can lead to the failure of even the most solid financial institutions. In fact, all banks use customer deposits for interest-bearing loans, so customer funds are not immediately available. It is no coincidence that several authors often mention the issue, in order to underline that trust is an essential precondition for market stability.

Another serious threat to financial markets is posed by its potentially systemic nature. The growing interconnectedness of today's financial system actually tends to turn individual banking crises into crises of the entire banking sector, a series of interconnected failures that can bring down the entire credit market infrastructure. Very often, central banks are questioned directly to avoid this. To prevent failure from becoming widespread, banks often have to intervene with direct guarantees or loans to banks affected by the crisis.

2.2.2 Too Big To Fail

After the financial crisis, attention to systemic risk has reached a very high level[71]. While there is still much debate about the root causes of the crisis, there is general consensus that the financial sector played a key role in creating unacceptably high levels of systemic

[70] Borsa Italiana, “Bank Run – La corsa agli sportelli per prelevare il proprio denaro depositato in banca”, 2013

[71] See Schwarcz, supranote 103, at 193 (describing the increasing attention to systemic risks and offering a conceptual framework for identifying them); Hal S. Scott, The Reduction of Systemic Risk in the United States FinancialSystem, 33 HARv. J.L. & PUB. POL'Y 671, 673 (2010) ("Going forward, the central problem for financial regulation (defined as the prescription of rules, as distinct from supervision or risk assessment) is to reduce systemic risk.")

risk[72]. However, in an interesting development, systemic risk has mainly been associated with a slightly different but similar concept: “too big to fail”[73].

"Too big to fail" is a term used to describe a situation where a company or institution has become so large, interconnected, and systemically important that its failure would have severe adverse effects on the economy and financial system, thus making it unlikely to be allowed to fail by the government or regulators.

Over the years the size of large banks has increased significantly, encouraged above all by deregulation and financial innovation, which have eliminated the rigid limitations on banking activity and have allowed both the geographical and operational expansion of banks[74].

Entities that are considered "too big to fail" play a crucial role in the functioning of the financial system or the economy as a whole. Their failure could lead to significant disruptions, contagion effects, and negative consequences for other financial institutions, markets, and the broader economy. Too big to fail institutions are often highly interconnected with other financial institutions, both domestically and internationally. Their failure could trigger a domino effect, spreading financial distress and instability throughout the financial system. These institutions are often complex in terms of their organizational structure, business operations, and financial products. Their failure could pose challenges for regulators and policymakers in managing the resolution process and mitigating systemic risks. Market participants and investors may believe that too big to fail institutions will receive government support or bailouts in the event of financial distress. This perception can create moral hazard by incentivizing excessive risk-taking behavior among these institutions[75].

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[72] For a sampling of the divergent views, see ALAN S. BLINDER, AFTER THE MUSIC STOPPED: THE FINANCIAL CRISIS, THE RESPONSE, *AND* THE WORK AHEAD (2013); Ross GARNAUT & DAVID LLEWELLYN-SMITH, THE GREAT CRASH OF 2008 (2009); CARMEN M. REINHART & KENNETH S.

[73] *See* ANDREW ROSS SORKIN, TOO BIG TO FAIL: THE INSIDE STORY OF How WALL STREET AND WASHINGTON FOUGHT TO SAVE THE FINANCIAL SYSTEM-AND THEMSELVES (2010) (detailing the financial crisis on Wall Street and the concept of "too big to fail"); John Crawford, *Predicting Failure, 7* VA. L. & BUS. REV. 171, 173 (2012) (describing the problems of "hidden risk and bureaucratic inertia in the regulation of systemically important financial institutions")

[74] Fondo Monetario Internazionale, Report 2014

[75] J. Armour, D. Awrey, P. L. Davies, L. Enriques, J. N. Gordon, C. P. Mayer, J. Payne, “Principles of Financial Regulation”, Oxford University Press, 2016

Examples of entities that have been considered "too big to fail" include large banks, insurance companies, and other financial institutions whose failure could have far-reaching implications for the stability of the financial system. During times of financial crisis or distress, governments and regulators may take measures to prevent the failure of these institutions, such as providing financial assistance, facilitating mergers or acquisitions, or implementing temporary regulatory interventions[76].

The concept of "too big to fail" has been a subject of debate and criticism, as it can create moral hazard, distort market incentives, and lead to unequal treatment of financial institutions. Efforts to address "too big to fail" risks have included regulatory reforms aimed at enhancing financial stability, improving risk management practices, and establishing resolution mechanisms for failing institutions.

Among the most emblematic State interventions, we remember the Paulson plan[77], defined to deal with the 2007 American financial crisis. This bailout plan, known as TARP, initially provided for $700 billion, destined for the main American banks, including JP Morgan, Goldman Sachs and Bank of America.

Dodd-Frank was the most far-reaching financial regulatory reform since the Great Depression. And while the law addresses nearly every imaginable aspect of modern finance, from creating new regulators to strengthening consumer protections to new laws governing the conduct of credit rating firms, it also reforms much of the "too big to fail" problem". Dodd-Frank takes three general approaches to solving the "too big to fail" problem[78]. The first set of approaches aims to prevent the creation of such institutions in the first place by prohibiting certain concentrations of assets and liabilities within the same enterprise. The second set of approaches aims to regulate the behavior of "too big to fail" institutions and reduce the risks and costs associated with them. For example, by monitoring their behavior more closely and limiting risky behaviors. The third set of approaches eliminates the perverse incentives created by the perception that financial institutions are "too big to fail" by preemptively tying the government's hands to prevent it from bailing out failed financial firms.

The close relationship between systemic risk and being "too big to fail" has been described in academic commentary on financial regulation. Much of the recent research

[76] J. Armour, D. Awrey, P. L. Davies, L. Enriques, J. N. Gordon, C. P. Mayer, J. Payne, "Principles of Financial Regulation", Oxford University Press, 2016

[77] Milano Finanza, "Ora il piano Paulson è legge", Numero 198 pag. 7 del 4 Ottobre 2018

[78] R. Johnston, "Did Dodd-Frank end "Too big to fail"?", Banking Policy Review Federal Reserve Bank of Philadelphia Research Department, 2016

on financial sector reform has focused on the risks that large financial institutions pose to the economy in the as a whole and on the mitigation of systemic risk, mainly as a matter of institutional dimension. This body of research argues that large financial institutions represent the greatest threat to financial stability for several interconnected reasons Financial institutions inevitably incur higher costs when they fail or face adverse circumstances. The failure of a bank with $1 billion in deposits will cost more than the failure of a bank with millions of dollars, even if all other banks do[79]. Second, major financial institutions have relationships with multiple parties, so when a failure or large loss occurs, the event spreads and affects multiple parties. Large financial institutions are therefore likely to impose higher costs on the economy as a whole than smaller financial institutions, both in terms of size and interconnectedness[80]. Third, and finally, large financial institutions are likely to be involved in the introduction of regulation, with regulators turning a blind eye or, even worse, legalizing banks' risky behavior altogether[81]. Through lobbying and the revolving door phenomenon, large banks exert significant influence on governments and therefore have the ability to significantly influence the content of regulations as they are designed and enforced. Indeed, regulatory control by big banks is the obvious explanation for the financial crisis. For all these reasons, the existing literature treats systemic risk more or less as a “too big to fail” phenomenon. According to this conventional wisdom, large financial institutions are prone to both risky actions and bad outcomes. It is therefore not surprising that systemically important financial institutions have become the focus of legislative and regulatory attention in recent years.

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[79] See Krishnamurthy, supra note 7, at 14 (noting that "the presence of large, interconnected, systemically important banks ensures that the externalities from their failure will be large")

[80] See Gordon & Muller, supra note 7, at 154 ("The failure of a large financial firm may threaten others both because financial firms are interlinked and because firms following similar business strategies are likely to sink together.").

[81] 154. See Adam J. Levitin, The Politics of Financial Regulation and the Regulation of Financial Politics: A Review Essay, 127 HARv. L. REV. 1991, 1995-2037 (2014) (describing regulatory capture during the financial crisis)

2.2.3 Leverage and Losses

One of the factors that facilitates the occurrence of systemic crises is the level of debt of financial institutions within the system. The latter is characterized by the maturity difference between assets and liabilities, also known as "maturity mismatch". This asymmetric structure means that financial institutions are exposed to financing risk. Greater difficulties arise when funding sources are scarce, for example when funds are illiquid or when borrowing from other funds becomes too expensive.

Leverage[82], or in Italian “effetto Leva”, is an indicator of the degree of indebtedness of an institution in relation to its entire volume of activities, more precisely it is defined as the ratio between total assets and equity capital.

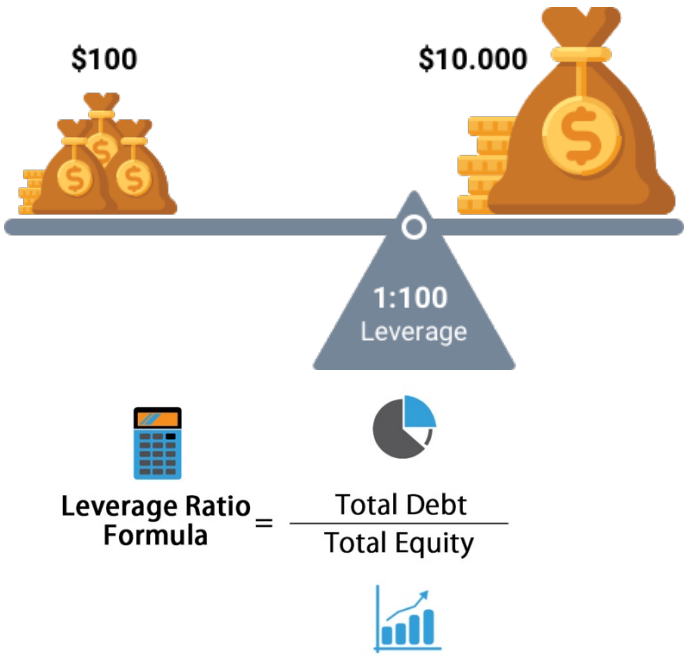

Fig.3: IFC Markets

This measurement tool allows you to understand the percentage of invested capital in your total investment. The Basel Accord[83] sets a maximum threshold for this ratio at 33.33, above which the system's financial institutions risk serious defaults if they do not

[82] Forbes, “Cos’è la leva finanziaria?”, 2024: https://www.forbes.com/advisor/it/investire/leverage-leva-finanziaria/#:~:text=La%20leva%20finanziaria%20o%20leverage,contratti%20attraverso%20i%20fondi%20raccolti.
[83] Accordi di Basilea 3

have sufficient capital reserves. The widespread use of leveraged financing methods has exacerbated systemic risk. This is because leverage generally increases profits during good times, but leads to losses and damage in the event of shocks or adverse economic conditions. The suffering is amplified.
Therefore, we can once again emphasize the importance of this element. This element represents one of the main mechanisms for creating loss synergies within the system and therefore transmitting crises.
The relationship between leverage and losses is particularly relevant because leverage can exacerbate the impact of losses. When investors or businesses use leverage to amplify their positions, even a small decline in the value of their investments or assets can lead to significant losses, potentially exceeding the initial capital invested. This phenomenon is known as leverage magnification or leverage risk.

2.3 Diffusion of Systematic Risk

Now that we know that crises are often caused by problems of liquidity and debt levels, we will now analyze in more detail the mechanism of shock propagation.
Two main diffusion channels can be distinguished: the "direct exposure channel" and the "information" channel[84], which can function together or separately. The first refers to the theme of connections and relationships that are established within the system between financial intermediaries. Information channels, on the other hand, refer to the problem of information asymmetry and the incorrect interpretation of market signals. These are important aspects for the final decision on a financial intermediary.

The concept of contagion comes directly from science[85]: "Contagion is the mechanism by which an infectious agent is transmitted from a source to a susceptible target." In the financial context, "infectious agent" can be translated as the initial shock, the source of the infection. The first infected person becomes the laboratory and the receptor becomes the next in the chain.

[84] S. Eickmeier, T. Ng, written fro EABCN Euro Area Business Cycle Network, “How do credit supply shocks propagate internationally?”, n. 8720, 2011
[85] Treccani, Contagio, in “Universo del corpo”, 1999

2.3.1 Domino Effect

The internal balance of the financial situation of financial institutions is a fundamental element that must be maintained to improve the functioning of the system. However, financial institutions' attempts to avoid solvency and liquidity problems can be a major cause of "infection".

The "domino effect" is a concept that describes the sequential propagation of an event through a series of causes and effects, similar to the phenomenon of a set of dominoes falling one after the other following the movement of the first tile. In the financial and economic sphere, the domino effect refers to the spread of a negative event through an interconnected system of markets, financial institutions or sectors of the economy, leading to knock-on consequences.

To illustrate this phenomenon, let's consider the example[86], illustrated by figure 4, of two banks where the first bank received a loan from the second bank.

Bank 1 has borrowed from Bank 2. Bank 2 has other assets, as well as its loans to Bank 1. Suppose that Bank 2 suf- fers credit losses on these other loans, but that the creditworthiness of Bank 1 remains unchanged. The loss suffered by Bank 2 depletes its equity capital. In the face of such a shock, a prudent course of action by Bank 2 is to reduce its overall exposure, so that its asset book is trimmed to a size that can be carried comfortably with the smaller equity capital.

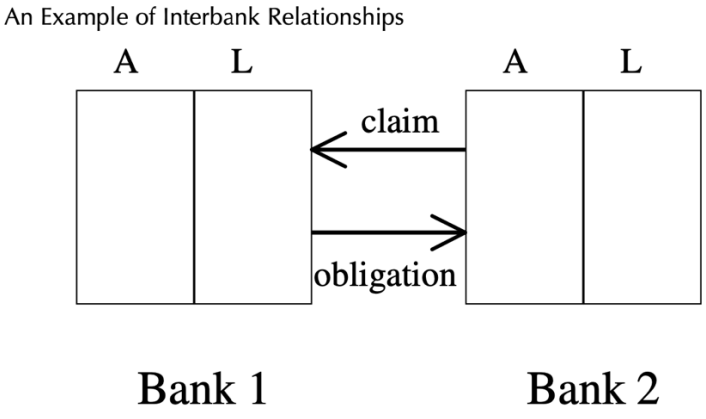

Fig. 4: The Fundamental Principles of Financial Regulation", Geneva Reports on the World Economy 11, Preliminary Conference Draft, 2009

[86] Geneva Reports on the World Economy, "The fundamental principles if financial regulation", 2009

Broadening our horizons, we must consider that in the interbank market the above-mentioned examples are connected for numerous institutions and develop further, creating a dangerous network of dependencies. This process represents a domino effect and is the basis of the "financial contagion theory"[87].

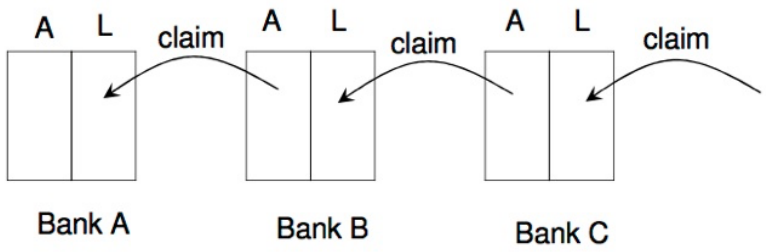

Fig.5: The Fundamental Principles of Financial Regulation", Geneva Reports on the World Economy 11, Preliminary Conference Draft, 2009

The domino effect model has been tested in numerous simulation studies conducted at central banks[88], with the general conclusion that the impact of the domino contagion model is very small. Only in the case of an incredibly large shock will the simulation lead to significant contagion.

Here are some examples of how the domino effect can manifest itself:

Failure of financial institutions: The failure of a large financial institution can trigger a series of events involving other institutions interconnected through loans, investments or derivative contracts. This can lead to panic among investors, freezing of credit and deterioration of confidence in the financial system.

Sovereign debt crisis: The deterioration of a country's finances can trigger a sovereign debt crisis, with negative effects on other European or global economies. The spread of the crisis can occur through financial markets, international capital flows and trade relations.

[87] F. Cusin, "Misure di Rischio Sistemico e Connettività nei Mercati Finanziari: Analisi del Mercato Europeo". PhD thesis, Università degli Studi di Venezia - Ca' Foscari, 2011-2012

[88] Geneva Reports on the World Economy, "The fundamental principles if financial regulation", 2009

Financial Contagion: A negative event in one financial market or geographic area can quickly spread to other markets or regions through financial contagion. For example, a banking crisis in one country can impact other countries' stock markets or currencies.

Global economic crisis: An economic or financial crisis in a key region of the world can have ripple effects on the global economy through international trade, capital flows, commodity prices and global supply chains.

To mitigate the effects of the domino effect, governments, financial institutions and regulators often adopt stabilization measures and emergency interventions, such as injecting liquidity into the financial system, strengthening regulation and supervision, or implementing policies expansionary fiscal and monetary policies. However, it is important to note that despite such measures, the domino effect can still have significant consequences on the economy and financial markets.

2.3.2 Growing Bubbles, Fads and Information Bubbles

However, the Domino Effect is not the only contagion mechanism, in fact in this paragraph we want to briefly report other contagion mechanisms in the form of examples of prices moving away from their fundamental value, discussed in 1989 by the American professor of behavioral finance, Colin Camerer[89].

Growing bubbles[90], in the context of finance and economics, refer to situations where the prices of assets, such as stocks, real estate, or other investments, become detached from their underlying fundamental values and continue to rise rapidly, often driven by speculation and investor exuberance. These bubbles can expand over time, inflating asset prices to unsustainable levels before eventually bursting, leading to sharp declines in prices and significant financial losses. The optimism provoked by the agents plays a

[89] Colin Camerer, "Bubbles and Fads in asset prices" in Journal of Economic Surveys, Vol.3 No.1 (1989)

[90] Olivier Blanchard, Mark Watson, "Bubbles, Rational Expectations and Financial Markets" in NBER Working Papers, No. 945 (1982)

fundamental role in the rise in prices, this optimism derives mainly from psychological and emotional, not rational, factors which convince the operators to continue and intensify the negotiations, in the expectation of a further increase in the value of the assets.
Examples of historical bubbles include the dot-com bubble[91] of the late 1990s, where internet-related stocks experienced a rapid rise in prices before collapsing in the early 2000s, as well as the housing bubble leading up to the global financial crisis of 2007-2008, where real estate prices soared before plummeting, triggering a severe economic downturn.
Here are some key characteristics and factors associated with growing bubbles:

Speculative Behavior: Growing bubbles are often fueled by speculative behavior, where investors buy assets primarily because they expect prices to keep rising rather than based on fundamental factors such as earnings or economic performance.

Lack of Fundamental Justification: As a bubble grows, the prices of assets become increasingly disconnected from their intrinsic values, making it difficult to justify the high valuations based on fundamental analysis.
Positive Feedback Loop: During the expansion phase of a bubble, rising prices attract more investors, leading to a positive feedback loop where increasing demand further drives up prices, reinforcing bullish sentiment and fueling the bubble.

Leverage and Easy Credit: The availability of easy credit and leverage can amplify the growth of bubbles, as investors borrow funds to invest in overvalued assets, magnifying both potential gains and losses.

Irrational Exuberance: Growing bubbles are often characterized by irrational exuberance, where investors become overly optimistic about the prospects of the asset or market, ignoring warning signs of overvaluation and assuming that prices will continue to rise indefinitely.

[91] A. Hayes, P. Williams, “Dotcom Bubble Definition” in Investopedia, 2023: https://www.investopedia.com/terms/d/dotcom-bubble.asp

Herd Mentality: Bubbles can also be driven by herd mentality, where investors follow the crowd without independently assessing the risks and fundamentals, leading to a self-reinforcing cycle of buying and price appreciation.

Recognizing and managing growing bubbles is important for investors, policymakers, and regulators to avoid excessive risk-taking, financial instability, and market crashes. Measures such as prudent risk management, increased market surveillance, regulatory oversight, and effective communication of risks can help mitigate the impact of growing bubbles on the economy and financial markets.

As a second example we can report the so-called "fads", definable as a deviation of average prices from intrinsic values caused by psychological or social forces, which generate a sort of temporary "fad" or enthusiasm, for example regarding political opinions or the consumption of certain products.[92]

Some examples of fads experienced in the last years, can include[93]:

- Fashion[94] fads such as bell-bottom jeans, neon-colored clothing or fidget spinners
- Cultural phenomena like Ice Bucket Challenge or the Harlem shake viral videos
- Consumer product such as Pokémon Go
- Social media such as hashtags, challenges and viral memes.

While fads can generate excitement, novelty, and cultural expression, they also pose risks for consumers, businesses, and investors. For consumers, participating in fads may lead to impulse purchases, overspending, or disappointment when the trend fades. For businesses, capitalizing on fads can be profitable in the short term but risky if demand collapses suddenly. For investors, investing in companies associated with fads requires careful consideration of market dynamics, competitive pressures, and long-term sustainability.

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[92] Robert Shiller, "Stock Prices and Social Dynamics" in Brookings Papers on Economic Activity, Vol.15, issue 2, pg. 457-510 (1984)

[93] M. Boorer, "Past promotional product fads that swept the nation", 2021: https://www.promotionproducts.com.au/blog/past-promotional-product-fads/

[94] M. Husain, "What are fads and why do they matter?", 2023: https://www.linkedin.com/pulse/what-fads-why-do-matter-mudassar-husain

Growing Bubbles and Fads are not necessarily independent of each other, but are often seen together, so it seems very difficult to distinguish between the two categories. However, it can be confirmed that Fads are generally irrational phenomena, while Growing Bubbles are based on the actions of rational or semi-rational actors. Furthermore, the latter are formed over a long period of time.

Finally, Camerer identifies a final category: information bubbles[95]. This occurs when the deviation of the price from the base value depends on the totality of information available on the market, and this arises from the fact that the market price does not fully reflect all the information available based on different economic opinions[96].

2.3.3 Externalities

A final note based on systemic risk concerns the so-called external effects, which play an important role in the diversification of risk globally and therefore in the central considerations of the regulatory process.
In economics, the term externality[97] indicates the repercussions, positive or negative, that the behavior of one subject causes on the well-being of another (or other subjects).
In this case, we consider the negative externality inherent in the financial dynamics of the increase in systemic risk. There are four main reasons for this negative effect in particular. The first reason is the so-called "information contagion"[98], that is, the rapid and widespread diffusion of information. This occurs especially in situations where financial intermediaries operate with strong asymmetries in the maturities of assets and liabilities. As we saw in chapter 2.3.1 dedicated to the Domino Effect, the failure of Bank A raises doubts about the solvency of Bank B, whose characteristics are considered substantially identical to Bank A. Therefore, depositors of Bank B lose confidence and withdraw their

[95] C. Camerer, "Bubbles and Fads in asset prices" in Journal of Economic Surveys, Vol.3 No.1 (1989)

[96] D. Friedman, M. Aoki, "Asset price bubbles from poorly aggregated information: A parametric example" in Economics Letters , Vol.21, issue 1, pg. 49-52 (1986)

[97] Treccani, "Esternalità" in Dizionario di Economia e Finanza, 2012
[98] M. Cipriani, A. Guarino, G. Guazzarotti, F. Tagliati, S. Fischer, "Il contagio informativo riprodotto in laboratorio" in Banca D'Italia Eurosistema, N. 1063, Aprile 2016

funds, creating liquidity problems for bank B and further jeopardizing its solvency. As for the 2007-2009 crisis, this occurred when the bankruptcy of Lehman Brothers quickly led to the end of the American real estate securities model (which forced Merrill Lynch to merge with Bank of America and which led to changes in Goldman Sachs and Morgan Stanley converting them to a simple bank). This suggests that, although the size of the institution affected by the shock plays an important role in the spread of negative information, it is not the only determining factor. Contagion, in fact, occurs when the impression is created that the failed banks are equal to each other and that consequently, being similar, the causes of the failure can be transferred. However, if the bank is considered unique and not similar to others, or if the causes that led to its failure are highly specific to that individual bank, then negative information is less likely to be transmitted.

The second external influence is a direct consequence of the first, as customers of the initially failed bank face greater difficulties in obtaining loans in the future. Banks therefore incur negative externalities related to the loss of some information on the connections between failed banks and their customers. This is because, according to Flannery's[99] model, in times of instability and uncertainty, banks receive incomplete information about the quality of potential borrowers. Banks are unable to assess the financial risk of potential new loans, so they are restricting their lending methods and standards. According to Stiglitz and Weiss[100], if banks set a very high average interest rate, first of all a problem of negative selection arises, as only the riskiest loan targets (logically those with the highest returns) maintain this rate. Low-risk investors will be unable to repay interbank debts and will be forced to exit the market. The second problem arises from the fact that the level of interest rates creates an incentive for the debtor to take on greater risk after signing the loan agreement.
If we think of bond clients in this model as financial institutions operating in the market, we can see how illiquid but solvent financial institutions can fail.

The third externality concerns the fact that many more transactions take place between banks and financial intermediaries than with other types of institutions. These interactions

[99] M. J. Flannery, “Financial crises, payment system problems and discount window lending” in Journal of Money, Credit and Banking, Vol. 28, 1996
[100] J. E. Stiglitz, A. Weiss, “Credit rationing in markets with imperfect information” in The American Economic Review, Vol. 71, 1981

concern not only the interbank market itself, but also the increasingly large derivatives market, including guarantees, CDS (credit default swaps), intermediation services, etc. The complexity of these relationships only increases the likelihood that risks will occur at a system level.

As a final externality we find that banks and financial intermediaries, instead of selling financial assets to restore liquidity and improve capital adequacy ratios, for example, rationing them with higher margins/cuts or increasing lending rates for loan disbursements , they may seek to limit new funding. This debt restructuring due to credit constraints generally causes a decline in production and prices, whether of goods, services or other goods in the economy. This increases the probability of default for all other borrowers. This creates another self-reinforcing spiral in which the credit crunch weakens the economy, leading to more defaults and falling asset prices, which in turn lead to an even bigger credit crunch.

In summary, financial institutions do not have to worry about how many other financial institutions will follow them in the event of bankruptcy. In particular, if a large, interconnected institution fails, the disproportionate risk of this negative impact will spread to other institutions. Furthermore, non-transparent market structures such as over-the-counter (OTC) markets will exacerbate these effects[101].
But perhaps what makes the situation worse than anything else is that the possibility of government bailouts[102] gives institutions an incentive to be "too big to fail" or, more precisely, "too connected to fail." The larger the organization, the stronger its ties to other organizations and the more likely it is to be rescued in a crisis. Simply put, the current system implicitly subsidizes the institutions responsible for the most negative externalities.

[101] Brunnermeier, "Deciphering the liquidity and credit crunch" in Journal of Economic Perspective, 2009
[102] J. Armour, D. Awrey, P. Davies, L. Enriques, J. Gordon, C. P. Mayer, J. Payne, "Principles of financial regulation", Oxford University Press, 2016

2.4 Regulatory Initiatives in Europe and Italy

The question of whether systemic risk should be regulated can be seen as a starting point for analysis into the question of whether financial risk should be regulated. Scholars argue that maximizing economic efficiency is the main[103], if not the only, justification for regulating financial risk[104]. These include "maintaining competition", "protecting investors from fraud and similar misconduct", preventing externalities (or encouraging those who cause externalities to internalize costs), and other market failures[105]. Since systemic risk is a form of financial risk, efficiency must be a key objective in regulating systemic risk. Without regulation, externalities caused by systemic risks are not prevented or internalized because market participants have an incentive to protect themselves rather than the system as a whole. No company has any incentive to limit risk taking to reduce the risk of contagion to other companies. This observation also applies to banks. Banks protect themselves (in the absence of regulation) but not the stability of the banking system[106]. Even if market participants could act collectively to prevent systemic risk, they may choose not to. This is because the externalities of system failure include social costs that can extend well beyond market participants. Therefore, market participants are not willing to internalize these costs and will not pay sufficient attention to avoid them. This results in a type of situation where the benefits arising from the exploitation of finite

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[103] Although scholars also view regulation through public choice theory, that is not a normative goal but, rather, a descriptive explanation of what actually occurs. "Public choice theory views regulation as the outcome of the efforts of interest groups, politicians, and bureaucrats to use the political process for their own personal benefit," generating regulations in the absence of market failures. RICHARD J. HER- RING & ROBERT E. LITAN, FINANCIAL REGULATION IN THE GLOBAL ECONOMY 82–83 (1995)

[104] See W. KIP VISCUSI, JOHN M. VERNON, & JOSEPH E. HARRINGTON, JR., ECONOMICS OF REGULATION AND ANTITRUST 9 (3d ed. 2000) (arguing that, where health and safety are not at issue, the rationale for regulatory policy is "foster[ing] improvements judged in efficiency terms"); Gillian K. Hadfield, Privatizing Commercial Law: Lessons from the Middle and the Digital Ages 58 (Stanford Law Sch., John M. Olin Program on Law and Econ., Working Paper No. 195, 2000), available at http:// papers.ssrn.com/sol3/papers.cfm?abstract_id□220252 ("The public value at stake in relationships be- tween commercial entities . . . is economic efficiency.")

[105] See DAVID GOWLAND, THE REGULATION OF FINANCIAL MARKETS IN THE 1990S 21 (1990). Regulating markets to correct market failure is sometimes referred to as the "public interest theory." Id

[106] See Rodrigo Cifuentes et al., Liquidity Risk and Contagion 17–18 (Bank of Eng., Working Paper No. 264, 2004), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id□824166 ("[W]hen choosing their portfolio allocation banks do not internalise the positive externalities that holding more liquidity has on the stability of the system. Therefore, the privately determined liquidity will be suboptimal.")

capital resources are given to individual market participants who seek to make the best use of their resources, while the costs of exploitation affecting the real economy are distributed everywhere. Although individual market participants may want to avoid the effects that systemic risks have on them, behavioral psychology suggests that these effects are very rare compared to other market risks, and therefore they are expected to ignore the effects of systemic risks[107] . For these reasons, regulating systemic risk is not only appropriate, but necessary[108].

Banking institutions, insurance companies and securities firms have always been highly regulated. Regulatory authorities, in fact, constantly try to define the boundaries within which the numerous functions covered by market participants must be performed. With respect to banking activity alone we find five main functions: credit, finance, investment, service functions and finally economic and social functions. Major global regulators, such as the Financial Stability Board and the Basel Committee, are seeking to limit the risks taken by financial intermediaries, including by increasing capital protection for banks. These institutions therefore limit possible market failures (such as the failure of Lehman Brothers in the 2008 financial crisis) and avoid the negative consequences that often arise from excessive use of leverage and unjustified grants of "easy credit". These failures and negative externalities often result in government bailouts and impose costs on taxpayers and communities as a whole. The question therefore arises whether and how to regulate new FinTech services. As we have seen, FinTech impacts many sectors, so different interventions can occur depending on the services involved.

The regulation of FinTech activities and related regulatory frameworks vary widely from country to country. In this context, the main challenge for the authorities is to find the right balance between the priority objectives of promoting innovation and competition, on the one hand, and maintaining the integrity of financial markets and ensuring consumer protection, on the other. 'other. Regulations should be designed to achieve these

[107] In other words, individual market participants may choose to act selfishly because their returns are assured, whereas a systemic collapse is not necessarily inevitable. LTCM, for instance, knew there was a risk of failure if the markets became irrational, but chose to trust models that made it money. See LOWENSTEIN, supra note 36, at 71–75, 173

[108] Cf. Cifuentes et al., supra note 64, at 20 (observing that because banks do not internalize externalities regarding financial-system stability, "liquidity and capital requirements . . . need to be externally imposed"). The need for regulation must be balanced, of course, by its cost. The extent to which the benefits of systemic-risk regulation exceed its costs, and the extent to which such regulation

objectives. Given the rapid change affecting the FinTech sector, regulation and supervision should be flexible, in order to encourage innovative projects and avoid any obstacles that may affect the supply of technology in the future. As Salvatore Rossi, General Director of the Bank of Italy, stated[109], "the rules are important not only in a defensive-punitive key, therefore as a tool to help the community defend itself from bad actors, but also in a positive way, as a tool to guide behavior of companies and promote innovation by those entering the market".

As for Europe, the regulatory framework encourages the use of these new technologies in the financial environment, but here too the strategies to ensure an "agile" environment vary from country to country. For example, in the United Kingdom, a country characterized by a particularly benevolent attitude, innovative start-ups can benefit from regulatory exemptions for a period of time.

As a result, 'playing enclosures' have been established in the Anglo-Saxon region, i.e. concessions that allow companies active in the fintech sector to develop new and innovative services for a limited period of time. In this case, fintech companies can benefit from a partial exemption from the regulatory framework and have easier access to financial markets. However, saver and consumer protection remains at an adequate level. On the other hand, continental Europe is characterized by more conservative national regulations and less tolerance for innovation than regulations such as that of the United Kingdom.

As regards Italy, a FinTech Coordination Committee has been established at the Ministry of Economy and Finance, in which the Bank of Italy and IVASS (Association for the Supervision of Insurance) participate together with other business organisations. As officially announced, the initiative, launched in July 2017, is a collaboration between authorities and public administrations within the FinTech Working Group, aimed at direct comparison between players in the technological and financial sectors and integrates the ongoing collaboration process . The Bank of Italy has also expanded its website with a fintech channel for the exchange of ideas between traditional companies and startups. There is therefore an area dedicated to operators to propose financial projects with innovative characteristics, the objective of which is to open channels of dialogue with various economic actors to support the innovation process[110].

[109] S. Rossi, in Banca D'Italia, "La tuteka del consumatore di servizi bancari e finanziari: un quadro normativo e competenze della Banca D'Italia", 2012

[110] Economic Finance Official press release from the Ministry, 2018

IVASS instead supported the launch of a development environment completely dedicated to blockchain technology. It is therefore essential to establish a permanent dialogue between the authorities and the companies supervised in this area. Indeed, each approach has advantages and disadvantages that should be carefully considered. Given the increasingly international nature of technology and financial services markets, overall regulation must have a global dimension. It is unwise to create regulatory walls between different jurisdictions or introduce national rules that could hinder cross-border competition.

But as we all know, the relationship between rules and innovation is often seen as contradictory. On the one hand there is the slowness and, in some cases, the misunderstanding of those who control the new phenomena, on the other there are the disruptive technologies, with their speed and strength of market innovation. In fact, creating balanced rules that satisfy the interests of all stakeholders is not always easy and becomes even more complex when it comes to financial innovation. To support the innovation brought about by fintech, while protecting the stability of consumers and the financial system from associated risks, it is essential that we strive to modernize our regulatory regime and adapt it to ongoing advances. Indeed, the technological and market innovations we have witnessed in recent years continue to challenge the traditional rules established before the digital age, and are therefore not necessarily suited to managing the opportunities and risks of fintech innovation. National institutions and supervisory authorities have therefore been called to study and adopt new regulatory approaches that make use of innovative tools and to abandon traditional and no longer adequate rules. Often influenced by their own legal traditions, the approaches are different and can be grouped into three macro categories[111]: 1) wait and study the phenomenon to verify the need to intervene ("wait and see"); 2) apply, where possible, the current regulatory framework ("same business, same risks, same rules"); and 3) introduce new rules aimed at capturing the specificities of new phenomena ("new functionality, new rules").

1) A "wait and see" approach is based on waiting and initially observing the phenomenon and on subsequent intervention once sufficient evaluation elements have been prepared to guide regulatory action. As long as the volume of the fintech market remained low, the wait-and-see option prevailed. According to this approach, in fact, it is not appropriate to intervene with the introduction of new

[111] A. Perrazzelli, "Le iniziative regolamentari per il FinTech: A che punto siamo?" per Banca D'Italia, Maggio 2021

rules until the innovative financial service or product is widely used and no longer represents a significant risk for the financial system as a whole. Educational institutions should take time to study and understand the phenomenon more deeply and avoid intervening too early. This limits the development and proliferation of new services. Therefore, as a rule, this approach is applied at the initial stage of financial innovation, so as not to expose the authorities to risks in case of rapid development of the phenomenon.

2) The "same business, same risks, same rules" approach states that if an innovative activity has the same economic functions and the same risks as an already regulated activity, then these same rules should apply. In the end, it doesn't matter what technology you need. It is the most used approach at an international and European level, as it guarantees uniform conditions for new and old operators and has the advantage of avoiding harmful regulatory rulings for companies already operating on the market. However, applying only this approach could underestimate the technological component in financial activities, i.e. the innovation and importance of some technologies such as blockchain and artificial intelligence. Failure to change your payments or loans could have a significant impact on the risk of your service and may require the introduction of new rules.
3) The "new functionality, new rules" approach[112] assumes that innovative products or services may involve both risks that are not adequately monitored and opportunities that are not exploited by existing regulations. In these cases, regulatory authorities are required to develop and develop new rules to strengthen the innovative character of this phenomenon and prevent its uncontrolled development.

It is important to clarify that the three approaches mentioned above are not mutually exclusive, but are usually used in a complementary or sequential manner, depending on the level of development and relevance of the phenomenon to be regulated.

To understand whether and how to apply current regulations to similar activities, or introduce new rules where appropriate, the European Commission has implemented an

[112] Reference is made, in particular, to the categorization adopted by M. Amstad (2019), "Regulating FinTech: Objectives, Principles and Practices", ADBI Working Paper Series, No. 1016, Asian Development Bank Institute (ADBI), Tokyo

ever-increasing series of regulatory initiatives on Fintech: the Digital Finance Strategy and the Retail Payments Strategy.

The Digital Finance Strategy is based on the idea that the future of finance is digital and, through a wide range of initiatives, aims to make European rules more favorable to the digital transition and to ensure that the current regulatory framework is adequate for the transition digital. Among the main measures envisaged in the Digital Finance Strategy are the two regulatory proposals of the European Commission on the crypto-asset markets (Proposal for a Regulation on Markets in Crypto-assets – MiCAR) and Stability of digital operations in the financial sector (Proposal for a Regulation on digital operational resilience for the financial sector - DORA). The first aims to introduce a harmonized framework for the issuance of crypto-assets and related services at a European level, including through the management of crypto-asset trading platforms. The second, however, aims to introduce uniform and complete rules on ICT security for all players in the financial sector. For example, the introduction of a European system of direct supervision for the main providers of ICT services to the financial sector, which involves the sharing of ICT, which provides service responsibilities and roles between European and national authorities. Both proposals therefore aim to encourage innovation while maintaining equal treatment with traditional operators.

A Retail Payments Strategy assumes that payments are always important. The Innovation Enabler proposes a series of measures to promote an innovative and competitive payments sector. This includes the implementation of digitalisation and instant payment solutions across Europe, harnessing the full potential of PSD2[113].

Among other regulatory innovations in the fintech field, it is worth mentioning the recent proposal to define a European framework for artificial intelligence. The European Commission's proposal, presented on 21 April 2021, introduces uniform rules for the placing on the market and use of artificial intelligence systems and introduces risk-based assessment and certification procedures for AI applications considered to be at higher risk

[113] "PSD2 is a payment services directive, which integrated the PSD1 regulation of 2007, and which is reviewed periodically. The purpose of this directive is to strengthen the protection of users of payment services, increasing transparency and security and implementing efficiency and innovation in this area, promoting greater competition on the payments market and giving greater openness to current account information banking". (https://www.pagamentidigitali.it)

, specifying its format. Since these high-risk applications also include mechanisms for assessing the creditworthiness of natural persons, this proposal could also have a significant impact on the activities of financial operators using these technologies.
When testing fintech innovations, this is usually done through so-called regulatory Sandboxes. The expression Sandbox[114] is currently used in computer languages to indicate a test area in which developers test new programs that are still in development before the plans are finally published. However, in the context of fintech, sandbox refers to its legal and regulatory profile and can be defined as an experiment in regulated activities in the banking, finance and insurance sectors. It is a protected space suitable for supporting the growth and development of fintech startups, while ensuring an adequate level of consumer protection and stability of financial balance sheets, allowing companies to develop innovative products. The system will be available for a limited period and will encourage financial innovation in the interest of consumers through close cooperation between businesses and authorities. Depending on how the sandbox is structured, the supervisory authority organizing the sandbox may allow promoters to waive some rules when implementing their projects, or it may allow promoters to waive some rules when implementing their projects. their projects, or if questions or doubts arise during the experiments. can assist you in interpreting and applying the rules. Since 17 July 2021 the sandbox has become a reality in Italy, following the example of the United Kingdom (in force since 2014). In fact, the regulation, issued by the Ministry of Economy and Finance (MEF), with the main Italian supervisory authorities, establishes the conditions and methods for carrying out experiments linked to fintech activities. In addition to the appointment of the Fintech Commission, the aim of the bill contained in the Growth Decree is that Italian fintech companies will no longer have to go abroad to grow and will have a favorable environment, a competitive ecosystem in their country of origin.

The very idea that risks could theoretically arise from fintech activities is in the interest of both the Financial Stability Board (FSB) and the Basel Committee[115]. The Basel Committee adopted the FSB definition because it is broader and could prove useful given the current fluidity of fintech development. It will be possible to identify a wide range of

[114] Corapi, E. (2019). Regulatory Sandbox nel Fintech?. In E. Corapi, R. Lener (a cura di), I diversi settori del fintech. Problemi e prospettive (pp. 13-29). CEDAM.
[115] Basel Committee on Banking Supervision, "Sound Practices: Implications of FinTech Developments for Banks and Bank Supervisors, February 2018

situations that may have regulatory relevance on the phenomenon. The implication that appears to arise from both institutions' interest in fintech is consistent with its function, indicating the importance of fintech activities for financial stability and the potential to advance its regulation and supervision.

Financial regulators cannot regulate these technologies without understanding this process[116]. To do this it is necessary to correctly evaluate the importance of the phenomenon and its impact. FinTech fits into the context of financial stability, which has been a key focus of regulators around the world since 2008. Before 2008, Basel II and financial stability regulations generally focused on microprudential approaches. Due to their expertise and existing responsibilities in the area of financial stability, the ECB and national central banks should play a leading role in macroprudential supervision. National supervisory authorities should be involved so that they can provide their specific knowledge. The participation of microprudential supervisory authorities in the work of the ESRB is essential to ensure that the assessment of macroprudential risk is based on complete and precise information about the performance of the financial system[117]. The authorities attach great importance to the safety and soundness of individual financial institutions and believe that this can be achieved through compliance with prudential regulatory standards[118]. Since 2008, financial stability regulation has focused on macroprudential risk and its management. However, in the context of digital financial transformation, incorporating and addressing technological risks into the framework created by Basel II does not appear to be sufficient to capture the full range of risks to which the financial system is exposed. Indeed, when considering digital financial transformation, an appropriate analytical framework[119] should include: 1) New sources of traditional risks. 2) new forms of risk; 3) consider entirely new markets and systems,

[116] V. Bevivino, Il Rischio Sistematico generato dalla FinTech, fascicolo 3|2023

[117] Documentazione Economica e Finanziaria a cura del CeRDEF, Regolamento UE del Parlamento europeo e del Cosiglio relativo alla vigilanza macroprudenziale del sistema finanziario dell'Unione Europea e che istituisce il Comitato europeo per il rischio sistematico, pubblicato in Gazzetta Ufficiale n. 331 del 15 Dicembre 2010

[118] Basel Committee On Banking Supervision (BCBS), International Convergence of Capital Measurement and Capital Standards. A Revised Framework, Comprehensive Version, (so-called Basel II), issued in 2004, and made definitive in June 2006.

[119] V. Bevivino. Il Rischio Sistematico generato dalla FinTech, fascicolo 3|2023

including regulation (such as RegTech and SupTech[120]); The areas[121] of analysis to be taken into account in the process of digital financial transformation concern in particular the areas of cybersecurity, security and data protection, as well as the emergence of new systemically important financial institutions based on completely new financial systems. It is possible to determine a profile characterized by the importance of interconnections and dependencies, as well as the emergence of new infrastructures and dependencies within (and between) financial markets.

[120] Regulatory interventions will always have to take a technological form, in the direction of the expanding phenomenon of Supervision Technology. SupTech stands for Supervision Technology and refers to innovations made by financial regulators that build on the same technological advances, such as automation and distributed ledger technology, that are integral to FinTech products and services produced by the private sector. See *Allen, Experimental Strategies for Regulated FinTech, op cit, 26*. Many SupTech-related experiments are reactive, meaning they are designed to help regulators process and report on the large amounts of data collected by financial institutions and markets.

[121] Buckley, Arner, Zetzsche, Selga, in Techrisk, cit. 36, passim.

CHAPTER 3

SUPTECH INNOVATION

3.1 The SupTech Concept

Over time, the banking/financial system has had a growing need for highly harmonized economic and business methods to organize, compare and monitor business activities. Supervision, which intertwines information, regulation and control, will guarantee that the availability and quality of the data collected in an appropriately structured archive (think of regular communications and accounting documentation, depending on the risk) is reflected in the reports, a fundamental tool in pursuing the objectives, using solid statistical mathematical techniques and cutting-edge technologies. Therefore, as already mentioned, "technological neutrality" combined with a risk-based supervisory approach could become a further reference parameter for determining the same supervisory/regulatory powers. The continuous and widespread technological innovation (starting from the advent of information technology) has undoubtedly contributed to the definition of increasingly complex operational situations and economic scenarios, providing intermediaries with tools to automate risk control and management processes and providing increasingly standardized authorities. The "databases" that have emerged over time have become the basis for the various tools available to the authorities, thanks to the development of automated systems that can be analyzed in their entirety using search keys, also aiming to develop aggregate, comparative and forward-looking analyzes to ensure the stability of the system and the currency[122].

Supervisory technology, or SupTech, is proposed to revolutionize the way financial supervision is conducted[123]. As a key player in this space, the Bank for International

[122] On the role of "surveys", e.g. for monetary policy, see A. Perrazzelli, Data Science in Central Banking: Enhancing the access to and sharing of data, final speech at the "3rd IFC and Bank of Italy Workshop", Rome, 19 October 2023; L.F. Signorini, The use of surveys for monetary and economic policy, health address at the conference ""The use of surveys for monetary and economic policy", Rome, 26-27 April 2023.

[123] The term 'SupTech' entered the lexicon of the financial industry in March 2017 when Mr Ravi Menon, the Managing Director of the Monetary Authority of Singapore (MAS), introduced the term to the public. See Ravi Menon, 'Financial Regulation – The Forward Agenda' (2017) Keynote Address at the Australian

Settlements (BIS) defines SupTech as the innovative use of technology to support supervision, facilitating the trend towards digitization of reporting and regulatory processes. Just like the term "fintech" that inspired it, suptech is an umbrella term for many different innovations and technologies, rather than a unified or coherent phenomenon[124]. SupTech has the potential to move prudential banking supervision from a backward-looking to a predictive process.

In 2019, suptech innovation really began to take off among financial regulators globally, with a particular focus on machine learning[125]. Machine learning is a subset of artificial intelligence (AI) that focuses on enabling computers to learn from data and improve their performance on a task without being explicitly programmed. It involves the development of algorithms and statistical models that allow computers to identify patterns and make predictions or decisions based on data. There are several types of machine learning approaches[126]:

Supervised Learning: In supervised learning, the algorithm is trained on a labeled dataset, meaning that the input data is paired with the corresponding output or target variable. The algorithm learns to map input data to output labels, enabling it to make predictions on new, unseen data.

Unsupervised Learning: Unsupervised learning involves training algorithms on unlabeled data, where there is no predefined output variable. The algorithm learns to find patterns or structure in the data, such as clustering similar data points together or reducing the dimensionality of the data.

Semi-supervised Learning: Semi-supervised learning combines elements of both supervised and unsupervised learning. It involves training algorithms on a dataset that contains both labeled and unlabeled data, allowing the algorithm to leverage the available labeled data while also discovering patterns in the unlabeled data.

Reinforcement Learning: Reinforcement learning is a type of machine learning where an agent learns to interact with an environment by taking actions and receiving feedback or

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Securities and Investments Commission (ASIC) Annual Forum 2017 on 20 March 2027, https://www.mas.gov.sg/news/speeches/2017/financial-regulation

[124] H. J. Allen, "Regulatory innovation and permission to fail: The case of Suptech" in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023

[125] H. J. Allen, "Regulatory innovation and permission to fail: The case of Suptech" in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023

[126] C. R. China, "Five Machine Learning Types" for IBM, 2023: https://www.ibm.com/blog/machine-learning-types/

rewards. The agent learns to maximize cumulative rewards over time by exploring different actions and learning from the outcomes of those actions.

Machine learning algorithms can be applied to a wide range of tasks and domains[127], including: Classification: Assigning labels or categories to input data, such as classifying emails as spam or non-spam.

Regression: Predicting continuous values or quantities, such as predicting housing prices based on features like location, size, and amenities.

Clustering: Grouping similar data points together based on their characteristics or features, such as segmenting customers into different market segments.

Dimensionality Reduction: Reducing the number of features or variables in a dataset while preserving its important structure or information.

Natural Language Processing (NLP): Analyzing and processing human language data, such as sentiment analysis, text summarization, and language translation.

Machine learning techniques have become increasingly prevalent in various industries and applications, including finance, healthcare, marketing, robotics, and more, where they are used to extract insights from data, automate processes, and make data-driven decisions.

The key components of SupTech include[128]:

Data Collection and Management: SupTech involves the use of advanced data collection methods, such as application programming interfaces (APIs), to gather data from financial institutions efficiently. Regulators can then use this data to monitor compliance, assess risks, and conduct supervisory activities.

Data Analysis and Risk Identification: SupTech enables regulators to analyze large volumes of data quickly and effectively using techniques such as artificial intelligence (AI), machine learning (ML), and natural language processing (NLP). By identifying patterns and trends in data, supervisors can better understand systemic risks and emerging threats to financial stability.

Compliance Monitoring and Reporting: SupTech solutions can automate compliance monitoring processes, making it easier for regulators to detect and address non-

[127] Thomson Reuters, "Understanding the key machine learning terms for AI", 2023: https://legal.thomsonreuters.com/blog/understanding-the-key-machine-learning-terms-for-ai/

[128] K. Mothibi, A. Rahulani, "Supervisory Technologies, SupTech: How SupTech empowers regulators to supervise efficiently and effectively" for Financial Sector Conduct Authority, 2021

compliance issues in real-time. Automated reporting tools can also streamline regulatory reporting requirements for supervised entities, reducing compliance costs and administrative burdens.

Predictive Analytics and Early Warning Systems: SupTech enables regulators to develop predictive models and early warning systems to identify potential risks and vulnerabilities in the financial system before they escalate into crises. By leveraging historical data and market indicators, supervisors can anticipate emerging risks and take preemptive action to mitigate them.

Regulatory Reporting and Communication: SupTech facilitates communication and information sharing between regulators and supervised entities through digital channels and online platforms. Regulators can provide guidance, disseminate regulatory updates, and engage with stakeholders more efficiently, enhancing transparency and accountability in the supervisory process.

The development of SupTech use cases occurs in two main application areas: investigative SupTech and preventive SupTech. Investigative SupTech involves identifying regulatory violations after they have occurred. These violations can range from minor to major deficiencies. SupTech's investigative activities include fraud analysis, data management and reporting.

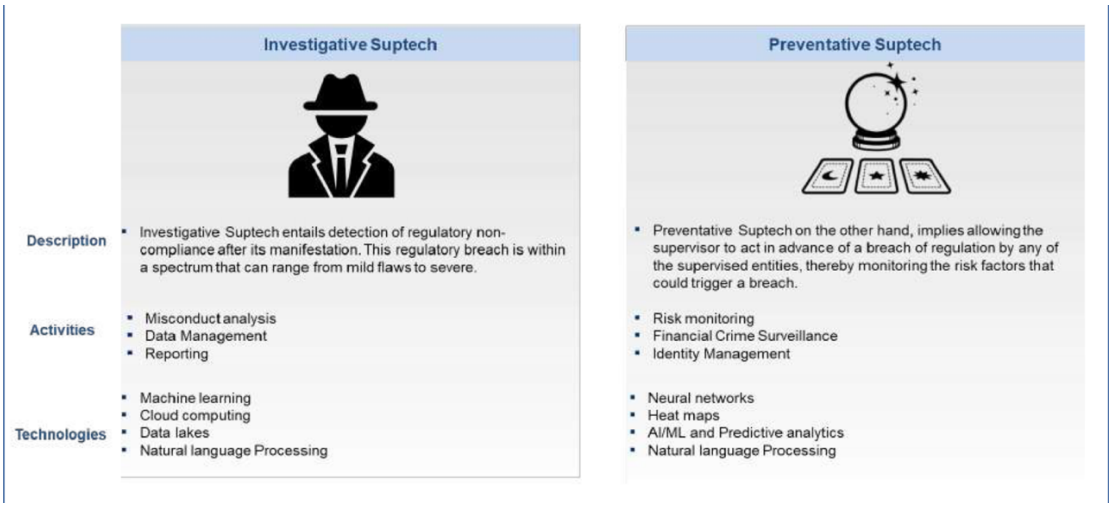

Fig.6: K. Mothibi, A. Rahulani, "Supervisory Technologies, SupTech: How SupTech empowers regulators to supervise efficiently and effectively" for Financial Sector Conduct Authority, 2021

SupTech technology enables regulators to conduct investigative activities more efficiently and effectively.

Preventive SupTech, on the other hand, means that supervisors can intervene in advance of rule violations by supervised companies and monitor the risk factors that lead to violations. SupTech's preventative activities include risk monitoring, financial crime monitoring and identity management. Similar to SupTech's exploratory activities, SupTech's preventative activities enable regulators to monitor and manage risks more efficiently and effectively.

As regulatory requirements for financial firms continue to increase, they must invest in better data management capabilities to meet regulators' expectations. Such innovation platforms offer financial institutions and regulators the opportunity to collaborate and explore the most effective ways to deploy new technologies, such as artificial intelligence and machine learning, to improve financial regulation and supervision[129]. The ultimate goal is to find a balance between regulatory compliance and innovation to ensure a stable and resilient financial system. While most SupTech tools are developed internally or in collaboration with external vendors, a significant portion is built entirely by third parties. It is important to pay attention to procurement processes that typically lack clearly defined technical requirements and specifications[130]. This way, financial regulators can ensure that the SupTech tools they use are safe, effective and fit for purpose.
Overall, SupTech offers significant opportunities for regulatory authorities to enhance their supervisory capabilities, improve risk management practices, and promote financial stability in the digital age. By embracing innovative technologies and data-driven approaches, supervisors can adapt to the evolving landscape of financial markets and fulfill their mandates more effectively. If supervisory activities reveal violations of the rules, regulators must respond. The answer depends on the situation. In some cases, regulators and regulated companies can work together to achieve desired outcomes. In other cases, regulators may take more stringent enforcement measures[131].

[129] A. Azzutti, P. M. Batista, W. G. Ringe, “Legal Landscape of AI-Enhanced Banking Supervision: Protecting EU Fundamental Rights and Ensuring Good Administration” in European Banking Institute Working Paper Series, n. 140, 2023
[130] B. Michael, “Will FinTech cause a reconsideration of the administrative and international law governing public procurement?” in European Procurement & Public Private Partnership Law Review, 2021
[131] I. Ayres, J. Braithwaite, “Responsive Regulation: Transcending the Deregulation Debate”, 1992

3.2 SupTech Tools

As mentioned above, surveillance technology refers to the use of technological innovations to support the efforts of surveillance agencies. As public expectations increase, the role of supervisory and regulatory authorities becomes increasingly complex and difficult. Furthermore, regulatory requirements since 2008 have required financial institutions to report more data[132], so regulators have become increasingly busy reviewing the data they receive. Considering the significance of data for supervisory agencies, any solution that could improve the quality, accuracy and quantity of data would naturally assist monitoring and decision-making processes.

Currently, SupTech solutions focus on two principal areas of applications; data collection and data analytics[133].

Data collection refers to the process of gathering and measuring information on targeted variables in a systematic manner, which then enables researchers or analysts to answer relevant questions, evaluate outcomes, and make informed decisions. Effective data collection is crucial for obtaining accurate and reliable information to support various analyses and decision-making processes. This process is crucial to supervision but can be a rather complicated and costly matter for both supervisors and financial entities. The quality of data can be generally evaluated by three distinct characteristics: completeness, timeliness and accuracy[134].

Nowadays, the most common way to collect regulatory data is through standard report templates compiled and submitted regularly by financial institutions. SupTech proposes a new approach to data reporting by offering automated and real-time solutions to data collection. Automated reporting refers to the process of generating reports using automated tools or software without requiring manual intervention. It involves setting up predefined templates, data connections, and rules so that reports can be generated automatically at regular intervals or on-demand basis. Automated reporting streamlines the process of compiling and distributing reports, saving time and reducing the likelihood

[132] "Post-crisis regulatory reforms have led to an upsurge in reporting requirements. This increases the need for efficient and effective monitoring to benefit from the resulting boost in data availability", D. Broeders & J. Prenio, supra note 88, at 3. See also H. J. Allen, "Regulatory innovation and permission to fail: The case of Suptech" in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023

[133] D. Broaders & J. Prenio, "Innovative technology in financial supervision (suptech): The experience of early users", in FSI Insight, 2018

[134] D. Dias & S. Staschen, "Data collection by supervisors of digital financial services", Working paper, CGAP

of errors that may occur in manual reporting processes. The European Central Bank (ECB) has developed an initiative to standardize and harmonize reporting data for European banks. The Integrated Reporting Framework (IReF) aims to consolidate reporting requirements into a single standardized approach to data collection[135]. To this end, an appropriate framework for collecting, organizing and disseminating reporting information has been developed to help achieve this long-term goal. The Banks Integrated Reporting Dictionary (BIRD) provides a set of rules and guidelines for converting bank input data extracted from internal IT systems into reporting data[136]. This system essentially transfers responsibility for the correct interpretation and implementation of the new reporting requirements from European banks to specific task forces within national central banks, as described below.

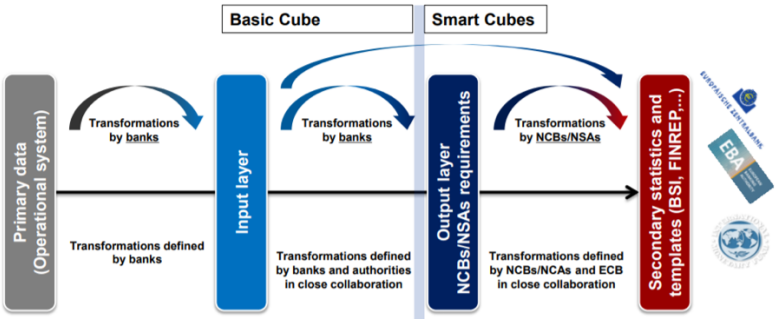

Fig. 7: EIFR, "The data production process of the BIRD"

The "crown jewel" of regulatory reporting appears to be the "pull approach", which allows regulators to pull data directly from regulated companies as needed. This reduces costs by eliminating the need for regulated companies to prepare reports for regulators. It also eliminates the possibility of human error in industry reporting[137]. It could also minimize the ability of private companies to arbitrate reporting obligations[138]. However, pull approaches must be carefully managed to ensure that regulators do not pursue information to which they have no legal right[139].

As mentioned before, another step towards automating the reporting process is to develop systems that give regulators real-time access to financial institutions' corporate data.

[135] ECB, "The ESCB's long-term approach to banks' data reporting", 2020
[136] ECB, "What is the BIRD?", 2019
[137] Fin. Stability Bd., supra note 10, at 33. See also H. J. Allen, "Regulatory innovation and permission to fail: The case of Suptech" in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023
[138] For other discussion of regulatory arbitrage see V. Fleischer, "Regulatory Arbitrage", 2010
[139] Infra section II.C.4

Unlike data pull approaches, where reported data is provided at specific time intervals, supervisors can directly access the supervised entity's IT systems at any time to extract the data they need[140]. In other words, these SupTech solutions could enable real-time monitoring of financial markets and transactions. An example of this is the Australian Market Analysis and Intelligence (MAI) system[141]. The Australian Securities and Investments Commission (ASIC) developed the MAI system to monitor Australia's primary and secondary capital markets as they trade. Transaction data is sent to the MAI system in real time to detect anomalies and issue risk alerts for further investigation.

SupTech could substantially enhance data validation, consolidation and visualization processes while at the same time provide new data management, storage platforms and virtual assistance[142].

Automating data collection is only the first step towards effective monitoring. The main strength of the innovative technology lies in its processing and predictive capabilities. New types of data require new processing methods. As technology advances, advanced analytical tools and models offer new opportunities for a deeper understanding of structured and unstructured data that can be used to monitor financial markets and companies. In the field of data analytics, SupTech solutions mainly focus on:

1) Market Surveillance: in addition to using technology to improve reporting, continuous, real-time financial monitoring enabled by technology is also of great interest, particularly as regulators find that fintech innovations are facilitating new forms of money laundering and fraud[143]. Market abuse may refer to any unlawful or manipulative trading behavior in financial markets that hinders market transparency and trust. In the context of MAR, market abuse encompasses practices such as "insider dealing, unlawful disclosure of inside information and market manipulation"[144]. Securities supervisors such as ASIC, FCA and SEC have incorporated advanced technologies in order to cope with the sheer amount of daily transaction data and enhance monitoring practices[145]. The SEC has had some

[140] N. Barney, "Real-time monitoring", in TechTarget Network
[141] D. Broeders & J. Prenio, 2018
[142] S. Castri, M. Grasser & A. Kulenkampff, 2018
[143] Castri et Al., supra note 9, at 11
[144] Regulation (EU) No. 596/2014. Art. 7
[145] ASIC, "ASICS's next generation market surveillance system commences", 2013

success using artificial intelligence to detect insider trading activity in securities markets. The SEC developed "ARTEMIS" (short for "Advanced Relational Trading Enforcement Metric Investigation System") and ATLAS ("Anomalous Trading and Link Analysis System"). ARTEMIS is designed to identify serial scammers, while ATLAS tries to find novice scammers[146].

2) Misconduct Analysis: Misconduct analysis refers to the examination of behaviors or actions that violate established rules, regulations, policies, or ethical standards within an organization or a specific context. The purpose of misconduct analysis is to identify, understand, and address instances of misconduct effectively. SupTech applications in the area of misconduct analysis involve solutions designed to facilitate supervisory action for AML/CTF[147], fraud and mis-selling. Digital services and innovative products have led to the emergence of new financial crime activities that are difficult to identify without sufficiently sophisticated tools. Artificial intelligence and machine learning models are increasingly being used to detect potential fraud and unauthorized sales of financial products. One such effort is for the SEC to use subsequent machine learning algorithms to detect fraudulent activity, such as in SEC filings[148]. SupTech provides tools for the risk rating of supervised entities based on the probability of non- compliance with AML/CTF regulation. One case example is FINTRAC[149]'s (The Financial Transactions and Reports Analysis Centre of Canada). Advanced tools can be used to analyze suspicious transaction reports, submitted by a variety of financial entities, in order to identify relationships and networks of suspicious activity. There are other several developing SupTech applications that focus on building networks. Examples include UIF, ROSFIN,

[146] H. J. Allen, "Regulatory innovation and permission to fail: The case of Suptech" in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023. See also, Engstrom Et Al., Supra note 2, at 23-24

[147] The role of AML/CTF supervisors is to ensure compliance of supervised financial entities with regulatory requirements for the prevention of money laundering (ML) and terrorist financing (TF). Supervisors are expected to evaluate and monitor the effectiveness of the measures undertook by financial institutions in order to prevent financial crime. They asses how well the process dedicated to the detection and management of ML/TF risk are conducted as well as wheter these abide by the requirements set out by the relevant legislation. These controls may include off-site and on-site inspections. In the event that supervisors identify possible system weaknesses or noncompliance with AML/CTF regulation, they proceed with adequate remedial actions. For more details see: FATF, "Effective supervision and enforcement by AML/CFT supervisors of the financial sector and law", 2015

[148] Bauguess S. W., "The role of big data, machine learning and AI in assessing risks: a regulatory perspective", 2017

[149] A model which ranks regulated entities in accordance to a variety of risk factors including their compliance history and reporting behaviour.

and AUSTRAC. The principal idea is that innovative technology can facilitate AML/CTF supervisory efforts by identifying suspicious networks and activities, assessing ML/TF risk and utilizing both structured and unstructured data to derive useful information for their objectives.

3) Microprudential Supervision: Many SupTech applications use machine learning to assess and monitor a financial institution's liquidity and credit risk, as well as various other key risk indicators, in a more timely and accurate manner. This helps regulators prioritize on-site inspections and monitor the operations of supervised companies. Banks make long-term loans based on short-term deposits. This timing mismatch resulting from the nature of banking operations can leave banks vulnerable to liquidity problems. Failure to repay deposits can lead to bankruptcies or, even worse, an industry-wide run due to consumers' fear of losing their deposits. For this reason, regulators closely monitor the liquidity risks of financial institutions. or the risk of not being able to meet our expected and unanticipated future obligations[150]. Advanced technology has the potential to improve microprudential monitoring in several ways. Tools that enable advanced analysis of large and complex structured and unstructured datasets will not only improve several processes related to the assessment and monitoring of specific risks faced by banks, but can also ensure regulatory compliance with regards to assets and liquidity.
4) Macroprudential Supervision: By identifying underlying trends and correlations in the financial sector and the broader economy, advanced tools can alert regulators to impending risks to financial stability. In particular, big data can have a significant impact on macroeconomic surveillance. Big data sources and tools can provide valuable information that complements traditional statistical methods such as surveys and improves the aggregation, evaluation and forecasting of price and inflation statistics[151].

[150] For more details about Technological innovation model predicting liquidity risk by using supervised machine learning see: R. Heuver & R. Triepels, “Liquidity stress detection in the European Banking Sector” in DNB Working Paper, no. 642, 2019

[151] B. Tissot, “The role of big data and survey in measuring and predicting inflation” in Journal of Mathematics and Statistical Science, ISSN 2411-2518, Vol. 6, 2019

Creative super-tech tools are needed to enable financial regulators to intervene when necessary to maintain financial stability[152]. As the financial industry embraces artificial intelligence, cloud and security technologies, the need for these creative tools increases. New operational risks are also a significant concern as the financial industry becomes increasingly technologically com- plex, and as we already analyzed, operational problems at individual financial institutions may interact in ways that cause problems for the stability of the financial system as a whole.

3.3 The Current Application of SupTech

Unfortunately, with the 2008 crisis, mathematics and deterministic approaches formally incorporate the "chaoticity" (in a quantitative sense) that characterizes financial phenomena and the "animal spirits" of Keynesian memory[153]: In fact, rather than predicting "through mathematical models" facts that can cause systemic crises, it is better to study the mechanism of extreme amplification of meteorological events such as the arrival of a hurricane (called the “butterfly effect”). However, the question posed by Queen Elizabeth to the leading economists of the London School on 15 December 2008: "Why didn't they notice?", remains etched in the memory[154].

However, regulatory reforms triggered by the global financial crisis have consequently created a broad regulatory landscape, significantly increasing compliance costs for intermediaries. The banking/financial system, which was also the backdrop to CBL[155], has undergone a fundamental transformation at an institutional level and is also affected at a global level by strong disintermediation processes as a result of the contamination

[152] H. J. Allen, “Regulatory innovation and permission to fail: The case of Suptech” in Journal of Law and Business for the New York University, n. 2 Volume 19, 2023
[153] The first hints of behavioral finance date back to Keynes who, with the term "animal spirits", was the first to underline how investors' economic choices and decisions are often instinctive and poorly thought-out. In fact, animal spirits represent the emotions of trust, hope, fear and pessimism that influence the decision-making process in the financial sector.
[154] G. Biesuz, R. Cattaneo & P. Troncatti, “La domanda della regina”, Guerrini e Associati, 2011
[155] The Consolidate Law on Banking and the Consolidated Law on Finance empower the banking and financial activity in order to guarantee stability, efficiency and competition in the financial system. See more at Bnca D’Italia, Legal Framework https://www.bancaditalia.it/compiti/vigilanza/normativa/index.html?com.dotmarketing.htmlpage.language=1#:~:text=The%20Consolidated%20Law%20on%20Banking%20and%20the%20Consolidated%20Law%20on,competition%20in%20the%20financial%20system.

between finance and technology[156]. By leveraging technology, we have been able to adopt a lean business model and provide effective services at lower costs, including compliance costs[157]. The phenomenon of "digital" transformation has become a vehicle for important changes in business models, corporate strategies and, in general, in the structure of the financial system. A fundamental change has therefore occurred in market dynamics, with consequent inefficiencies with respect to regulatory implications and important and relevant ethical issues have been triggered related to the functioning of artificial intelligence which is increasingly approaching human intelligence[158]. It is important to underline that, thanks to the availability of standardized “machine-readable” data, the regulation itself has long since begun to respond to this technological development, with significant and unprecedented results, and with significant support even at the uncovered supervisory level.

Regulation and supervision are no strangers to the fundamental market adjustment transformations that give rise to these phenomena. One of the most interesting outcomes resulting from the increase in regulatory complexity and the simultaneous increase in obligations and sanctions is the introduction of SupTech. In 2015, the Financial Conduct Authority launched a call highlighting the potential of using technology solutions to meet

[156] On European attempts to curb its deleterious effects, see L. Torchia, The supervisory, control and sanctioning powers in the European regulation of digital transformation, in Rivistarale di dirio Pubblico, 2022, 4, pp. 1101 ff. (it should be noted that the volume contains the interventions of a symposium on Digital regulation in the European Union, with interventions also by G. Resta, B. Carotti, G. Sgueo, A. Simoncini, O. Pollicino, M. Libertini and G. Finocchiaro)

[157] Finally, for a concise and transversal look at open banking, e-money and the platform system, see S. Maccarone, Considerations regarding technological innovation in the financial services market. Subjects, products and money, in Bank and financial market law, 2023, 2, pp. 277 ff. It should also be kept in mind that a large part of FinTech companies (whose business models are platform-based) populate the "dangerous" world of shadow banking: a recent investigation in C. Curi, L.M. Murgia, M. Murgia, This is how the global banking system is changing, in lavoce.info, 27 April 2023

[158] Among the widespread literature now present on the subject, please refer to the contributions in L. Ammannati, A. Canepa, G.L. for a broad overview of the same and for further bibliographical references. Greco, U. Minneci (ed.), Algorithms, BigData, digital platforms. The regulation of changing markets, Turin, 2021; R. Lener, G. Luchena, C. Robustella (eds.), Regulated markets and new value chains, Turin, 2021; V.V. Cuocci, F.P. Lops, C. Motti (ed.), The circulation of wealth in the digital era, Pisa, 2021; A. Pajno, F. Donati, A. Perrucci (eds.), Artificial intelligence and law: a revolution?, Quaderni Astrid, 2022; M. Passalacqua (ed.), The ecosystem of the European market between law and innovation, suppl. at no. 4/2002 of the quarterly journal of economic law; L. Ammannati, A. Canepa (eds.), Finance in the age of algorithms, Turin, 2023; V. Falce (ed.), Data strategy and artificial intelligence. Towards a new legal order of the market, Turin, 2023. Among the specific themes treated in monographic works, see, among others, those considered by A. Canepa, The merchants of the digital era. A contribution to the study of platforms, Turin, 2020; A. Davola, Decision-making algorithms and banking transparency. The paradigm of interference in the regulation of emerging technologies, Turin, 2020; F. Mattassoglio, Money and technology. How artificial intelligence and DLT are transforming the monetary instrument, Turin, 2022; B. Russo, Financial education in the era of digital technologies, Turin, 2022; M.T. Paracampo, Service providers for crypto-assets. Between MiCA mifidization and MiFID tokenization, Turin, 2023

legal/regulatory requirements. The aim was to meet the needs of intermediaries who are burdened with stricter reporting obligations and compliance with new standards, while costs and compliance levels increase significantly[159]. Initially, SupTech was seen as part and evolution of FinTech, but the challenges that have emerged in this area to support adaptation, compliance and reporting processes extend beyond the financial sector[160]. Compared to traditional software, SupTech solutions are based on more advanced computational algorithms and use artificial intelligence (divided into macro categories such as machine learning, behavioral biometrics and semantic models) and data analysis, so an immediate response is possible while saving time and money[161]. The pervasiveness and speed of technological change has clearly caught the attention of regulators themselves, with regulatory frameworks continually reshaping risk management, reporting requirements, client conduct and transparency[162]. The possibility of using innovative technologies also for surveillance and law enforcement purposes improves timeliness and effectiveness, opening a parallel frontier of the so-called SupTech. It is also a useful technology for supervisory activities, which are driven by the regulatory system itself[163].

As banking supervisory work increases the cause of new rules by international bodies such as the FSB and the Basel Committee on Banking Supervision (BCBS), some supervisors have started to use SupTech as an important support tool in their supervisory work. Its purpose is to ensure more efficient management and evaluation of the

[159] See FCA, Call for Input: Supporting the development and adoption of RegTech, November 2015.
[160] Deloitte's work is interesting, RegTech is the new FinTech. How agile regulatory technology is helping firms better understand and manage their risks, 2016; for further information and other references see Deloitte, Riding the disruptive wave: how regulators are dealing with emerging technologies in the financial sector, edited by A. Rigoni, S. Savarese, 7 November 2020
[161] See PWC, RegTech. The push for the new financial market, 2021, see pp. 3 s.
[162] Aware of the risks inherent to the phenomenon of technological innovation in the financial field, in 2018 the ECB addressed the problem with reference to access to the banking system: for further information, see A. Brozzetti, The new typology of FinTech banks in the " guides" of the ECB on the subject of granting authorisation, in M.T. Paracampo (ed.), FinTech, 2 ed., vol. Secondo, cit., pp. 71 ff
[163] In 2018 the BCBS underlined the opportunities of "Suptech" in the context of Implication 8, in these terms: "The same technologies that offer efficiencies and opportunities for FinTech firms and banks, such as AI/ML/advanced data analytics, DLT, cloud computing and APIs, may also have the potential to improve supervisory efficiency and effectiveness"; yes see Basel Committee on Banking Supervision, Sound Practices: implications of FinTech developments for banks and bank supervisors, 19 February 2018. Among the BIS works, available on the relevant website, please refer to D. Broeders, J. Prenio, Innovative technology in financial supervision (suptech) – the experience of early users, in FSI Insights, n. 9, 16 July 2018; R. Coelho, M. De Simoni, J. Prenio, Suptech applications for anti-money laundering, ibidem, n. 18, 29 August 2019; J.C. Crisanto, K. Kienecker, J. Prenio, E. Tan, From data reporting to data-sharing: how can suptech and other innovations challenge the status quo of regulatory reporting?, ibidem, n. 29, 16 December 2020

compliance measures of supervised companies. However, since SupTech is still a young phenomenon, some countries are still testing some supervisory tasks based on established implementation plans or ad hoc plans[164]. For example, the ECB uses a dataset called "AnaCredit" (analytical credit datasets) which contains harmonised information about individual loans in the euro area[165].

Supervisory tasks where SupTech has been used with some success mainly include data mining, market surveillance, money laundering and terrorist financing risk detection and automated reporting. In these four areas, several banking supervisors have developed tools based on SupTech technology that provide interesting support to supervisory activities.

The case of National Bank of Rwanda (NBR) provides a good example of the application of this SupTech tool[166]. Data pull involves the direct extraction of data from the IT systems of the monitored company. For NBR, data is automatically extracted at specific times depending on the transaction (for example, for payment transactions, relevant information is extracted every 15 minutes) and automatically organized to improve the efficiency of NBR analysis. The system also contributed to the harmonization of information distributed by supervisory authorities and also created codes to automatically reject data that did not meet certain criteria[167]. As a result, NBR's use of SupTech has helped increase the level of standardization of disclosed data. This standardization is critical because it reduces costs for monitored organizations by defining what information should be disclosed. It also improves monitoring efficiency and contributes to more accurate comparative analysis between disclosed data.

When it comes to market surveillance, a good example of applying SupTech to this oversight role is at the Australian Securities and Investments Commission (ASIC), which has developed a SupTech system known as the Market Analysis and Intelligence System

[164] S. Di Castri, S. Hohl, A. Kulenkampff & J. Prenio, No. 29
[165] J. M. Israël, V. Damia, R. Bonci & G. Watfe, for ECB, "The Analytical Credit Dataset. A magnifying glass for analysing credit in the euro area" in Occasional Paper Series, No. 187, 2017
[166] NBR, National Bank of Rwanda, "Towards a price based monetary policy framework" in The Rwandan Banker Magazine, No. 31, ISSN 2410-6844, 2018

[167] W. Kamali & D. Randall, "Leveraging SupTech for financial inclusion in Rwanda" in Private Sector Development Blog, 2017. Available at: https://blogs.worldbank.org/psd/leveraging-suptech- financial-inclusion-rwanda

to collect data[168]. Stream trades across primary and secondary capital markets, including equities and derivatives, in real time. The system also supports ASIC's activities by providing real-time alerts on market anomalies and providing big data analysis of market history, which can be further explored depending on assessments performed by ASIC[169]. Therefore, this SupTech tool increases the monitoring efficiency of ASICs in the sense that it enables daily monitoring of transactions through the actual feed mechanism. Furthermore, analyzing historical big data creates optimal conditions to monitor potential trends and imbalances while identifying potential risks that could negatively impact the market, thus benefiting from it. It also supports macroprudential supervision of markets. Market stability.

Regarding issues related to money laundering and terrorist financing risk identification, as briefly discussed in the previous section of this thesis, MAS (Monetary Authority of Singapore) provides hundreds of reports on transactions and money laundering and terrorist financing risk identification[170]. For that, MAS created a system that facilitates the identification of potential anti-money laundering violations using a machine learning-based program that automatically alerts MAS to transactions that may require further investigation. This new tool represents a significant evolution in the supervisory processes and efficiency of MAS, as can be seen by comparing the time needed to analyze suspicious transaction reports when the analysis was performed manually (this analysis task took two years on average) and how much time is currently needed when using a machine learning system (analysis only takes a few minutes to perform)[171].

The automated reporting system created by the Central Bank of the Republic of Austria (OeNB) together with the supervised entities, is a system where the monitored companies report information to the system according to harmonized contractual terms[172]. Then, in full compliance with the rules agreed between the supervisory authority and the supervised company, the system converts the disclosed information into an acceptable format, which is then evaluated by the OeNB. The characteristic of this tool is that it not only increases the efficiency of supervision, but at the same time reduces the burden on

[168] P. Hanrahan, "Under Surveillance" for the Australian Institute of Company Directors, 2022
[169] D. Broeders & J. Prenio, No. 27
[170] R. Menon, "Anti-Money Laundering", 2017. https://www.mas.gov.sg/regulation/anti-money-laundering
[171] R. Menon, "Singapore FinTech Journey 2.0" for the Singapore FinTech Festival, 2017. https://www.bis.org/review/r171115a.pdf
[172] J. Lux & M. Piechocki, "Reforming regulatory reporting: Are we headed toward real-time?", 2015

the supervised companies, as it harmonizes the reports and information disseminated and eliminates the doubts that usually arise. This can occur during bank reporting procedures[173].

In order to better understand what explained in this paragraph and in paragraph 3.2, I would like to present two concrete cases of potential application of SupTech that are consultable in more details on the website of the Financial Stability Board[174]. The first case concern the Bank of England and the Prudential Regulation Authority (PRA). The innovation referred to in this case is the extraction and analysis of unstructured data using machine learning. As part of the ongoing assessment of regulated institutions (FIs), the PRA receives large amounts of unstructured data in the form of text, tables, graphs and images. This data often represents a company's representation of internal or external developments and management's thinking on current and emerging risks. It is estimated that the largest financial intermediaries alone send more than 1.7 million words to the PRA every week. Verifying all this corporate management (MI) information is an impossible task for any authority group. Previously, authorities focused their reviews on matters relating to a company's current financial situation. However, this has led authorities to spend a lot of time identifying and collecting basic information within unstructured data, rather than analyzing it when it is readily available. Additionally, employees, especially those at large financial institutions, were unable to identify company- and industry-wide trends and issues that could pose potential risks to financial stability. To address these challenges, PRA has launched a POC in ML (approximately 2 million documents) for unstructured MI companies. The aim of the POC was to demonstrate that machine learning and reinforcement learning can provide effective and time-saving monitoring benefits. The technologies used were supervised and unsupervised ML, NLP (optical character recognition), and API connections to the PRA

[173] B. Shah, "The road to making regulatory more efficient: A case study in the application of best practices and data standards in regulatory reporting" in Journal of Securities Operations & Custody, Volume 11, No. 2, 2019

[174] The Financial Stability Board (FSB) coordinates at the international level the work of national financial authorities and international standard-setting bodies in order to develop and promote the implementation of effective regulatory, supervisory and other financial sector policies. The two case studies are consultable in more details at: FSB, "The use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions" for Market Development and Financial Stability Implications, 2020

file repository and external market sources to obtain historical and supplementary data. The main objectives are:

Expand your use of enterprise MI: Quickly save time for employees who consume large amounts of unstructured data and spend a lot of time selecting and processing enterprise MI.

Improve data discovery efficiency: Leverage supervised and unsupervised machine learning to classify enterprise MI to enable more accurate information extraction and identify important topics more efficiently.

Share relevant trends with colleagues: Interpret past and current trends, conduct peer analysis, and explore industry trends over time.

Get more value from enterprise MI: Predictive and rapid process analysis based on “key areas” identified by your organization as monitoring priorities.

The POC demonstrated that machine learning and NLP can save end users significant time and provide insights into new risks that were previously difficult to detect. The tools developed within the POC allow cross-comparison between unstructured data based on supervisory priorities (monitoring of money laundering) and other topics of potential interest included in the body of the document. the next step was, Following very positive feedback from end users, to launch a major project to bring machine learning to unstructured enterprise data.

The second case is about Banca d’Italia. The innovation concern the anomaly measurement in transactions using Big Data. The Financial Information Unit of the Bank of Italy (FIU) collects approximately 100,000 Suspicious Transaction Reports (SOR) and approximately 100 million registrations per month, aggregated by amount (these registrations are anonymous and worthless. is received every year approximately 15,000 euros or more, SARA database). Furthermore, operators in the Italian gold market (mainly banks and registered gold traders) report gold transactions exceeding 12,500 euros to the UIF. Furthermore, a value-based transaction system has recently been introduced for cash withdrawals above 10,000 euros. Regarding the SARA database, the FIU uses a big data dashboard to monitor remittances to and from selected countries. By combining structured data and, to a lesser extent, unstructured data (such as press

articles), this tool can calculate metrics that help measure the degree of anomaly in each stream. FIU, on the other hand, leverages external vendors and open source tools to create dashboards and visualization tools that can analyze large amounts of data in seconds and combine data from different sources.

The examples and cases mentioned in this paragraph demonstrate the potential of SupTech as an important tool for supporting financial stability, where more efficient supervision fundamentally leads to the analysis of trends and the correction of market imbalances. However, the use of SupTech involves legal and operational risks and must be accompanied by an appropriate legal framework.

3.4 The Main Legal and Operational Problems

Regulatory developments indicate that there is a right to oversight of risk management with regards to capital adequacy. Risk governance and appropriate organizational structures in banks are important areas for supervisors themselves and are also characterized by the availability and quality of data. However, the annual SREP[175] exercise on the supervisory review and evaluation process shows that intermediaries' "data aggregation and reporting" is lacking and that the quality of the data itself and the effectiveness of the IT fragmentation of the infrastructure are low[176]. The ECB believes that rapid and accurate access to data and reporting is key to effective strategic guidance. However, it is currently pushing supervised institutions along the path of digitalisation, emphasizing that it is a prerequisite for risk management and informed decision-making, and on-site inspections have become a tool to meet supervisory expectations, including those relating to the principles established by the Basel Committee[177]. Challenges therefore remain open for SupTech tools, including the implementation of qualitative and quantitative indicators related to information obligations (particularly considering the difficulty of climate-related risks) and the ability to monitor the compliance of banking

[175] Supervisors assess the risks banks face and check that banks are equipped to manage those risks properly. This activity is called the Supervisory Review and Evaluation Process, or SREP, and its purpose is to allow banks' risk profiles to be assessed consistently and decisions about necessary supervisory measures to be taken

[176] See Introductory interview with Andrea Enria, Chair of the Supervisory Board, to the ECB Annual Report 2022

[177] See point 1.6.2 Priority 2 of the ECB Annual Report for 2022, cit., dedicated to how to address the challenges posed by digitalisation and strengthen the steering capabilities of the administrative bodies

operations. The operations contribute to making the discipline, whether legislative or regulatory, more effective. Furthermore, the impact of poor risk management and the devastating impact of the digital divide on those responsible for ensuring system stability are well known. The lack of awareness of the subprime mortgage phenomenon was at the root of the global financial crisis. Decades later, the weak financial system and America's "baroque supervisory system"[178] (the result of President Trump's desired deregulation) have failed to address the critical operational problems of Silicon Valley banks. Information deficiencies can also have repercussions on regulatory tools such as stress tests (also much discussed), used to intercept possible instabilities on the micro level - as a counterweight to the use of internal models by banks - and on the macro level. with respect to systemic stability, which are in turn important tools in terms of the data made available to the control authorities.

Like any innovative product, SupTech creates new risks that can negatively impact the financial system. Regulators and market participants must address these risks before implementing SupTech. Speaking of the risks generated by Suptech, it is possible to distinguish two categories: operational risk and legal risk.

Operational risk refers to negative impacts on market participants, excessive concentration of technology provision by a single supplier, and IT risks generally associated with the use of technology. One of the most significant risks arising from the operational risk in question is the creation of SupTech protection programs used by regulated companies[179]. In fact, after implementing SupTech, the monitored organization can begin to develop a program dedicated to identifying the information and concepts that are most likely to represent red flags for the SupTech program. This allows supervised entities using these programs to comply with reporting routines and avoid potential identification of fraudulent activity by regulators through SupTech. As a result, anti-SupTech programs could negate the regulatory efficiency gains that SupTech could generate[180]. To potentially avoid this problem, program developers should be subject to specific liability regimes and qualification standards, and agreements between

[178] In these terms P. Ciocca, A. Roselli, On the crisis of the Silicon Valley Bank, in Bancaria, 2023, 7-8, pp. 42 ff., in part. p. 44
[179] V. Murinde & E. Rizopoulos, "The FinTech revolution: What are the opportunities and risks?" in Centre for Global Finance, Working Paper Series, No. 12, 2020
[180] D. Broeders & J. Prenio, "Innovative technology in financial supervision (suptech) – the experience of early users" for FSI Insight on policy implementation, No. 9, 2018

programmers and financial companies should include, where necessary, mandatory minimum provisions to ensure the development of technology programs. This solution ensures shared responsibility between users of SupTech security programs and their developers. Furthermore, to reduce the risks of this type of program development, the proposed solution ensures that only program developers who adhere to a strict code of ethics can develop programs intended for use by financial market participants.

Another operational risk is that the delivery of SupTech programs to regulators is concentrated in a single entity[181]. In this case, a relatively small operational error on the part of the supplier could result in a failure to apply oversight of the SupTech program. This risk is becoming increasingly important in the field of EU financial supervision, as EU supervisors should aim to use the same SupTech programs to ensure some supervisory consistency and standardization of reporting routines[182]. If EU regulators were to use different SupTech providers to avoid this concentration, this could lead to discrepancies in the interpretation of the applicable legal terms and different approaches by different regulators to the same regulation. It could also be argued that the EU could consider creating an internal SupTech program development unit for use by all EU regulators. This unit must be equipped with the necessary expertise to effectively manage any obstacles and avoid significant damage to the circumvention of EU supervision.

Cyber risks typically arise from the increased use of technology. When sensitive information is automatically monitored and reviewed by technology programs, it runs the risk of being exposed to attacks by hackers who can compromise the monitoring functions performed by these programs[183]. Regulators must therefore ensure the robustness of IT systems to reduce exposure to cyber attacks and have adequate tools to respond and control the consequences that may arise. These tools include creating secure backup systems that allow supervisors to continue their work in the event of a cyber incident.

When it comes to legal risks arising from SupTech, it is mainly about the functionality of the algorithms used in the technology and the possibility of violating the rules established

[181] European Securities and Markets Authority ESMA, "RegTech and SupTech – change for markets and authorities", Report on trend, risks and vulnerabilities, ESMA Report, No. 1, 2019
[182] ESMA, "RegTech and SupTech – change for markets and authorities", Report on trend, risks and vulnerabilities, ESMA Report, No. 1, 2019
[183] R. P. Buckley, D. A. Zetzsche, A. W. Douglas, B. W. Tang, "Regulating Artificial Intelligence in Finance: Putting the Human in the Loop", 2021

by the GDPR[184]. Before explaining algorithmic problems, it is important to understand what an algorithm is. In general, an algorithm corresponds to a mathematical formula used by some SupTech tools (such as machine learning) to react after receiving specific information[185]. For example, when applied to SupTech, the algorithm receives reports from monitored companies and, based on legal requirements, identifies violations or confirms that the reporting company is fully compliant with legal requirements and provides a response to this information. This means that for the algorithms used by SupTech to work, the regulations that apply to financial institutions must be codified[186]. To this end, some authors advocate creating algorithmic microinstructions in two groups. One group includes instructions for simple tasks such as data mapping, while the other includes rule of law principles to ensure that such instructions can be integrated into the SupTech "Legal Order" program system[187]. The problem with encoding laws in algorithmic languages is that laws and their interpretations can change regularly, not to mention the fact that laws are written in abstract terms. Therefore, if you code a particular rule, the program may interpret and apply the same rule correctly in some cases, but poorly in others. This situation can create gaps in oversight of the use of SupTech if the program can only partially enforce the rules. To alleviate this problem, financial regulators should partner with SupTech programmers to interpret algorithms and apply the law comprehensively. Furthermore, regulators must ensure that algorithmic languages are constantly updated to ensure the most up-to-date and accurate application of the law[188]. However, the "legalization" of this new technology is essential for its use in the financial system. Until this coding system is fully operational, regulators and supervisors will test their ability to codify legislation and their knowledge of semantic tools to help in this task, as in the case of language processing natural (NLP)[189].

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[184] OECD, "Artificial Intellicìgence, Machine Learning and Big Data in Finance: Opportunities, Challenges, and Implications for Policy Makers", 2021

[185] International Institute in Geneva, "Understanding Algorithms in Computer Science", see more at: https://www.iig.ch/en-en/blog/computer-science/algorithm-computer-science-definition-and-understanding

[186] J. A. Kroll, J. Huey, S. Barocas, E. W. Felten, J. R. Reidenberg, D. G. Robinson & H. Yu, "Accountable Algorithms" for University of Pennsylvania Law Review, 2017

[187] M. Zalnieriute, L. B. Moses & G. Williams, "The rule of law and automation of Governament decision making", 2019

[188] Digital Regulatory Reporting, "Phase 2 Viability Assessment", 2020

[189] An NPL corresponds to a program capable of processing and manipulate natural language (the one used by humans) either by counting and analyzing words in order to compare different styles of writing or by understanding and subsequently apply the meaning of natural language. See more at: S. Birs, E. Klein & E. Lope, "Natural Language Processing with Python" for O'Reilly Media, Inc., 2009

Despite what said above, another legal problem arising from the use of algorithms by SupTech tools is the lack of standards and transparency in technological programs that make decisions that impact the legal sphere of individuals and businesses. The current approach is to place responsibility for decisions made by a technical program on its owner, regardless of the influence of the program's developer. This approach is also found in robot investment advisors, where MiFID II places responsibility for the investment decisions and advice provided by the robot on the owner. MiFID II also provides evidence that EU legislators have chosen a technology-neutral approach, applying the same rules to financial services provided with or without technology. However, in some situations, this neutral approach cannot adequately address the specific problems posed by the technology[190]. EU legislators must therefore reconsider this approach to avoid gaps in the legal framework that could potentially jeopardize the use of technology in financial services and financial supervision and regulation. They should also start establishing mandatory transparency standards for algorithms applied in financial services to ensure a level of standardization.

Regarding potential GDPR violations through the use of SupTech, supervisors should be aware that they handle large amounts of sensitive data in their supervisory work. Therefore, using SupTech to monitor and analyze this data could lead to a violation of the GDPR if the data controller is not authorized by the data owner to process such data[191]. To avoid this risk, administrators must not only process the data approvals necessary to process and monitor data through the SupTech program, but also ensure that the owner's IT systems guarantee the protection of the data received and must also be sufficiently resilient.

However, the use of technology can also lead to overconfidence by supervisors in the technological systems in place, which in turn can lead to decreased accuracy and efficiency of supervision[192].

[190] W. G. Ringe & C. Ruof, "A Regulatory Sandbox for Robo Advice" for EBI Working Paper Series, No. 26, 2018
[191] D. Broeders & J. Prenio, No. 27
[192] S. Eley, "RegTech and SupTech: Innovation, Risks and Opportuities" for the 18th Annual WBG-IMF-FRB Conference on Policy Challenges for the Financial Sector, EBA, 2018: https://thedocs.worldbank.org/en/doc/692151528989872128-0130022018/original/20180607Session4RegTechSupTechSlavkaEley.pdf

Despite the risks and possible solutions proposed in this part of the paper, there is no doubt that financial supervisory and regulatory authorities will have to acquire new skills to face the new challenges of technology. Furthermore, EU legislators also need to review the current legal framework[193].

The current phase, which sees RegTech still in its early stages, could be the best time to start the coordinated implementation of SupTech at a European level. In my opinion, greater efficiency of supervision and regulation, as well as restrictions imposed on RegTech, can be achieved through the introduction of preventive legislation, in fact, the European Commission assumed the relevance of having financial supervisors, among other entities, deploying services based on AI which assists these entities in their activities[194]. Furthermore, the Fintech Action Plan[195] also demonstrates the EU will to develop a financial environment where technology is a crucial tool to increase the efficiency of financial markets. In addition, the EU Commission recently initiated a consultation process with the aim of propose a new FinTech action plan[196], and has already received some relevant analysis by several entities, including ESMA[197]. Finally, EBA launched a survey on the use of RegTech solutions and ways to support the adoption of RegTech across the EU[198].

SupTech is certainly a tool that should be used in a harmonized manner across the EU, this is because SupTech can play a key role in achieving financial stability by supporting banking supervisory and regulatory authorities in a number of assigned tasks. Therefore, the EU must start considering the legal and operational issues arising from SupTech without jeopardizing its development. It should be underlined that our country has also moved in line with the European strategy, dedicating particular attention to supporting innovation and RegTech solutions: just remember the initiatives implemented by the

[193] G. Giorgio, "Commissione Nazionale per le Società e la Borsa" for Financial Markets Law, University of Naples Federico II, 2019
[194] European Commission, "White Paper on Artificial Intelligence – A European approach to excellence and trust", 2020
[195] Communication from the European Commission, No. 20
[196] European Commission, "Consultation on a new digital finance strategy for Europe – FinTech action plan", 2020
[197] ESMA, "ESMA's response to the European Commission's consultation on a new digital finance strategy for Europe", 2020
[198] EBA, "EBA consults on the use of RegTech solutions and ways to support the uptake of RegTech across the EU", 2020

Bank of Italy[199], as well as the other competent authorities of the countries of the EU, in order to establish a dialogue with the market through the FinTech channel, the regulatory sandboxes and the Milano Hub innovation center[200], useful initiatives for that indispensable dialogue that distinguishes the European Supervisory Authorities themselves with the support of the 'European Forum for Innovation Facilitators (EFIF)[201]

[199] The role of Consob has already been mentioned (see above nt. 61) which in 2018 created an ad hoc series: see C. Schena, A. Tanda, C. Arlotta, G. Potenza, The development of FinTech Opportunities and risks for the financial industry in the digital era, Consob FinTech Notebooks, n. 1, 2018, and opened its own Consob-Tech

[200] An extensive excursus on the topic of regulation relating to digital finance also in A. Perrazzelli, Regulatory initiatives for FinTech, cit., in part. pp. 4 ff.; for considerations also referring to our country, see recently I. Visco, Monetary policy, financial stability and banking prospects, in Banking, 2023, 7-8, pp. 6 ss., in part. pp. 10 ff

[201] See EBA assesses benefits, challenges and risks of RegTech use in the EU and puts forward steps to be taken to support sound adoption and scale-up of RegTech solutions, 29 June 2021; Finally, the European authorities draw attention to ITC risks, see ESAs call for supervision in the face of mounting financial risks, 25 April 2023

CHAPTER 4

EMERGING WORLD ECONOMIES: BRICS

4.1 Who and What Are The BRICS

The global economic landscape is built on a web of ever-evolving dynamics in which contradictory realities seek to maintain or create desired positions. Here new forces will emerge that will upset the already delicate balance by asserting their influence and potential. This has been the case for the so-called BRICS countries over the past two decades, which have grown individually and jointly to take on a central role as the new driver of the global economy.

BRIC is the acronym for the world's major emerging economies, Brazil, Russia, India and China, which many economists predict will be among the world's major suppliers by 2050. China and India specialize in the production of goods and services, while Brazil and Russia supplies itself with raw materials[202]. In 2010, the title was changed to BRICS when South Africa was invited to join the group.

Analyzing its origins, it all started in 2001 with the book "A Better World Economy for the BRICs", written by economist Jim O'Neill and published as part of the Goldman Sachs World Economics Paper No. 66. In this study, this acronym was not proposed to represent a formal institution or political alliance, but instead, it only served to indicate the power these countries hold as an economic bloc. Indeed, his article argues that the BRIC countries will be the building blocks for building a new global infrastructure, as they were the fastest growing economies in 2001 and 2002, while the G7[203] in terms of size was based on the assumption deaf of an excessive growth in expected GDP[204]. As a result of this growth, he supported the reform of the country's representation in the international political arena with the aim of incorporating these new influential realities.

[202] S. Dua & A. Upadhyaya, "A study on GDP growth rate of BRIC and comparison with Global GDP", XX Annual International Conference – Global Vision 2030, 2019
[203] Group of 7 countries with the most advanced economies: Canada, France, Germany, Italy, Japan, The United Kingdom and the United States
[204] O. Kolesnichenko, A. Rozanov & L. Debin, "The Role of BRICS in Global Politics", Globalistics and Globablization Studies, 2016

In defining what BRICS countries are and what they represent, it is also important to note that not everyone has the same vision on this issue. Indeed, there are two main criticisms leveled at these groupings of countries: the neglect of limited resources and the inclusion of China[205]. For critics of growth projections, the objection stems from the fact that such growth models were developed assuming unlimited natural resources and therefore ignore the finite nature of fossil fuels, uranium and other vital resources and will certainly impact the growth of the BRICS countries. But the second goal is to recognize China as a special case. Goldman Sachs data also shows that the country's growth, GDP and political influence far exceed those of the other four countries, with the BRICS group having the greatest weight. Therefore, many consider it to be in a category of its own.

Beyond the terms of the economic bloc, the beginning of cooperation between the BRICs was marked in 2006, when the foreign ministers of Brazil, Russia, India and China met publicly for the first time on the sidelines of the General Assembly of the United Nations (BRICS China, 2022). Three years later, cooperation was raised to the summit level and the first summit was held in Yekaterinburg, Russia. Since then, the BRIC countries have continued to cultivate and expand their ties, granting access to South Africa in 2010 and becoming BRICS[206]. This cooperation is not structured in the form of a formal organization with a fixed location. It is based instead on annual meetings between heads of state and national government held in the designated locations of the country that is president that year, according to the order of the letters in the acronym B-R-I-C-S. Although the summit is the main event, BRICS continues to strengthen cooperation with sectoral meetings held between each annual meeting, thus helping to build a "comprehensive and multi-level framework" (BRICS China, 2022). Some examples of meetings include: BRICS Energy Ministers Meeting, BRICS Communications Ministers Meeting, and BRICS Agriculture Ministers Meeting. The 2017 Xiamen Summit saw BRICS leaders unanimously agree to develop a closer, broader and more comprehensive strategic partnership and strengthen tricycle cooperation, including economic security, political security and people-to-people exchanges. It was a major turning point. Last but not least, BRICS has achieved important achievements in the financial field by

[205] J. O'Neill, "Building Better Global Economic BRICs", Goldman Sachs Global Economies Paper No. 66, 2001
[206] Department of Employment and Labour, Republic of South Africa, "History of BRICS", 2023

establishing a single structure consisting of the New Development Bank and the Emergency Reserve Authority (CRA)[207].

Looking back to 1990, the BRIC countries accounted for 4% of world trade and 10% of global GDP, a statistic that only increased with the annexation of South Africa. Comparing these data with the current situation, the degree of growth in each country emerges [Figure 1][208]. In fact, in 2022, the BRICS countries will represent 18% of global trade and 25% of nominal GDP[209]. More specifically, in 2020, BRICS was responsible for the import and export of $3.5 trillion worth of goods and $350 billion worth of related services, representing a significant portion of trade total. This confirmed previous claims that the BRICS are on track to become the world's leading supplier[210].

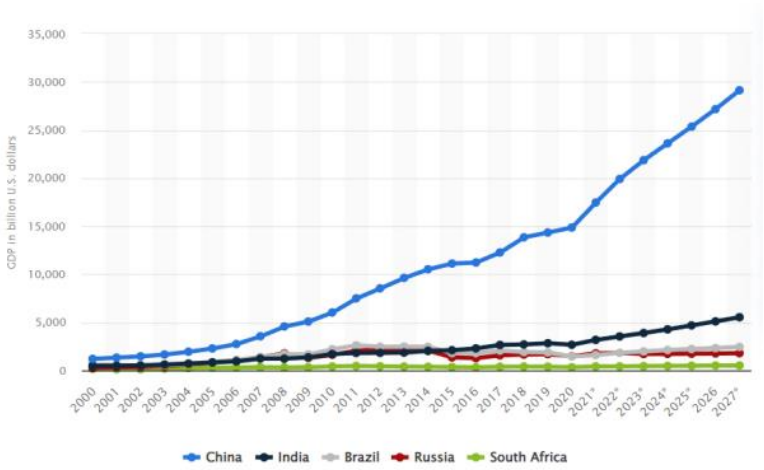

Fig.8: Gross Domestic Product of BRICS countries from 2007 to 2027, Statista, Based on data produced by the International Monetary Fund in their World Economic Outlook Database, April 2022

Trade growth is not the only cause of the reported increase in GDP. These countries are not only important suppliers of raw materials, but are also of great interest to industrialized countries, which will require low labor costs and productivity as important competitive advantages, making them attractive for foreign investment. Furthermore, when analyzing GDP, the size of the country must also be considered. In this case, the

[207] W. Schöllman, "The BRICS Bank and Reserve Arrangement: Toward a new global financial framework?" for EPRS European Parliamentary Research Service, 2014
[208] Statista, Based on data produced by the International Monetary Fund in their World Economic Outlook Database, April 2022
[209] Emerging Market Institute, 2022
[210] UNCTAD, 2021

BRICS countries have a population equivalent to approximately 40% of the total world population and are spread over more than 30% of the world's land surface[211].

As already mentioned, the market size of the BRICS group has grown significantly, mainly due to the large domestic market and the large number of low-skilled workers, which gives them an advantage and makes them excellent candidates for foreign investments. The most important direct result of this new economic power and influence is increased bargaining power and improved trading conditions. The Organization for Economic Co-operation and Development (OECD) explains: “The terms of trade are defined as the relationship between an export price index and an import price index. A country is positive if its prices export prices increase more than import prices. This is because it is possible to buy." This improvement therefore represents an opportunity for both established powers and developing countries to modify existing power relations and trigger new agreements. Discussions will therefore be necessary to rebalance the situation and avoid the possibility of trade wars and optimal tariffs.

If we look at the history of member states, we can see that they are already members of organizations such as the World Trade Organization (WTO) and were previously members of the General Agreement on Tariffs and Trade (GATT). The latter allowed participation but, like others at the time, was designed to favor large integrated economies. The others have to deal with unsatisfactory trading rules. In this sense, the transition to the WTO introduces a new balance. In particular, the greatest sign of change was the Doha Round, which began in 2001 and, although ultimately inconclusive, called for a “comprehensive reform of the international trading system through the reduction of trade barriers and the revision of trade rules”. Here, the group played a central role in representing and defending the interests of developing and least developed countries, where their differences with developed countries ultimately became the focus of discussion. Indeed, both countries have reaffirmed their commitment to achieving fruitful outcomes at multiple summits, with point 15 of the 2013 eThekwini Declaration (Durban Summit) stating: “We hope to achieve a balanced and meaningful outcome that addresses the key development concerns of the WTO's poorest and most vulnerable members." Furthermore, the BRICS, comprising four out of five countries, act as spokespersons for the Global South not only in their established institutional contexts, but also in their

[211] Emerging Market Institute, 2022

agendas. A good example is the "BRICS+ cooperation" proposed at the 2017 Xiamen summit. This is a conceptualization of how to include countries outside the Big Five in multilateral dialogue and initiatives.

4.2 What are the 2024 Objectives

On September 29, the Global South in the World Order network discussed the prospects and pitfalls confronting the BRICS after the recent 15th BRICS Summit in Johannesburg, South Africa. 2024 will be marked by the expansion of the BRICS group, which will officially include Egypt, Ethiopia, Iran, Saudi Arabia and the United Arab Emirates in addition to its current members (Russia, Brazil, China, India and South Africa). This is the largest expansion of the group of countries to date and the first since South Africa joined in 2010. The move expands the group's membership to 11 countries, which together represent 43% of the world's population and 16% of global trade[212]. This move showcases the BRICS' efforts to be seen as an inclusive grouping representing the Global South, especially as both China and Russia have projected themselves as belonging to the Global South.

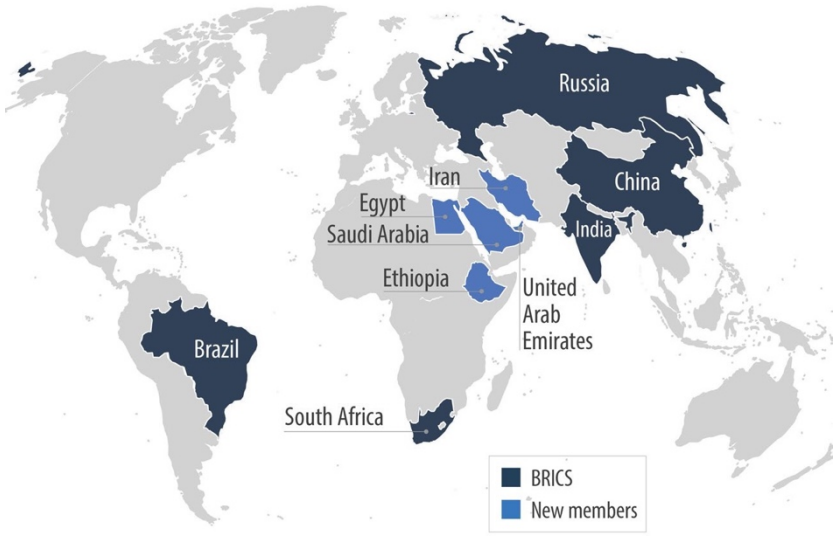

Fig. 9: BRICS+, Graphic by EPRS

[212] O. Abdel-Razek, "BRICS: Hopes and challenges in 2024" for TRTAfrika, 1 January 2024

Argentina was also due to join on January 1 but withdrew its plans just at the last minute, Argentine President Javier Milei has announced that his country would not join the BRICS bloc and emphasised that leaving BRICS does not mean trade will not be conducted with member countries and stressed that the relationships would continue. Milei further added that there would be significant changes in foreign policy, instructing the cutting of diplomatic ties with "dictatorships" in Venezuela, Cuba and Nicaragua[213].

This expansion prompts questions about the future of the BRICS, which can be analyzed through three dimensions[214]:

1) The “top-down view” reflects the geopolitical nature of the BRICS. From this perspective, BRICS seeks to accumulate economic, political and military capabilities over traditional powers, particularly the United States and Europe. International tensions resulting from the election of Donald Trump in the United States, U.S. efforts to contain China, the Russian invasion of Ukraine, the emerging alliance between Russia and China, and other impacts on the BRICS countries have led members to seek greater influence. The "West versus East" dynamic that arose from these events also emphasized the group's initial geopolitical rather than economic orientation.

2) The “horizontal” (or lateral) perspective focuses on relationships within the bloc, i.e. on convergence and asymmetry between states. For example, BRICS members have sought to strengthen cooperation through the creation of working groups and memoranda of understanding in various sectors such as healthcare, finance and energy. At the same time, economic asymmetries between the group's members, due in particular to China's economic dominance, have created trade relations within the BRICS that resemble the traditional China-centered international division of labor. In the case of Brazil, China has lost its

[213] R. Plummer, “Argentina pulls out of plans to join BRICS bloc” for BBC News, 29 December 2023
[214] A. Darnal, R. Beri, A. A. Garcia, S. Naidu & T. Sahay, “ The Future of BRICS: Between Objectives and Challenges”, November 2023

position as a major exporter of industrial products[215] to other South American countries and this asymmetric interdependence contributes to the hollowing out of the country's economy in the medium term.

3) A “vertical” (or bottom-up) perspective describes how each BRICS member state acts as a regional power, influencing its own region and seeking to influence more through its relationships with other states on the BRICS “periphery” trying to accumulate economic power[216]. For example, the actions of large multinationals in the BRICS countries of Africa and Latin America can reproduce exploitative practices traditionally observed in trade relations between the West and the Global South. As a result, inequalities of wealth and income persist, both in the extraction of raw minerals and other natural resources and in the use of local labor.

The recent enlargement can be seen as a step forward towards building a more balanced world order and towards greater visibility of the perspectives of the Global South, at the center of the global debate. Therefore, it is important to consider BRICS+ in the broader context of the multilateral framework. Although the group itself does not belong to any international organization, its members are represented in several international organizations, as well as variants of the BRICS+ format that pursue specific objectives (such as BASIC, which deals with climate), financial institutions, infrastructure and investments are also represented . The EU and its Member States participate in some of these organizations and train with BRICS+ countries, but are not represented in others. To better understand what explained in these lines see table 10 in the next page.

As mentioned above, BRICS countries engage in cooperation through various BRICS formats, such as the IBSA Dialogue Forum, BASIC and BRICS Plus. The IBSA Dialogue Forum was established in 2003 by India, Brazil and South Africa with the aim to address global governance reform, WTO negotiations, climate change and

[215] A. E. S. Garcia, C. Grinsztejn, C. Brito & M. E. Rodriguez, “Chinese Investment in Brazil: Investment Data,Public Policies for Investment Facilitation and the case of the Manaus Industrial Pole” for the BRICS Policy Center, 2023
[216] P. Bond & A. Carcia, “BRICS: An Anti-Capitalist Critique”, Pluto Press, 2015

terrorism, based on shared values and the established goal of global institutional accountability. BASIC, whose members include Brazil, South Africa, India and China, was founded in 2009 with the aim of addressing climate issues in line with the interests of the G77 and developing countries. South Africa's participation in IBSA and BASIC has been perceived as strategic diplomacy contributing to its membership of BRICS. China's proposal to establish a BRICS+ cooperation platform in 2017 aimed to strengthen cooperation with emerging and developing countries and potentially expand BRICS' sphere of influence. After the decision to expand BRICS in 2023, China proposed to change the name of the BRICS+ group. However, this name is not yet official and there is a risk of confusion with the BRICS Plus cooperation platform[217].

Multilateral framework	BRICS+ members	EU Member States
International organisations/Formats		
United Nations	All members, China and Russia are also permanent members of the UN Security Council	All Member States; France is also a permanent member of the UN Security Council
WTO	All members, except Ethiopia and Iran	All Member States
OECD	None	All Member States (except Bulgaria, Croatia, Malta, Romania, Cyprus)
G7	None	Italy, Germany, France, EU (observer)
G20	All members, except the United Arab Emirates and Iran, Egypt and Ethiopia through the African Union	Italy, Germany, France and the EU
G77	All members except Russia	None
Shanghai Cooperation Organisation (SCO)	Russia, China, India and Iran	None
Eurasian Economic Union (EAEU)	Russia	None
Variations of BRICS format		
BRICS Plus	All members	None
BASIC	Brazil, South Africa, India and China	None
IBSA	India, Brazil and South Africa	None
Financial institutions		
New Development Bank (NDB)	All members, except Ethiopia, Iran and Saudi Arabia	None
World Bank	All members	All Member States
Asian Infrastructure Investment Bank (AIIB)	All members	All Member States (except Bulgaria, Czechia, Estonia, Latvia, Lithuania, Slovakia and Slovenia)
Infrastructure and investment initiatives	Participating BRICS+ members	Participating EU Member States
Belt and Road Initiative (BRI)	All members, except Brazil and India	17 EU Member States
Global Gateway	Brazil, South Africa and Egypt	EU
India-Middle East-Europe Economic Corridor (IMEC)	India, Saudi Arabia and the United Arab Emirates	Italy, France and Germany
14+1 Initiative	China	Bulgaria, Croatia, Czechia, Greece, Hungary, Poland, Romania, Slovakia and Slovenia

Fig.10: Participation of BRICS+ and the EU in multilateral frameworks, Source European Parliament Research Service, March 2024

[217] M. Jütten & D. Falkenberg, "Expansion of BRICS: A quest for greater global influence?" for the EPRS European Parliament Research Service, PE 760.368, March 2024

The BRICS countries have adopted a system with the main objective of increasing the influence of emerging and developing countries in global financial institutions[218], especially in light of criticism[219] of the outdated and inadequate operating rules of Bretton Woods institutions such as the World Bank and the International Monetary Bank.

Despite the fact that BRICS+ countries have a higher total GDP than the G7 and the EU, their share of capital and related voting rights within institutions such as the International Bank for Reconstruction and Development (IBRD) remain significantly lower (see Figure 11). Meanwhile, India and Brazil became the largest beneficiaries of IBRD financing in 2023, despite contributing only 5% of the capital[220].

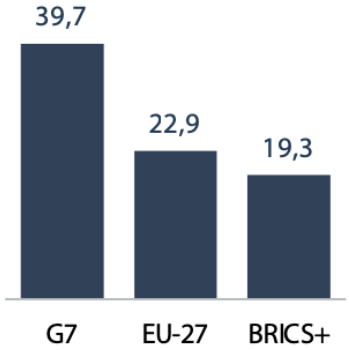

Fig.11: Distribution of voting power within the IBRD, 2023 in %, source IBRD: https://finances.worldbank.org/Shareholder-Equity/IBRD-Percentage-of-subscription-by-Country/x27d-wn3v

To address these issues, BRICS countries established the New Development Bank[221] (NDB) and the Contingency Reserve Arrangement[222] (CRA) in 2014. The NDB distributes voting rights equally among BRICS members and provides financing for infrastructure and sustainable development. The CRA guarantees mutual support in the event of a currency crisis.

[218] BRICS Information Center, "Jont Statement of the BRIC Countries' Leaders" for the University of Toronto, Yekaterinburg, Russia, June 2009
[219] M. Chirkov & A. Kazelko, "BRICS New Development Bank: A Second Bretton Woods or a New Trend with its Own Future?", Valdai Discussion Club, 2022
[220] M. Jütten & D. Falkenberg, "Expansion of BRICS: A quest for greater global influence?" for the EPRS European Parliament Research Service, PE 760.368, March 2024
[221] BRICS Information Centre, "Agreement on the New Development Bank" for the University of Toronto, Fortaleza, Brazil, July 2014
[222] BRICS Information Centre, "Treaty for the Establishment of a BRICS Contingent Reserve Arrangement" for the University of Toronto, Fortaleza, Brazil, July 2014

BRICS+ countries support the idea of "de-dollarization," or reducing dependence on the US dollar for trade[223]. Therefore, some countries such as Iran, Russia and China have already reached agreements to trade with each other in their respective national currencies. A common currency for BRICS+ has been discussed, but experts say it is unlikely to materialize, especially now that the alliance has expanded[224]. Meanwhile, the country's central bank, the People's Bank of China, has bilateral swap agreements with all BRICS+ countries except Iran and Ethiopia[225]. These agreements aim to facilitate the use of local currencies in trade and can also be used to address the shortage of central bank foreign exchange reserves in times of crisis.

Other point on the agenda of these countries is the promotion of sustainable development[226]. BRICS leaders often highlight their role in advocating for greater "stability, sustainable development and prosperity" in the world. In recent years, South-South cooperation has emerged as an important tool for promoting global sustainable development, and BRICS policy in this regard is evident through India and China's bilateral efforts towards Africa's least developed countries. These efforts to promote sustainable development are notably achieved, as we said before, through the BRICS' New Development Bank (NDB). This bank's main objective is to promote infrastructure and sustainable development projects in emerging and developing countries[227]. Additionally, the BRICS was also active in promoting South-South cooperation during the United Nations negotiations for developing the 2030 Agenda for Sustainable Development. However, given the BRICS goals of promoting sustainable development and combating climate change, it will be important to monitor the impact of including more oil-producing countries in this agenda[228]. South African President Cyril Ramaphosa said at the BRICS summit in August: "BRICS is an equal partnership of countries with different views, but with a common vision for a better world.

[223] R. Greene, "The Difficult Realities of the BRICS' Dedollarization Efforts – and the Renminbi's Role", Carnegie Endowment for International Peace, December 2023
[224] M. Young, "Russia talks up prospects of BRICS countries developing new currency", March 2023: https://cointelegraph.com/news/russia-talks-up-prospects-of-brics-countries-developing-new-currency
[225] R. Greene, "The Difficult Realities of the BRICS' Dedollarization Efforts – and the Renminbi's Role", Carnegie Endowment for International Peace, December 2023
[226] A. Darnal, R. Beri, A. A. Garcia, S. Naidu & T. Sahay, " The Future of BRICS: Between Objectives and Challenges", November 2023
[227] E. Basile & C. Cecchi, "Will the BRICS succeed in leading the way to sustainable development?, Rivista di Studi Politici Internazionali, A. 85, N. 2: 223-234, 2018
[228] U.S Energy Information Administration, "Oil and petroleum products explained – Where our oil comes from?", April 2024

4.3 How They Address the Problem of FinTech and Systematic Risk

As we have analyzed in the previous chapters of this thesis, the financial system is subject to instability from time to time due to the vulnerabilities of major market participants such as banks, financial services and insurance companies. Due to the contagious nature of financial institutions, the instability of market participants in the financial system often extends to all other institutions connected to them. The transmission of negative shocks from one institution to another can cause severe macroeconomic shocks in the economy. Contagious negative shocks lead to catastrophes called systemic risks. there are some important studies regarding determinants of systemic risk in developed countries[229]. However, empirical evidence on the measurement and key determinants of systemic risk in emerging and developing economies is still scarce.

As we already mentioned BRICS is a major regional economic cooperation alliance. Member countries are strengthening mutual cooperation and networks to become world leaders in the near future. One of the main reasons for this alliance is interdependence to improve the financial stability of each member state. The growing regional interdependence and interconnectedness among the financial institutions of these member countries makes it even more important to identify the firm-specific determinants of systemic risk for each financial institution in the BRICS member countries. Empirical evidence on the influence of financial characteristics on the systemic risk of the BRICS financial system shows that the size of financial institutions, Tier 1 ratio, liquidity ratio, operating profit margin and market-to-book ratio are associated in statistically significant way to systemic risk[230]. There are correlations in the financial system. The empirical results further suggest that Tier 1 ratio is only one variable negatively and significantly related to systemic risk for all types of financial institutions in BRICS countries. However, this result suggests that although the deposit coefficient is negatively correlated with the systemic risk that financial institutions expect from insurance companies, the estimated coefficient does not appear to be statistically significant. The findings are

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[229] Cai, J., F. Eidam, A. Saunders, and S. Steffen. 2018. Syndication, interconnectedness, and systemic risk. *Journal of Financial Stability* 34: 105–120.

[230] Laeven, L., L. Ratnovski, and H. Tong. 2016. Bank size, capital, and systemic risk: Some international evidence. *Journal of Banking & Finance* 69: S25–S34.

especially important for policy makers and regulators in BRICS countries, as they provide insights into systemic risk measurements, trends and firm-specific determinants. These findings can help regulators design financial regulation by considering the important relationship between each firm-specific determinant and a financial institution's systemic risk. A regulatory framework created taking into account business-specific drivers will help reduce systemic risks in the financial systems of BRICS countries.

Up to September 2021 and from that moment on, the BRICS countries (Brazil, Russia, India, China, and South Africa) have been focusing on addressing the challenges posed by fintech and systemic risk through various means. Here are some general strategies and approaches that these countries have been adopting:

1. Regulatory Frameworks[231]: BRICS countries have been working on developing and updating regulatory frameworks to govern fintech activities within their jurisdictions. This includes measures to ensure consumer protection, data privacy, and cybersecurity.

2. Collaboration and Information Sharing[232]: BRICS countries have been engaging in bilateral and multilateral cooperation to share best practices and insights on managing fintech risks. This collaboration helps in developing a more coordinated approach to address systemic risks.

3. Fintech Sandboxes[233]: Some BRICS countries have established regulatory sandboxes to allow fintech companies to test innovative products and services in a controlled environment. This helps regulators understand new technologies and their potential risks.

4. Supervision and Monitoring: Enhancing supervision and monitoring of fintech activities is crucial to identify potential systemic risks early on. Regulators in BRICS countries have been increasing their focus on monitoring fintech developments to maintain financial stability.

[231] L. Belli & D. Doneda, "Data Protection in the BRICS Countries: Legal Interoperability through Innovative Practices and Covergence", International Data Privacy Law, Oxford University Press, 2022
[232] BRICS Information Centre, "BRICS and Africa: Partnership for Mutually Accelerated Growth, Sustainable Development and Inclusive Multilateralism", XV BRICS Summit Johannesburg II Declaration, August 2023
[233] E. Gromova, "Regulatory Sandboxes (Experimental Legal Regimes) for Digital Innovations in BRICS", BRICS Law Journal, May 2020

5. Financial Inclusion: Promoting financial inclusion through fintech can help mitigate systemic risks by bringing more people into the formal financial system. BRICS countries have been leveraging fintech to expand access to financial services, which can help reduce vulnerabilities in the financial system.

4.3.1 Brazil

Coming out of the grave recession of 2014-2016 and then again battling the economic strains posed by the 2020 pandemic, Brazil has begun to prioritize the digital transformation as the key to counteract said obstacles and strive for growth. Over the past decade, fintech has transformed Latin America's financial sector. Digital payment systems are growing rapidly, digital banks are getting big, and alternative finance and insurtech are starting to flourish. As of 2021, there were over 300 million digital payments users and over 30 million digital banking users, most concentrated in Brazil and Mexico. One of the largest digital banks in the world is located in Brazil. Alternative finance and insurtech are not very big yet, but they are growing rapidly. Since the last FSAP in 2002, the Brazilian financial system has grown in size, diversity and complexity as the Brazilian economy has developed. Over the past decade, financial sector assets have doubled thanks to macroeconomic stabilization, significant progress in financial inclusion, expansion of securities and derivatives markets, and significant participation of institutional investors. Government debt structures are becoming more resilient and private debt markets, while still small, are becoming more dynamic. The banking sector continues to be dominated by domestic financial institutions, with public banks holding a large share, while foreign investors play an important role in the capital and derivatives markets. Fintech increases competition. With the proliferation of new financial technologies and digital banks, credit spreads are also tightening. This is important because credit spreads in Latin America are traditionally high. But fintech companies don't just compete with banks and insurance companies. We also provide new technologies and services to banks and insurance companies.

Fintech also entails risks such as:

- Risks to financial stability. Fintech companies may not be fully prepared to deal with market fluctuations. This could result in a loss for the customer. Technology

that enables instant bank transfers and withdrawals also increases the speed of banking installations. Because fintech companies often collaborate and share information with other financial institutions, the impact of an outage or outage can be widespread. If they were to operate on a large scale, their failure could lead to widespread financial system failure. Financial health risks. Fintech platforms can facilitate cross-border fraud, theft and money laundering.

- Regulatory risk. Since fintech is a relatively new industry, there may be regulatory gaps and inconsistencies that can negatively impact stability.
- Risks to market integrity. These risks arise from companies such as Bigtech that are based in other jurisdictions and whose primary business is in the non-financial sector (e.g. e-commerce).
- Cyber security risk. Fintech companies are vulnerable to cyber attacks, which can lead to significant financial and reputational damage.
- Data protection risks. Fintech companies often deal with sensitive financial and personal information, making them prime targets for cybercrime.

Although systemic risk is currently low, the Brazilian financial system is in a challenging environment. Policymakers must navigate a volatile global environment and monitor emerging signs of vulnerability at the national level. At the same time, policies should aim to foster the development of long-term private finance. While this may introduce new risks, there is a need to maximize the financial sector's contribution to growth. Authorities are preparing to reform the resolution framework to fill some gaps, align it with new international standards and prepare for future shocks. In this context, operational procedures and systems for providing emergency liquidity assistance (ELA), including reporting obligations, could be strengthened. This reflects the Mission's recommendation that the role of deposit insurance companies (Fundo Garantidor de Créditos (FGC) – Credit Guarantee Funds) is evolving beyond the payroll role and that the situation should reflect recent governance. The authorities should also ensure that the FGC has safe and adequate sources of financing in the event of a systemic crisis. Purchasing and employment powers and the powers of bridge banks must be supported by removing fiscal and labor barriers to their effective implementation. The authorities will consider updating the current multi-party Committee for Supervisory Coordination and

Information Sharing, giving it clear mandates for the oversight of systemic risk, crisis preparedness and crisis management, and expanding it to include the FGC[234].

Fintech also offers other tools to manage these risks. Financial authorities and regulated companies are increasingly using technology (regtech and suptech) to ensure regulatory compliance and to collect and process data. Politicians support the development of fintech. Many countries use innovation hubs and regulatory sandboxes to test new solutions before they go into production. Open banking and open finance have the potential to further stimulate innovation, but must be accompanied by an evolving regulatory environment. So far only Brazil and Mexico have adopted it[235].

4.3.2 Russia

In modern Russia, FinTech is associated with the development of the financial sector of the economy. The government is currently evaluating the prospects for the development of artificial intelligence, blockchain and big data technologies in the areas of budget, tax, customs and other reporting. However, the development of fintech in Russia faces many problems. First, the lack of digital infrastructure for cryptocurrency mining, information security issues, and the potential risk of illegal and depersonalized transactions through blockchain technology. It is necessary to analyze the nature of institutional problems and identify solutions. The Federal Law on Digital Financial Investments will play an important role in overcoming the difficulties but does not entirely solve the problem of non-personified illegal transactions carried out by blockchain technology, since the Internet information and telecommunications network is cross-border in its legal nature,

[234] J. Vinals & N. Eyzaguirre, "International Monetary Fund – Brazil", Financial System Stability Assessment, Prepared by the Monetary and Capital Markets and Western Hemisphere Departments, June 2012

[235] This chapter is guided by the Bali Fintech Agenda, a set of 12 policy elements aimed at helping IMF (IMF 2018) member countries to harness the benefits and opportunities of rapid advances in financial technology that are transforming the provision of financial services while managing the inherent risks. This chapter also explores developments in financial technology in Latin America regarding the following BFA principles: (1) embrace the promise of fintech; (2) enable new technologies to enhance financial service provision; (3) reinforce competition and commitment to open, free, and contestable markets; (4) foster fintech to promote financial inclusion and develop financial markets; (5) monitor developments closely and deepen understanding of evolving financial systems; (6) adapt regulatory framework and supervisory practices for orderly development and stability of the financial system; (7) modernize legal frameworks to provide an enabling legal landscape; (8) ensure the stability of domestic monetary and financial systems.

has a number of technological possibilities for proceeding transactions in impersonal format (via darknet), which can be performed outside the scope of Russian law (from abroad), but in reality the services are provided on the territory of the Russian Federation. Hereby the analysis of the practice and the way in which the adopted law is executed will allow to evaluate the effectiveness of the prescribed norms, which are aimed at the development of the system of national digital resources in the Russian Federation[236].

Financial stability risks[237] that may arise in the financial system can be divided into internal risks and external risks. External risks include the global economic crisis, a deterioration of the external economic environment, a decline in prices of export raw materials important for the country and many other situations. These also include developments such as trade wars, the imposition of sanctions by foreign countries and collapse processes that are occurring with increasing frequency in today's world. Internal risks include bubbles or overheating in individual markets and loss of stability in large financial institutions. The Bank of Russia regularly monitors systemic risks (of financial institutions, financial market infrastructures, development institutions, shadow banks) and evaluates the stability of the financial system organization, including through stress tests. The Bank of Russia's key instrument to maintain financial stability is macroprudential policy which is a set of measures to mitigate systemic risk in the financial market or its individual segments.

Macroprudential tools achieve two main objectives:

1. Reduce vulnerabilities in the financial system (e.g. caused by rising household debt or weakening lending standards). Specifically, in October 2019, the Bank of Russia introduced the debt service-to-income ratio (DSTI), which measures borrowers' debt burden. Banks and microfinance organizations use the borrower's DSTI when deciding whether to issue a loan or microcredit to avoid bubbles in the consumer credit market where people do not have enough income to repay their debts.
2. Accumulate capital reserves in the financial system to cope with future shocks. In particular, the Bank of Russia imposes sectoral risk weight premiums if the credit

[236] M. A. Ponomareva, D. V. Karpukhin & A. N. Stolyarova, "FinTech in Russia under circumstances of IT technologies development: development challenges and solutions", E3S Web of Conferences 224, 2020
[237] Financial Stability Department for the Bank of Russia, "Financial stability is the resilience of the financial system to shocks and its smooth and effective operation"

risk of certain types of assets is assessed at a relatively high level. This means that banks are forced to “freeze” some funds to cover losses and continue to provide loans to the economy even in difficult economic conditions.

The National Financial Stability Board (NCFS) was established in July 2013 to improve communication between authorities. The NCFS includes senior officials from the Ministry of Finance, the Ministry of Economic Development, the Deposit Insurance Agency and the Bank of Russia, as well as representatives of the Presidential Administration. The NCFS discusses financial stability issues and makes recommendations to authorities. When the Ministry of Finance, the Ministry of Economic Development or the Bank of Russia receives a recommendation from the NCFS, they must report whether they will comply with the recommendation within the deadline specified in the meeting minutes (principle of compliance or explanation).
In 2011, the Bank of Russia established the Financial Stability Bureau to regularly monitor systemic risks (of credit financial institutions, non-bank financial institutions, development institutions and shadow banks) and develop macroprudential policy tools to address them in a manner effectively, monitoring and regulating systemically important risks. financial market. We support infrastructure organizations and participate in stress tests of systemically important lenders, NPFs and insurance companies.

Looking at more recent events, the Russia-Ukraine conflict has increased the systemic vulnerabilities of the global financial system. Precisely for this reason I believe it is important to develop a news database and investigate the implications of the systemic risk of the conflict on Russia, Ukraine, France, Germany, Italy, the United Kingdom, the United States and China. It is possible to deduce that the systemic instability costs of the conflict go beyond Russia and Ukraine. Sanctions cause systemic risk impacts on European countries and the United States.

4.3.3 India

India's digital world has grown exponentially over the past decade, making it one of the largest and fastest growing countries in the world, with a population penetration rate of 41% (around 600 million people) and, according to OECD, reported $83.41 billion in revenue from consumer online purchases. Companies in this market are also adopting IT, albeit at different rates in different sectors, creating the majority of new job and productivity opportunities. Despite optimistic growth forecasts, India continues to lag behind in digitalization and faces many challenges that hinder its progress. Most of these obstacles can be better understood when compared to Digital India, the flagship national plan for digital development[238]. The Digital India programme was first introduced in 2015 by the then Prime Minister Narendra Modi as the flagship governmental initiative envisioning to «transform India into a digitally empowered society and knowledge economy» (Ministry of Electronics and IT, n.d.). The Digital India purpose is encapsulated into three vision areas on which the government intends to act[239]:

- Digital Infrastructure as a core utility to Every Citizen: its main area of action involves ensuring, to the whole population, access to high speed internet to facilitate the delivery of services. Moreover it includes the creation of a safer cyber-space and the promotion of a greater participation to online financial services through mobile phones and e-banking accounts.

- Governance & Services on Demand: The vision here is to be able to have fully integrated services for all departments and jurisdictions, which would consequently make the provision of online services in real-time a lot smoother. The idea of “on demand” moreover includes the digital transformation of business services and of modes of payment.

- Digital Empowerment of Citizens: Looking directly at the citizens’ education it proposes to act on digital literacy and therefore on the availability of digital resources for everyone and in all Indian languages. Along with that, to further increase their active role

[238] Ministry of Electronics and Information Technology, Government of India, 2021
[239] HSBC, “What is Digital India? Initiatives, Objectives and Benefits”, February 2024

as part of a governmental reality, collaborative digital platforms should be increasingly used.

The financial services landscape in India is being transformed by Fintech firms. The Research conducted (EY Fintech Adoption Index 2017) showed that India has moved forward to the second place after China with regard to the adoption of Fintech services. Fintech adoption in India is surprisingly very high.

Despite the enormous opportunities offered by fintech, the road ahead is still bumpy[240].

1. Entering and operating in the Indian market is not that easy as there is a strict regulatory framework to prevent fraud.
2. Other obstacles include an unbanked population, poor internet connectivity infrastructure and low literacy levels. The majority of the Indian population (48%) does not yet have a bank account, which is essential for online transactions. Even if you have a bank account, you still face issues of poor internet connectivity and long processing times to complete transactions. Therefore, people tend to prefer cash transactions over online transactions. Most Indian citizens still do not have enough financial literacy to do so, other than having a bank account and an internet connection.
3. Various scams resulting in loss of money in online transactions are a very difficult pill for customers to swallow. People's money is being looted by tech-enabled scammers, which is a big challenge for fintech companies, so companies need to work hard to improve their infrastructure and become more consumer-friendly.
4. Indian FinTech lacks government support and incentives to protect its interests.
5. Like any other industry nowadays, the fintech sector has difficulty gaining the trust of investors.

Systemic risks are the non-conventional risks associated with the collapse or failure of a system. The past financial crisis of the US in 2008-09 and European crises in 2010-11 have proved that it is paramount to take note of factors in the systemic risk to financial institutions arising from other parts of the world. Initially the Indian banking system was relatively unaffected by the crises mentioned above, but it was indirectly affected due to

[240] A. Kanagala & P. K. Priya, “Fintech Issues and Challenges in India”, International Journal of Recent Technology and Engineering, September 2019

the presence of foreign banks in India[241]. This has proved that monitoring of systemic risk is essential to avoid potential system failure. The COVID-19 pandemic in 2020 is yet another existing example of triggering a systemic risk that might cause the economy to collapse. It is important to note that in India, the government has rolled out fiscal packages to boost economic growth and help the borrowers to pay their debt. However, it is also vital to consider the stress it puts on the banks and whether the banks will withstand this strain. The Reserve Bank of India (RBI) conducts the Systemic Risk Survey (SRS) to understand the perception of experts, including market participants, on the material risks faced by the financial system[242]. SIBs are considered "too big to fail" banks. This has raised expectations that the government will support these banks in difficult times. As a result, banks enjoy an unfair advantage in the financial markets. However, this support increases risk-taking behavior and decreases discipline, thus increasing the likelihood of future difficulties. Therefore, to avoid such failures and reduce the associated moral hazard, SIBs are subject to a number of additional policy measures. In accordance with the provisions of Basel III, a governance framework for domestic systemically important banks (D-SIBs) has been created. Under the D-SIB framework, national authorities carry out assessments to assess the impact on local economies and banks and take measures to limit the negative impact of external systemic influences and provide the necessary stimulus. The RBI will publish a list of these D-SIBs based on data collected from the banks and notify the systemically important banks through a press release.

[241] R. Verma, W. Ahmad, G.S. Uddin & S. Bekiros, "Analysing the systemic risk of Indian banks", Economics letter, 2019

[242] Ministry of Finance, Govt. of India, New Delhi, "Report on Trend and Progress of Banking in India 2014-15 and Financial Stability Report 2015", Reserve Bank of India.

4.3.4 China

In recent years, China has significantly expanded its digital capabilities and markets, becoming a leader in multiple areas of the digital economy and rivaling the United States as one of the world's leading digital superpowers. The country has made significant progress in the fintech sector, which is primarily concerned with the provision of financial services through the use of information technology. Innovations mainly focus on the use of digital payments, third-party mobile payments, non-banking platforms, peer-to-peer lending and microcredit, used by around 86% of the population, with increasingly active players in the field. They are trying to build an integrated ecosystem of seller-customer relationships. China is also home to a third of the world's unicorns[243] and is considered one of the world's leading hubs for digital investments and startups. This achievement is largely due to China's growing venture capital sector which pays particular attention to new technologies such as virtual reality, artificial intelligence and big data. The overall rapid digitalization process was also supported by appropriate government procedures. Indeed, Chinese policymakers have chosen a "light-touch" approach in the early stages of digital development. As a result, there has been a relative lack of policies regulating these new processes and industries, and companies operating in this sector have been free to test and evaluate new innovations. Only years later, as the market matured, governments moved to a proactive approach that included regulatory frameworks and tools to strengthen and support the digital economy both as consumers and authors[244].

As China's economy transitions from rapid growth to high-quality development, industrial restructuring and improvement require the financial sector to better contribute to the real economy. Technology-driven financial innovation reduces transaction costs, eases social and financial tensions and has significant inclusion effects. However, fintech can introduce new risks that positively impact the efficiency of financial transactions. In this context, as the leader of China's financial system, the banking industry relies on the systematization of compliance and supervision of individual licensed enterprises[245]. They can thus provide a high-quality application platform for the technology. Compared to other financial institutions, the banking sector can benefit from fintech while maintaining

[243] Start-up with a value of over 1$ billion
[244] L. Zhang & S. Chen, "China's Digital Economy: Opportunities and Risks", IMF Working Paper, Asian Pacific Department, January 2019
[245] A. Ali, "Beyond traditional micro-finance: Financial incusion for Unbanked Kenyans", International Journal of Social Science Studied, 2016

financial stability. As a result, China has turned to the banking sector as a pioneer and pillar of fintech development. However, the widespread use of technology, while improving the operating efficiency of financial institutions, makes systemic risk more complex, contagious, covert and sudden and endogenous risk accumulated in the system[246].

Although banks' internal risk management is sound compared to other financial institutions and their external supervision systems are also good, the development and application of fintech in the banking sector has shown two obvious effects. On one hand, fintech applications such as big data and blockchain can significantly reduce information asymmetry and transaction costs, facilitate business, increase the supply of credit to small and medium-sized enterprises, improve the efficiency of banks, eliminate non-systemic risks such as liquidity risk[247]. Innovative technologies such as intelligent algorithms and cloud computing have expanded the accessibility and depth of comprehensive financial services[248]. On the other hand, the development of fintech poses new challenges to China's financial supervision, increasing risk-taking by banks, increasing risks endogenous to the system, and ultimately exacerbating systemic risks in the banking sector[249].

The 14th Five-Year Plan[250] proposes to speed up the reform, opening up and development of the financial sector with six moves, including preventing financial risks and growing the fintech. It sets the tone for preventing and resolving the systemic risk. Therefore, it is critical to find out the impact of fintech development on systemic risk in the banking industry and the supervisory measures.

Speaking of China, it is right to open a small debate on what are the most advanced cities in this context and specifically in Eastern Asia. The cities we are talking about are Singapore and Hong Kong. Asia's two main financial centers, Singapore and Hong Kong,

[246] Y. Fang, L. Wang, W. Wang & Y. Wang, “Systemic Risk in Fintech: A prespective on endogenous risk”, Journal of Central University of Finance & Economics, 2020
[247] T. Sheng & C. Fan, “Fintech, Optimal Bnaking Market Structure and Credit Supply for SMEs”, Journal of Financial Research, 2020
[248] F. Guo, J. Wang, F. Wang, T. Kong, X. Zhang & Z. Cheng, “Measuring China’s Digital Financial Inclusion: Index Compilation and Spatial Characteristics”, China Economic Quarterly, 2020
[249] M. Liu, “Fintech and Commercial Banks’ Systematic Risk – An Empirical Study on Listed Banks in China”, Wuhan University Journal, 2021
[250] The 14th Five-Year Plan for Economic and Social Development and Long-Term Goals to 2035 of the People's Republic of China is a set of economic goals designed to strengthen China's economy between 2021 and 2025.

are ranked third and fourth respectively, behind London and New York, in the latest edition of the biannual Global Financial Center Index (GFCI). In terms of competitiveness, Singapore was rated better than Chinese cities in all five criteria used, including business environment, human capital, infrastructure, financial sector development and reputation. Shanghai moved up one place to 6th place, Seoul to 10th place, while Beijing dropped two places to 15th place.

Singapore and Hong Kong are at the forefront of the fintech sector through a combination of favorable regulations, government support, investment, advanced infrastructure, access to skilled talent and a strategic location in Asia. These elements help create a dynamic and innovative ecosystem that fosters the growth and adoption of fintech technologies. Regarding infrastructure and regulations:

- Favorable Regulations: Both countries have adopted regulations that facilitate the development of fintech. The financial authorities of Singapore (MAS - Monetary Authority of Singapore) and Hong Kong (HKMA - Hong Kong Monetary Authority) are proactive in creating a regulatory environment that supports innovation while ensuring financial security and stability.
- Regulatory Sandboxes: Both countries offer "regulatory sandboxes" that allow fintech startups to test their products in a controlled environment before a full launch. This helps reduce the risks associated with innovation and facilitates the adoption of new technologies.

Regarding Ecosystem and Innovation:

- Technology and Innovation Hubs: Both Singapore and Hong Kong are recognized as global innovation hubs, with advanced technology infrastructure and strong support for research and development. This creates fertile ground for the growth of fintech technologies.
- Investments and Financial Support: Both countries attract huge investments from both public and private entities. The Singapore government, for example, has launched various support funds for fintech startups. Hong Kong, for its part, offers tax incentives and other forms of financial support.

Talking about Talent and Collaboration:

- Skilled Talent: Both countries have access to a highly skilled workforce, with many universities and research institutes offering specialized programs in fintech and related technologies.
- International Collaborations: Singapore and Hong Kong have established numerous international collaborations with other nations, technology companies and financial institutions, thus facilitating access to new ideas, technologies and markets.

Regarding Access to Markets:

- Strategic Location: The geographic location of Singapore and Hong Kong as gateways to Asian markets is another key factor. This allows fintech companies to easily access a large base of customers and business partners in the region.
- Culture of Innovation: Both countries foster a culture of innovation and risk-taking, with a vibrant business environment that encourages experimentation and growth.

Examples of Success:

- Notable Projects: Singapore and Hong Kong are home to numerous successful fintech projects and initiatives. For example, Singapore has developed its own real-time payment system, PayNow, while Hong Kong has launched the Faster Payment System (FPS) initiative.
- Events and Conferences: Both countries host major global fintech events, such as the Singapore Fintech Festival and Hong Kong Fintech Week, which attract thousands of participants from around the world, creating opportunities for networking and collaboration.

Singapore and Hong Kong are certainly among the most powerful financial hubs in the world, thanks to the combination of factors mentioned above. However, competition with other financial centers such as New York, London and Tokyo is intense, and each of these hubs offers unique advantages that continue to maintain their importance in the global

financial landscape. Here's an overview of their strengths and how they compare to other global financial hubs:

As for Singapore, it is known for its political stability and a robust, well-managed economy. This stability attracts investors and companies from all over the world. The Monetary Authority of Singapore (MAS) takes a progressive and pro-innovation approach, including advanced fintech regulation. Singapore offers world-class technology and communications infrastructure that is essential for the financial sector. it is also a pioneer in the adoption of advanced technologies, such as artificial intelligence and blockchain, and offers regulated test environments (sandboxes) for fintech startups.

Speaking of Hong Kong, its position as a gateway to mainland China is a significant strategic advantage for international financial firms. Hong Kong has one of the most liquid stock markets in the world and a strong presence of global financial institutions. The Hong Kong Monetary Authority (HKMA) and other local authorities maintain a robust and transparent regulatory framework that is attractive to global investors. Hong Kong is a hub of fintech innovation, supported by a vibrant ecosystem and international events such as Hong Kong Fintech Week.

One of the main strengths is that both countries have diversified economies and do not depend on a single economic sector. They are both attractive cities for global talent thanks to favorable migration policies and a high quality of life; and, as we have already said, they are centers of innovation, especially in fintech, with significant support from local governments and private institutions.

4.3.5 South Africa

South Africa[251] has established itself as one of the leading powers of the African continent, being greatly more developed than many other realities of that same region. However, its results are still lacking when compared to those of OECD or G20 countries. Given the urgency for faster economic growth and the mentioned crucial role of the digital economy, the Department of Communication and Digital technology has worked hard in the creation of a comprehensive strategy for the achievement of a proliferous and most of all inclusive digital empowerment, providing both visions of what could be obtained and practical plans for their implementation. 'The ICT and Digital Economy Masterplan' was developed through a long process of research and consultations around the transversal digital impact, all of which have culminated in a program structured around four "big bets" needed for ZA's digital world to reach the main objectives of inclusive growth, job creation and digital transformation with the support of a series of enablers, including inclusion, skills and governance. Each of these bets is then further dissected to present the current situation, possible impacts and main areas of action[252]:

- Physical technology production: It relates to the production of the necessary components for the manufacture of innovative technologies, form 3D printing to AIs. Seeing as they require multiple components and their spread is constantly increasing, this sector could generate great opportunities for business growth and job creation. In particular, South Africa aims at bringing this production in-house, exploiting the overall lower cost of 4IR technologies' production and the consequent higher possibility for economies of scale compared to traditional goods, in whose manufacture South Africa has always struggled
- Transformative tech applications: If South Africa really plans on gaining the full advantages of the digital revolution, producing the components for outside realities will not be enough. Industries applying said digital processes and business models will also need to be drawn into the country, in the form of global players' local plants and domestic companies. Their presence will in fact have positive spill-over effects on the further encouragement of innovation and start-

[251] C. S. Chivvis, Z. Usman & B. Geaghan-Breier, "South Africa in the emerging World Order", article published on Carnegie on 2023.
[252] Genesis Analytics and Knowledge Executive, "ICT and Digital Economy masterplan for South Africa, 2020

ups, on the increment of skills and value-added activities and on the creation of job opportunities.

- Digital platforms: They are the core instrument to make supply and demand meet, offering big and small business realities an easier and more effective way to enter new markets and keep track of their consumer base needs and activities, as well as involving a reduction in transaction costs. Even though South Africa has a number of platforms already operating in its territory, most of them have yet to reach significant scale and maturity, specifically if one looks at the low skill service sector.
- Digitally traded services: These services are part of the so called Global Business Services (GBS) and relate to IT-enabled services available and deliverable anywhere, anytime. In the last few years especially, these types of services have allowed multinational companies to diversify their locations in an attempt to reduce geographically-induced risks. If exploited well, South Africa could reap great results from this sector, gaining higher foreign direct investments and creating more jobs.

For what concerns the fintech filed, Fintech is developing in Africa in ways that are unique when compared to other jurisdictions. There appear to be four trends emerging in key African regions in relation to Fintech, these being 'formal meets informal', 'physical meets digital', technology convergence and sector convergence. Data is a central component in the world of Fintech. What is interesting to observe in Africa is that data hubs are decentralised (i.e. data is being collected, mined and analysed at the same time by various players in the Fintech ecosystem for various purposes). This means that there are potentially a lot more players that can, and do, hold data, which is critical for Fintech operations. Africa is also fertile ground for Fintech development due to the opportunities that exist given the real and relative size of its unbanked population which needs access to financial services[253].

[253] Bowmans, "Fintech in Africa: Unpacking risk and regulation", 2017

Key Fintech Sectors[254] in South Africa

Payments and Remittances: Mobile payment solutions and remittance platforms are revolutionizing the way people transfer money. Companies like Yoco and SnapScan are making it easier for merchants to accept digital payments.

Peer-to-Peer (P2P) Lending: P2P lending platforms are making it easier for small businesses and individuals to access credit. These platforms use advanced algorithms to assess risk and determine loan eligibility.

Insurtech: Insurance technologies are emerging as a key area of fintech, with startups offering personalized insurance policies and risk management services through digital platforms.

Blockchain and Cryptocurrencies: Although still in its early stages, blockchain and cryptocurrency adoption is growing, with a growing number of companies exploring how these technologies can be used to improve the efficiency and security of financial transactions.

Regtech: Regulatory technologies (Regtech) are helping financial institutions manage regulatory compliance more effectively and reduce associated costs.

Consequently the most relevant challenges and opportunities that need to be addressed are:

Financial Education: One of the main challenges is financial education. Many South Africans are still not fully comfortable with the use of digital financial services. Financial literacy campaigns are crucial to increasing the adoption of these services.

Internet Infrastructure: Although mobile penetration is high, broadband internet access remains limited in some rural areas. Improving telecom infrastructure is essential for the expansion of fintech.

[254] FINASA (Fintech Association of South Africa), is a non-profit organization dedicated to promoting and supporting the growth and development of the fintech industry in South Africa. They offer a range of services and resources to help fintech companies thrive. These include networking events, mentoring programs, regulatory guidance, and access to funding opportunities. See more: S. Thorne, “What to expect for Fintech in South Africa in 2024”, 2024

Cybersecurity: With the increase in digital transactions, cybersecurity has become a growing concern. Fintech companies must invest in robust solutions to protect customer data and prevent fraud.

A famous example of Fintech Startups in South Africa is Luno[255]: Developed in South Africa, Luno makes buying, selling, storing and selling cryptocurrencies easy and accessible to all. Their mission is to empower everyone with the power of crypto, and manage virtual assets such as Bitcoin, Ethereum and other coins.

A stable and well-functioning financial system contributes significantly towards balanced and sustainable economic growth. When the risks and vulnerabilities affecting the financial system are mitigated, systemic events are less likely to occur. Systemic events are likely to negatively affect 'real' economic variables such as gross domestic product growth and unemployment, and may reduce public trust and confidence in the financial system[256]. The Financial Sector Regulation Act 9 of 2017 (FSR Act) as amended makes the SARB responsible for protecting and enhancing financial stability in South Africa[257]. If systemic events occur, the SARB will manage them and lead efforts to restore financial stability.

The SARB[258] is not the sole custodian of this mandate. In addition to its own contributions, the SARB coordinates the efforts of government, financial sector regulators, organs of state, self-regulatory bodies, financial market participants and other

[255] See Luno website for more details about cryptocurrencies in South Africa: https://www.luno.com/en/about

[256] FSCA (Financial Sector Conduct Authority). The Financial Sector Conduct Authority (FSCA) is a unique independent institution established by statute to ensure a fair and stable financial market where consumers are informed and protected and where those who jeopardise the financial wellbeing of consumers are held accountable. Furthermore, the FSCA enhances and supports the integrity of the financial system.
The FSCA has six core divisions namely: the Licensing and Business Centre, Regulatory Policy, Conduct of Business Supervision, Market Integrity, Retirement Funds Supervision, Investigations and Enforcement. We also have specialized support departments such as, Human Resources, Financial Management, Legal, Communications and Language Service, Facilities and Security, Governance, Risk and Assurance (GRA), Supply Chain Management and Information Communications and Technology, to support the core divisions.

[257] South African Reserve Bank, "Financial Stability", 2020

[258] SARB (South African Reserve Bank). In August 2017, a Fintech Unit was established within the SARB to explore the implications of fintech innovation for the SARB and financial services in South Africa in a structured, organised and proactive manner. The main goal of the Fintech Unit is to respond to the rapidly changing environment with agility, flexibility and speed by assessing how financial services innovation driven by technological developments impact on policies and regulations, and to assist in aligning policies and regulations with emerging innovation when required.

stakeholders to protect financial stability. To achieve this goal, the Governor of the SARB and the Minister of Finance have agreed on a policy framework that outlines:

- the SARB's responsibility for mitigating the build-up of risks and vulnerabilities that could threaten the stability of the domestic financial system; and
- a crisis management framework for systemic risks and events.

In conclusion we can therefore say that the fintech sector in South Africa is rapidly evolving and offers many opportunities for innovation and growth. With the right support in terms of regulation, infrastructure and financial education, South Africa has the potential to become a leader in the fintech sector in Africa and beyond.

CONCLUSIONS

Based on what has been said so far we can have an overview of the financial sector scenario and how it has been the protagonist of numerous changes. As mentioned in various chapters, the use of cutting-edge, innovative and efficient technologies will transform not only lifestyles, but also markets, economies and the world in general, expanding them towards new horizons. As for the banking sector, we can say that it is going through an important evolution and a complete transformation towards sustainability and technology. Partnerships between banks and fintech startups have and will continue to increase more and more, with the former providing capital and experience in the finance, electronic money and credit sectors, and the latter offering strong technological and innovative potential. We live in the 4.0 era, where digitalization is a daily part of our lives and an essential vision for turning challenges into successes. Marco Giorgino, Scientific Director of the Fintech & Insurtech Observatory, explains: "Digital is revolutionizing the Italian financial ecosystem, encouraging the emergence of innovative players and creating new needs". Regarding the European fintech sector, we can say that it is very dynamic and Europe is considered an innovator in the payments sector. Therefore, it can be said with certainty that there will be no difference between financial services companies and fintech companies, as not all companies in the sector can become fintech. In recent months there has been much discussion about the birth of the Metaverse, a persistent three-dimensional online universe that connects different virtual spaces. It's natural to think that if one day it were possible to meet at a specific point in the metaverse, it would also be possible to purchase products or services or make financial transactions. From security to immediacy, from spending security to traceability, the world of fintech is preparing to take another, perhaps decisive, step forward in an increasingly technological world.

The financial crisis of 2007-2009 not only had a devastating impact on the global real economy, but, along with the rise of fintech, environmental concerns about financial technology have become even more salient consequently identifying “systemic risk”. In this study I wanted to use Schwarcz's definition of systemic risk. Economists and other academics have historically tended to think about systemic risk from the perspective of financial institutions such as banks, and rarely from the perspective of financial markets.

However, given the growing disintermediation that allows companies to access capital market financing without going through banks and other intermediaries, more attention needs to be paid to financial markets and market-institution relationships. After the 2008 financial crisis, it was widely recognized that “too big to fail” financial institutions posed a significant risk to the overall health of the economy. The objective is to understand whether a particular level of connectivity is associated with a precise level of systemic risk. If the results are positive it will be possible to plan interventions to adjust and resolve systemic vulnerabilities. However, it should be considered that the predictive power of systemic risk associated with centrality indices is always limited and not entirely exhaustive. Financial markets, in fact, are protected by a level of complexity that cannot be fully understood. Finance and markets are interconnected globally, so a system collapse in one country will inevitably affect markets and systems in other countries. Only the right approach can improve our understanding of market vulnerabilities and volatility, enabling better structured regulatory policies and more efficient shock response systems.

In particular, with regards to systemic risk, we referred to and considered the so-called "SupTech". SupTech could revolutionize the regulatory and supervisory framework. In an ever-changing regulatory and financial landscape, uncertainty is the only stable variable. In this context, it can be said that supervision faces various technical and other challenges. The scale and speed of change have reshaped many aspects of the economy, society and law in search of new legal categories for a world dominated by technology. In the financial sector, the SupTech phenomenon has offset the difficulties related to the rapid tightening of regulations. The digital age represents an epochal change in supervision and supervisors' usual ways of working are at high risk of obsolescence and inefficiency. Suptech tools have the potential to improve monitoring efficiency by providing tools that can analyze and process large amounts of data in a short period of time. This is crucial at a time when the amount of data received by banking regulators is enormous. Data availability and innovative technological paradigms will also lead to better predictive capabilities for surveillance and prediction of risky behavior, providing an advantage in ensuring system stability. SupTech can play an important role in achieving financial stability by supporting banking supervisors and regulators in their various tasks and should therefore be used in a harmonized way across the EU. The EU must therefore start addressing the legal and operational issues arising from SupTech without endangering its development. It should be underlined that our country is also

moving in line with the European strategy, paying particular attention to supporting innovation and Suptech solutions. We consider the efforts made by the Bank of Italy and other responsible EU authorities. To establish a dialogue with the market through the FinTech channel, the regulatory sandbox and the Milan Hub Innovation Center, initiatives have been implemented with the support of the European Innovation Champions Forum which will contribute to this important dialogue that distinguishes the European supervisory authorities (EFIF).

Last but not least, we wanted to analyze how the countries of emerging economies, better known as BRICS, experience the fintech phenomenon in this digital era that is revolutionizing the world. We have noticed how growth and innovation are the cornerstones, in fact BRICS countries are emerging as fintech innovation hubs, thanks to a combination of young populations, high mobile penetration and the availability of risk capital. Fintech in these countries is growing rapidly, contributing to financial inclusion and access to banking services for previously unserved populations. Regulation varies significantly between BRICS countries. While China and India have more developed regulations and a more proactive approach to regulating fintech, other countries such as Brazil and South Africa are still refining their regulatory frameworks. Government policies play a crucial role in promoting or limiting fintech innovation. As for digital infrastructure, it is constantly evolving in BRICS countries, with improvements in internet connectivity and electronic payment systems facilitating the adoption of fintech. China, in particular, has made great strides with its digital payment infrastructure, becoming a world leader in this sector. Partnerships between local fintechs and traditional financial institutions, as well as international collaborations, are key to the expansion and success of fintechs in BRICS countries. These collaborations help overcome challenges related to scalability and consumer trust. One of the biggest impacts of fintech in BRICS countries is financial inclusion. Fintechs are providing financial services to segments of the population that have historically been excluded from the traditional banking system, improving access to credit, payments and other essential financial services. Despite numerous opportunities, BRICS countries also face significant challenges, such as cybersecurity, data protection and risk management. Fintechs must address these issues to earn and maintain consumer trust. Looking ahead, BRICS countries have the potential to become global leaders in fintech. With continued investment in technology, regulatory improvements and a focus on innovation, these nations can push the boundaries of what

is possible in fintech, promoting greater inclusion and economic growth. In summary we can say that, if on the one hand, specifically in the developed countries of the West, fintech is seen purely with the aim of modernizing and improving the existing financial system, making it more accessible, efficient, safe and in line with needs of a digital and globalized economy, on the other hand the objective of fintech in BRICS countries and emerging economies is to democratize access to financial services, promote technological innovation, improve efficiency and contribute to development sustainable economy. These companies are at the forefront of transforming the financial landscape, making services more inclusive, accessible and convenient for a wide range of users. BRICS countries are playing an increasingly important role in the global fintech landscape. Their unique approach to technology, combined with strong growth potential, positions them as emerging leaders in this dynamic and rapidly evolving industry.

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