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From Deregulation to the Twin Transition: Exploring Banking Strategies for Sustainability and Digitalisation

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Abstract

This article explores the evolution of empirical banking research in developed countries over the past 30 years, reflecting the sector's adaptation to changing regulatory and economic environments. We identify key areas that have shaped banking research, including priorities and strategies during the deregulation era and the culture crisis triggered by the global financial crisis. The discussion then shifts to two critical emerging themes: sustainability and digitalisation, highlighting their convergence in a 'twin transition' that addresses the interconnected challenges of climate change and technological disruption, both of which demand transformative approaches to banking practices, strategies, and policies.

Keywords: Banking Sector Deregulation; Great Financial and Culture Crisis; Net zero; Sustainable Digitalisation; Twin Transition.

JEL Classification: G21; G28; Q54, O33

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1. Introduction

Governments have traditionally exerted considerable influence over the banking sector. This involvement often included direct ownership, regulation of interest rates, credit allocation, and other interventions aimed at stabilising the economy, promoting development, or achieving specific policy objectives. In many industrialised countries, particularly during certain historical periods, governments imposed strict controls on interest rates and credit quotas, directing banking activities to support industrial growth and other national priorities (Gardener and Molyneux, 1990; Schwartz, 1992; Stiglitz, 1994).

The shift towards a more market-oriented approach emerged with the rise of neoliberal economic policies, resulting in extensive liberalisation and deregulation during the late 1980s and early 1990s. This transition marked a significant departure from government-driven models, as banks began prioritising efficiency, productivity, and competitiveness, with many transitioning into private, profit-oriented institutions (Altunbas et al., 2006). During the late 20th century, deregulation shaped a financial paradigm focused on market-driven growth and improved performance.

Key factors contributing to this shift included major advances in information technology, financial innovation, and a greater emphasis on prudential supervision over direct government intervention. The 1990s also witnessed a sharp increase in bank consolidation (DeYoung et al., 2010), as institutions expanded their asset bases through mergers and acquisitions and entered new geographical and product markets. These strategies were driven by the growing integration of global financial markets, which offered both opportunities and challenges for the sector.

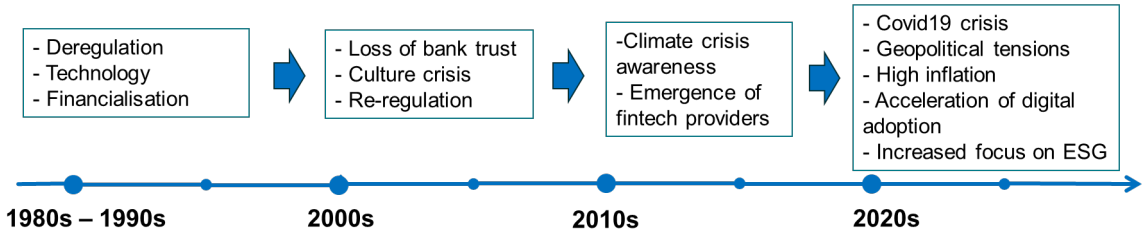
During this time, the financial sector became more dominant, a shift encapsulated by the term '*financialisation*.' Epstein (2005) defines financialisation as "*the increasing*

importance of financial markets, financial motives, financial institutions, and financial elites in the operation of the economy and its governing institutions, both at the national and international level." Fundamentally, the concept highlights the growing influence and power of finance in shaping economic decisions, resource allocation, and even social outcomes. While financialisation enabled the rapid growth of the sector, it often came at the expense of broader societal well-being and long-term economic stability, as observed by scholars such as Lapavitsas (2011) and Krippner (2012).

Despite its widespread adoption, neoliberalism has been associated with numerous negative consequences. For example, it has contributed to a marked increase in income inequality and wage stagnation (Palley, 2007; Epstein, 2021), a reduction in social safety nets (Lavinas, 2023), and heightened financial instability (Van der Zwan, 2014). Several studies (e.g., Born, 2011; Claessens and Kodres, 2014; Thakor, 2015) have established links between the deregulation processes underpinning neoliberal policies and the onset of financial crises.

These deregulation efforts have also been linked to a broader culture crisis within the banking sector (Figure 1 and Table 1 in the Appendix) that has manifested in repeated instances of bank misconduct (Nguyen et al, 2016; Bertsch, 2020, Arnaboldi et al, 2021) and the widespread mis-selling of financial products and services (Brannan, 2017). Such episodes have not only eroded public trust but also highlighted systemic ethical failings within the sector.

Figure 1. Environmental trends affecting the banking sector (1980s–2020s)



The onset of the 21st century brought new global challenges, prompting a reassessment of banking priorities. Heightened awareness of systemic risks, including climate change and technological disruptions, has necessitated a dual emphasis on sustainability and digitalisation. This evolution reflects the sector's response to the urgent need for innovation and resilience in an increasingly interconnected world. In addition, as biodiversity faces an unprecedented crisis (Brondízio et al., 2019; Giglio et al., 2023), numerous studies have underscored the urgent need for action and the adoption of more balanced and socially responsible economic frameworks.

Among the various institutions implicated in this transition, banks are often perceived as bearing greater responsibility than others (EBA, 2021). This heightened responsibility arises from their unique role as financial intermediaries and the significant volumes of funds they control. By channelling funds from savers to borrowers, banks are well-positioned to support investments in sustainable projects, advance green technologies, and, more broadly, facilitate the transition to a low-carbon economy. Moreover, their capacity to influence financial flows and assess risks positions them as crucial players in aligning economic activities with global sustainability goals.

Some argue that governments should provide incentives to encourage banks to actively participate in the transition to sustainability.[3] Over the past thirty years, global greenhouse gas (GHG) emissions have risen by more than 60 per cent, with carbon dioxide (CO_2) accounting for approximately three-quarters of these emissions. As the primary driver of climate change, reducing CO_2's is critical to achieving net zero targets. However, data from Rainforest Action Network, a coalition of campaign groups, suggest that the world's largest banks have provided funding for a total of $6.9 trillion to the fossil fuel industry in the eight years since the signing

[3] https://www.theglobalcity.uk/insights/scaling-transition-finance.

of the Paris Agreement in 2015.[4] While it is possible that some of these fossil fuel-related projects may have green components, the lack of detailed data makes it difficult to assess their sustainability credentials. This highlights a significant issue: focusing solely on improvements in green investments is insufficient if banks simultaneously increase their financing of 'brown' assets. The lack of transparency and the unavailability of comprehensive data present major challenges to achieving the transition to net zero.

Simultaneously, the rise of digitalisation presents its own set of challenges for the banking sector. While the adoption of digital technologies offers the potential to enhance efficiency, improve customer experience, and foster financial inclusion, it also introduces significant risks. Key challenges include concerns over data security and privacy, especially with the increasing reliance on big data and cloud technologies (Carriere-Swallow and Haskar, 2019). Moreover, algorithmic biases in artificial intelligence (AI) systems, such as those used in credit scoring or loan approvals, can inadvertently exacerbate inequalities, creating reputational and regulatory risks (Bartlett et al, 2021).

Additionally, the growing market dominance of large technology firms in financial services raises concerns about digital monopolies (Doerr et al, 2023; Farboodi et al, 2019). This concentration of market power not only limits competition but also increases systemic risk. Banks must also contend with the environmental impact of digitalisation, such as the carbon footprint of data centres and blockchain technology, which could undermine their sustainability objectives.

In this paper, we provide a selected literature review organised under the following key themes: bank strategies and priorities during the deregulation era, focusing on efficiency and competition (Section 2); the financial and cultural crises (Section 3); the role of banks in

[4] https://www.ft.com/content/92e59d2a-1b8d-4e19-a5b6-4278820d0f24

promoting sustainability (Section 4); and the impact of digitalisation on the banking sector (Section 5). Finally, Section 6 concludes by synthesising these insights and discussing the implications of the twin transition for the future of banking.

2. Banks' strategic priorities during deregulation: Efficiency and competition

During the 1980s and 1990s, the banking sectors of most industrialised countries underwent significant transformation, driven by several key forces of change. Structural and conduct deregulation enabled banks to expand into new geographical and product markets, consolidate through mergers and acquisitions, and diversify into a broader range of financial activities. These changes fostered greater competition and innovation across the sector. Concurrently, advancements in technology revolutionised banks' internal processes and operations, enhancing the range and sophistication of financial products and services offered to clients (Gardener and Molyneux, 1990; Molyneux, 1990; Berger et al., 1995; Berger, 2003).

As banks were allowed to privatise and restructure ownership into joint-stock companies, many institutions rapidly adopted a shareholder value-oriented culture (Altunbas et al., 2001; Fiordelisi and Molyneux, 2006; 2010). Between 1995 and the mid-2000s, significant consolidation occurred both nationally and globally, leading to the emergence of the largest banking conglomerates (Amel et al., 2004; DeYoung et al., 2010). Key objectives during this period included achieving economies of scale, reducing labour and operational costs, and minimising inefficiencies. As Goddard et al. (2007) observe, many banks shifted their focus away from net interest margins, which faced increasing competitive pressures, towards non-interest income sources such as bancassurance and off-balance-sheet activities that generate fees and commission income.

Scale and scope economies are often cited as rationale for why financial institutions tend to growth in size and complexity over time (Boot, 2003) and have been the subject of extensive academic research (Leaven and Levine, 2007). Earlier studies emphasised the benefits of achieving economies of scale and scope through larger and more diversified operations (Clark and Speaker, 1994; Altunbas and Molyneux, 1996). More recently, the rise of fintech has shifted the focus to more specialised operators and the value of diversification (Boot, 2017). One alternative (or complementary) explanation is that implicit or explicit government guarantees, along with concerns about institutions being too big to fail (TBTF), may provide size-related competitive advantages. As a result, we witnessed the growth of universal banks: despite not being particularly efficient, these institutions generate enough revenue to remain competitive against more specialised financial institutions.

The drive to contain operational costs and minimise inefficiencies led to an extensive body of literature that examines bank efficiency, employing various methodologies across different countries and regions. Early studies, such as those reviewed by Berger and Humphrey (1997), emphasised achieving cost savings through optimal firm size and product diversification, focusing on scale and scope economies. These studies also explored operational efficiency, including both technical and economic dimensions.

Popular parametric methods for estimating cost functions include the stochastic frontier (SFA) approach (Aigner, Lovell, and Schmidt, 1977), while data envelopment analysis (DEA) (Charnes, Cooper, and Rhodes, 1978) is the most widely used non-parametric technique. Comprehensive surveys of bank efficiency literature include: Berger and Mester (1997); Berger (2007); Yldrim and Philippatos (2007); Paradi and Zhu (2013); Fethi and Pasiouras (2010). The earlier literature highlights that banks operated below optimal efficiency levels, indicating significant potential for cost savings. Additionally, technological advancements were identified

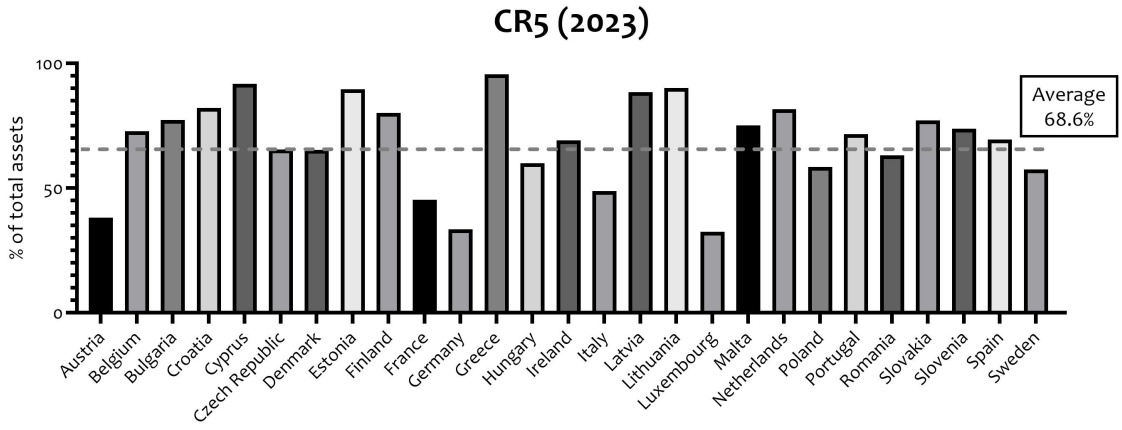
as a key driver of efficiency improvements, particularly when effectively implemented and integrated within banks' operations (Berger and Mester, 1997).

The role of regulation is acknowledged in shaping the competitive landscape and operational frameworks, which significantly impact bank efficiency (Berger et al, 2009; Chortareas et al, 2012; Gaganis and Pasiouras, 2013). Cross-country variations in efficiency scores further highlight the impact of differing market conditions, regulatory structures, levels of competition, and stages of economic development (Casu and Molyneux, 2003; Carbó Valverde et al, 2007). More recently, Ayadi et al., (2025) look at the relationship between digitalisation and bank efficiency and find that IT investments improve profit efficiency. They also find that retail banks benefit the most from the digital transition.

These insights have provided a foundation for understanding how banks can enhance efficiency while adapting to dynamic economic and regulatory landscapes. Surveys of the more recent efficiency literature include Emrouznejad and Yang (2018); Ahmad et al (2020). Doumpos et al., (2023) review 338 publications using operational research or AI methods applied to banking, of these 108 on bank efficiency. They note the increase in the number of publications using machine learning techniques, to leverage data rich corporate environments.

As predicted by the early bank efficiency literature, consolidation did become widespread in the industry, especially post global financial crisis (GFC). Even accounting for cross-country variation, the EU banking markets are highly concentrated, with the market share of the top 5 banks (by total assets) averaging at 68.6% vs 42% in the US (see Figure 2).

Figure 2: Bank concentration (CR-5) EU banking markets



Source: Data from the European Data Warehouse.

While efficiency improvements have been a central focus in the evolution of banking, competition also plays a critical role in shaping the conditions under which banks operate, influencing their market behaviour, cost structures, and strategic priorities. The competitive environment in the banking sector has been a prominent focus for both researchers and policymakers (Liu et al., 2013; Casu et al., 2021). Competition in banking is critical because it affects efficiency, innovation, financial stability, and the quality of services offered to customers.

The early literature frequently employed the structure-conduct-performance (SCP) paradigm, which posits that market structure determines competitive behaviour, which in turn impacts performance. Early studies such as those by Gilbert (1984), Evanoff and Fortier (1988), and Molyneux and Forbes (1995) relied on this framework to explore the relationship between market concentration and competitive dynamics. However, the SCP paradigm faced criticism for its indirect assumptions, which led to a shift in the methodological approaches. Tools such as the H-statistic from the Panzar-Rosse model, the Lerner Index, and the Boone Indicator provide more nuanced insights. Reviews of competition measurement in banking, such as those by Bikker and Haaf (2002) and Claessens and Laeven (2004) provide valuable context for

understanding these dynamics and their implications for policy and practice. These studies generally suggest that competition is influenced by market-specific factors, regulatory frameworks, and technological advancements. For example, the liberalisation of financial markets and the growth of fintech have increased competitive pressures in some regions, while high market concentration and barriers to entry persist in others.

The study of banking competition has received significant attention, particularly in the aftermath of the GFC, as policymakers sought to define a desirable market structure that balances competition and financial stability (Vives, 2016). The *competition-fragility view* suggests that higher competition reduces markups, thereby encouraging risk-taking and increasing financial instability (Keeley, 1990; Allen and Gale, 2004; Beck et al, 2013). In contrast, the *competition-stability view* argues that concentrated markets amplify systemic risks, as limited competition increases borrowing costs and incentivises riskier firm behaviour (Boyd and De Nicoló, 2005; Curti et al, 2022). Elekdag et al., (2025) revisit this debate by considering competition arising from the increase in fintech activities. They find a positive association between the presence of fintech and bank risk-taking, thus providing support for the competition-fragility hypothesis.

Advances in modelling have contributed to a deeper understanding of these dynamics. Traditional dynamic stochastic general equilibrium (DSGE) models often assumed perfect competition, disregarding the market power and strategic interactions inherent to banking markets. More recent frameworks incorporate oligopolistic competition, which better reflects real-world banking structures. These models suggest that concentrated markets amplify both real and financial shocks more than monopolistic competition, highlighting the importance of market structure in shaping the transmission of shocks and the dynamics of interest rate setting. Benchimol and Bozou (2024) formalise the trade-offs faced by policymakers when balancing financial stability and competition and propose that a moderately concentrated banking market,

with five to eight dominant banks, may strike the optimal balance between these competing objectives. Such findings emphasise the need for nuanced regulatory frameworks that consider the interplay of competition and stability in designing effective policies.

3. The financial and culture crises

The liberalisation process, while fostering competition and innovation, also had significant downsides. It contributed to increased risk-taking and heightened systemic vulnerabilities, as banks grew larger, more interconnected, and more powerful. The concentration of financial power became evident in the growing size of the financial sector relative to the overall economy, a phenomenon often described as "financialisation" (Epstein, 2005). This shift saw finance increasingly dominate economic decision-making, typically at the expense of broader societal goals and long-term economic stability. In many countries, the size of the financial sector relative to the economy increased substantially in the 1990s and early 2000s. For example, in the decades prior to the financial crisis, the UK financial sector grew more than twice as fast as the economy (Bank of England, 2011).

The rapid expansion of financial activities was accompanied by a shift in organisational culture. Many banks adopted a shareholder value-oriented approach, prioritising profit maximisation over ethical considerations. This cultural transformation exacerbated misconduct, as institutions engaged in excessive risk-taking and unethical practices, including the mis-selling of financial products and the manipulation of key benchmarks such as LIBOR (London Interbank Offered Rate). These behaviours not only undermined public trust but also highlighted systemic ethical failings within the sector.

The GFC further exposed the fragility and ethical deficiencies of the banking system. A significant number of studies (Ayar, 2012; Kim et al, 2013) emphasise how the combination

of these factors played a crucial role in the lead-up to the 2007-2008 GFC, demonstrating the complex trade-offs involved in financial deregulation. Risk taking occurred despite international efforts to strengthen bank capital regulation (the Basel II accord), as this was too focused on the risks associated with the traditional banking business and did not adequately address the emerging complexities and interconnectedness of modern financial markets.

Public bailouts of major financial institutions to prevent systemic collapse placed an enormous burden on taxpayers, fuelling widespread resentment and calls for accountability. Post-crisis investigations revealed pervasive issues such as fraudulent trading, tax evasion, and failures in governance, cementing the perception of a "culture crisis" in banking (Barth and Mansouri, 2021).

Rebuilding trust in the banking sector has since become a central challenge. Scholars and policymakers have advocated for a stronger emphasis on ethical practices, transparency, and diversity within organisations to address systemic biases and create a more accountable financial system. Gender diversity, for example, has been linked to reductions in misconduct episodes and improved decision-making within financial institutions (Arnaboldi et al., 2021). Regulatory measures, such as the UK's Senior Managers and Certification Regime, have also sought to instil greater accountability and improve behavioural standards in the industry.

The culture crisis underscores the critical need for systemic change within the banking sector. Addressing these deep-rooted issues requires a dual focus on fostering a values-driven culture and implementing robust regulatory frameworks to ensure ethical conduct and long-term stability.

The costs to society deriving from misconduct episodes and fraudulent practices can be vast and far-reaching as they erode trust in the financial sector and cause instability. On one hand misconduct can create uncertainty about the business model, solvency, and profitability

of banks (ESRB, 2015; Sikka, 2015). In a recent large study on banks operating in 160 countries over 2000-2016, Ammar et al. (2024) find that banks' loan officers' corruption significantly affects bank performance. On the other hand, misconduct episodes are also associated human costs when they result in financial loss for individual savings, investments and /or pensions and cause stress, anxiety, and other mental health issues to individuals and affect their family lives. In the US, in 2008 millions of people lost their homes, jobs and savings due to subprime mortgages; in 2016 the Wells Fargo cross-selling fraud resulted in financial losses for many savers and investors; the LIBOR scandal affected loan rates for millions of customers. The Economist's infamous cover "*Banksters*" (2012) summarised the public's views about the excess and irresponsibility in banking and about groupthink. The widespread malpractices were symptoms of a culture crisis as emphasised in the 2014 UK Banking Standards Review: "*Over the past 20 years, the norms of behaviour in important parts of the banking sector have fallen below what the public has a right to expect*" and "*A loss of trust in the banking sector as a whole has broad and damaging consequences*". In this context, public opinion shifted resulting in a greater demand for regulation and controls, and a change in culture towards more responsibility and accountability. Nobel laureate economist Joseph Stiglitz twenty years earlier famously wrote "*not only we have banks that are too big to save, but too big to be held accountable*" (Stiglitz, 1994). Little seemed to have changed since then.

Bank misconduct has been shown to have wide-ranging consequences, including a subsequent increase in online lending demand at the state and county levels, as borrowers may seek alternatives to traditional banking institutions due to trust erosion (Bertsch et al., 2020). Additionally, misconduct significantly affects a bank's reputation, undermining public confidence and stakeholder trust, which can have long-term implications for customer loyalty and brand equity (Soana et al., 2024). Furthermore, bank misconduct impacts equity returns

and valuations, as highlighted by the European Central Bank (2019), with reputational damage and potential regulatory fines often leading to declines in investor confidence and market value.

Finally, there is a plethora of studies (Cardillo et al, 2021) that identified lack of diversity as one of the main contributing factors to systemic biases and inequalities within banks and the finance sector at large where the environment allows malpractices to persist and even become normalised within the organisations. The narrow perspectives made it easier for unethical behaviours to go unchecked and a reduced chance of whistleblowing or challenging the status quo.

An emerging strand of the literature focuses on risk culture, measured using a textual analysis approach. In this context, risk culture - or risk awareness - is associated with the standards, attitudes, and behaviours related to risk management practices that can mitigate perceived and actual risks. Acheampong and Ibeji (2024) find evidence that risk culture is negatively associated with the cost of capital. Examining bank CEOs' risk culture, Semeyutin et al., (2023) identify a positive link between risk culture and financial stability confirming that improvements in governance can have a positive effect in reducing risk-taking.

3. Sustainability and the role of banks

The mid-2010s witnessed a rapidly growing awareness of the climate emergency, driven by scientific evidence and noticeable changes in the environment, including extreme events, such as floods, fires, droughts, and biodiversity losses. At a global level, a significant impetus was given in 2015 by the adoption of the United Nations' Agenda for Sustainable Development and its related Goals (UNSDG), and by the signing of the Paris Climate Agreement. Specifically for the banking sector, several initiatives have been launched to promote sustainability, align financial activities with climate goals, and encourage responsible

practices across lending, investments, and operations. In 2019 the UN Environment Programme Finance Initiative (UNEP FI) developed a set of guidelines known as the Principles for Responsible Banking (PRB) to help banks align their business strategies and practice with the UNSDGs and the Paris Agreement. The Principles provide a framework for banks to demonstrate their commitment to sustainability and responsible banking practices and tackle the climate crisis by shifting their loan books to energy renewable sources. With over 345 signatory banks (as of December 2024), representing more than half of the global banking sector, the PRB consists of six Principles aimed at introducing purpose, vision and ambition in sustainable finance (Figure 3).

Figure 3. The six principle for responsible banking

Source: UN Principles for Responsible Banking https://www.unepfi.org/banking/bankingprinciples/

Another important initiative is the establishment of the Net-Zero Banking Alliance (NZBA) in 2021. The NZBA is a global coalition of banks dedicated to aligning their lending and investment portfolios with net-zero greenhouse gas emissions by 2050. It offers frameworks, guidance, and peer-learning opportunities to support members in setting and achieving science-based targets by 2030 or earlier. However, a growing number of large banks

has recently left the target setting group, in a move that seems to be linked to the re-election of US president Donald Trump.[5]

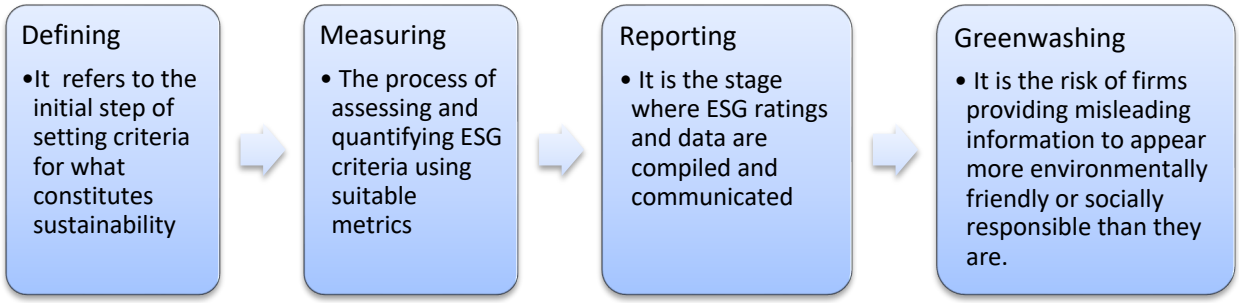
Within these initiatives, the concept of "*responsible banking*" takes on a broad connotation, encompassing sustainability in the form of, for example, ethical and green investing, social responsibility, transparency and accountability, trust and stakeholder engagement. In the transition to net zero, banks are increasingly focusing on incorporating environmental, social, and governance (ESG) criteria into their operations. This includes offering sustainable finance products such as green bonds, financing renewable energy projects, and implementing policies to reduce their own carbon footprint. The goal is to support a transition to a more sustainable economy and mitigate climate-related risks.

Responsible and sustainable banking emphasises the integration of ESG factors into banks' financial decision-making processes, such as lending practices, investment strategies, risk management, and corporate governance. Recent research has shown that companies that are more environmentally sustainable are less risky and more stable as they have lower default risk but also lower systemic risk. Chiaramonte et al (2021) provide evidence that a greater focus on social performance mitigates the effect of the financial crisis on bank stability. Studies on the relationship between sustainability and bank risk-taking include Anginer et al., (2018) on governance and Gangi et al., (2019) on the environmental dimension.

Despite these developments, according to the most recent finance and accounting literature there remain four key priorities that demand a coordinated international approach to address the pressing global challenges facing the world today and to mitigate potential risks effectively. These priorities are: i) defining sustainability, ii) measuring it, iii) reporting it, and iv) addressing the risks associated with greenwashing (Figure 4).

[5] https://www.ft.com/content/82c193c9-a52d-41fa-a945-e91273754 1b0

Figure 4. Four sustainability priorities that affect banks in their role as lenders and investors



Defining sustainability is the initial fundamental step of setting criteria for what constitutes sustainability. In a recent article, Stark (2022) wrote: "*Some people prefer sustainability, while others prefer responsible investing, ESG, or corporate social responsibility (CSR), yet, there is no clear understanding of how these terms differ or even what a given term means*." She also added: "*Until we see more agreement on what the various sustainability terms mean, existing research needs to be considered in light of how authors frame the research question*". Stark (2022) gives a very important and urgent message. Given the lack of a clear definition and agreement on what is sustainability and what it means, it is challenging to create comparable metrics.

One way to *measure* sustainability is to use the ESG ratings or scores, that reflect firms' performance along several non-financial dimensions, including environmental impacts, social welfare and fair labour practices (Houston and Shan, 2022). The problem is that there can be discrepancies between the scores produced by different rating agencies, such as KLD, Sustainalytics, Moody's ESG (Vigeo-Eiris), S&P Global (RobecoSAM), Refinitiv (Asset4), and MSCI.

Recent studies (e.g., Berg et al., 2022) have highlighted the issue of low correlation between ESG scores based on ratings from different ESG rating agencies. Other have flagged the problem of focusing on aggregated ESG measures, as this can obscure poor performance in the individual E, S, or G components and even confuse investors (Morman and Morman, 2022). A case in point is that of Tesla Inc., a company that dominates the electric vehicle market, that was removed in 2022 from the S&P 500 ESG Index. Among the cited reasons were the company's inadequate response to a federal investigation into deaths linked to its self-driving cars as well as for allegations of racial discrimination and poor working conditions at its Fremont, California, factory.

In addition to defining and measuring sustainability, a key role is played by firms' non-financial *reporting*. If banks and the finance sector can play a significant role in driving change, they must be able to assess the projects they invest in effectively—not only in terms of financial viability but also for their non-financial (i.e. societal and environmental) impact. In other words, deposits and savings can increasingly be redirected away from the fossil fuel industry and towards sustainable projects or organisations that are committed to divesting from brown assets and transitioning to net zero. However, for banks it is crucial to be able to distinguish between firms and projects based on their environmental and sustainability practices. This may seem simple but there are two distinct sets of problems. The first concerns how transparent organisations are when reporting their sustainability and environmental performance; the second is associated with the risk of *greenwashing*.

In recent years, several steps have been taken to enhance firms' integrated disclosure of non-financial information (Cuomo et al. 2024). For example, among the the most recent efforts in Europe are the compilation of an "EU taxonomy for sustainable activities", that is a tool to help investors understand whether an economic activity is environmentally sustainable and navigate the transition to a low-carbon economy. More recently, the enactment of the 2023

European Corporate Sustainability Reporting Directive requires all large companies and all listed companies (except listed micro-enterprises) to disclose information on what they see as the risks and opportunities arising from social and environmental issues, and on the impact of their activities on people and the environment. Compared to previous European regulation, a broader set of large companies, as well as listed SMEs, will now be required to report on sustainability and some non-EU companies will also have to report if they generate over EUR 150 million on the EU market.

To enhance accountability to their customers and promote socially responsible lending and investment practices, banks must adopt measures that prioritise transparency, ethical decision-making, and long-term societal impact. These efforts require the establishment of a global non-financial disclosure regulation, ensuring consistent reporting standards across industries and enabling stakeholders to assess the broader implications of financial activities. A recent study by Baboukardos et al. (2023) reveals that organisations often use voluntary non-financial reporting as a greenwashing tool, showcasing positive impacts and ambitious commitments with minimal evidence of real action, while downplaying harmful activities. The study also notes that, despite undeniable evidence of climate change, these organisations engage in 'discourses of climate delay' that undermine meaningful action.

Greenwashing can be defined as a way to mislead stakeholders because it is about misrepresentation, mis-statement and false or misleading practices in relation to ESG (Ziolo et al., 2023; Galletta et al., 2024). Greenwashing carries reputational, regulatory and litigation risks for companies. These risks can affect banks indirectly when businesses they lend to - or invest in - are involved in greenwashing (Pears et al. 2023). In this context, in UK, the Financial Conduct Authority (FCA) has launched new 'anti-greenwashing' rules in May 2024.[6] Giannetti

[6]https://www.fca.org.uk/news/press-releases/fca-confirms-anti-greenwashing-guidance-and-proposes-extending-sustainability-framework

et al. (2023) examine how banks engage in greenwashing, misrepresenting their sustainability efforts to attract ESG-focused investments and enhance their reputation. They highlight the negative consequences, including reputational damage, regulatory scrutiny, and a loss of trust in ESG-labelled products. Widespread greenwashing undermines progress toward genuine sustainability, underscoring the need for stricter oversight and transparent disclosures to ensure the credibility of banks' ESG claims. Venturelli et al. (2025) and Curcio et al. (2025) explore the broader implications of greenwashing practices in the financial sector, highlighting the significant risks these behaviours pose to trust, market efficiency, and sustainability goals.

Despite progress and the emergence of best practices, along with the fact that many large organisations now have sustainability strategies or green agendas, significant work remains to be done in this area. More robust controls, regulations, and research are essential to drive meaningful change. One potential measure could be the adoption of a straightforward index, such as a ratio of banks' brown to green assets (similar to the Green Asset Ratio as a KPI proposed in the European Banking Authority (EBA) 2021 and enacted in 2024), to monitor banks' commitments to sustainable investments. Such an index would not only provide valuable insights for investors but also serve as a tool for lenders and policymakers to assess and guide sustainable practices. [7]

[7] In recent years, the EBA has taken significant steps to enhance transparency and integrate sustainability considerations into the financial sector. The EBA's binding standards on Pillar 3 disclosures on ESG risks (EBA, 2022) provide detailed templates and reporting frameworks for banks to disclose their environmental, social, and governance (ESG) risk exposures. These templates are designed to standardise disclosures, enabling stakeholders to better assess the ESG risks banks face and their approach to managing these risks. By mandating consistent reporting, the Pillar 3 requirements aim to improve comparability and accountability across the banking sector, ultimately fostering greater market discipline.
In addition, the EBA's Guidelines on the management of ESG risks (EBA, 2025) represent a comprehensive framework for incorporating ESG considerations into banks' governance, risk management, and decision-making processes. These guidelines outline supervisory expectations for identifying, assessing, and mitigating ESG risks, emphasising their integration into traditional risk categories such as credit, market, and operational risks. They also highlight the importance of scenario analysis and stress testing in evaluating the long-term impact of climate and environmental risks on financial stability.

In addition to improving transparency, a range of stakeholders, including the Network for Greening the Financial System (NGFS) propose offering greater incentives - such as reduced capital requirements for financing sustainable projects, paired with penalties for supporting unsustainable ones - to further encourage banks to align their operations with environmental and societal goals.[8] Advocates of these proposals argue that the urgency of climate and sustainability related risk justify using capital ratios as tools to encourage banks to reallocate capital towards green and more sustainable investments (Oehmke and Opp, 2023; D'Orazio and Popoyan, 2019a). Proponents claim that environmental risks are inherently financial risks, as climate change affects asset quality, credit risk, and financial stability. Integrating climate considerations into regulatory tools is therefore justified. While intuitively appealing, these proposals have met criticisms (including from the EBA), who argue that using bank capital ratios for achieving goals other than financial stability may weaken the regulatory architecture and lead to ineffective capital standards.[9] The argument here is that such adjustments can blur the line between prudential credit risk assessment and environmental goals and may lead to a misrepresentation of banks' solvency (Castren and Russo, 2024). The role of macroprudential policies in addressing climate-relate risks remains a topic for debate. D'Orazio and Popoyan (2019b) present a comprehensive database of "green" macroeconomic regulations and instruments to consider the evolving debate on the adoption of "green" prudential requirements.

[8] The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) is a global coalition of central banks and financial regulators established in 2017 with the primary aim of enhancing the financial system's resilience to climate-related risks and supporting the transition to a sustainable economy. Its key objectives include: (i) promoting sustainability in finance; (ii) climate risk assessment and management; (iii) capacity building and knowledge sharing and (iv) mobilising capital and the low-carbon transition. The NGFS main contributions include climate scenario analysis, practical guides and recommendation for integrating climate risks and advocacy for international cooperation to harmonise the regulatory framework.

[9] The Tinbergen Rule is often quoted in this debate. The rule, named after Dutch economist and Nobel laureate Jan Tinbergen, states that for effective policy-making, the number of independent policy instruments must be equal to or greater than the number of policy objectives. In other words, using the same instruments to achieve multiple desirable goals (in this case, bank stability and the transition to a more sustainable economy) may lead to unintended results.

A phased implementation of climate-focused policies alongside traditional financial stability measures, without over-relying on capital ratios, could allow for more effective regulation and minimises disruption.

4. The Digitalisation of Banking

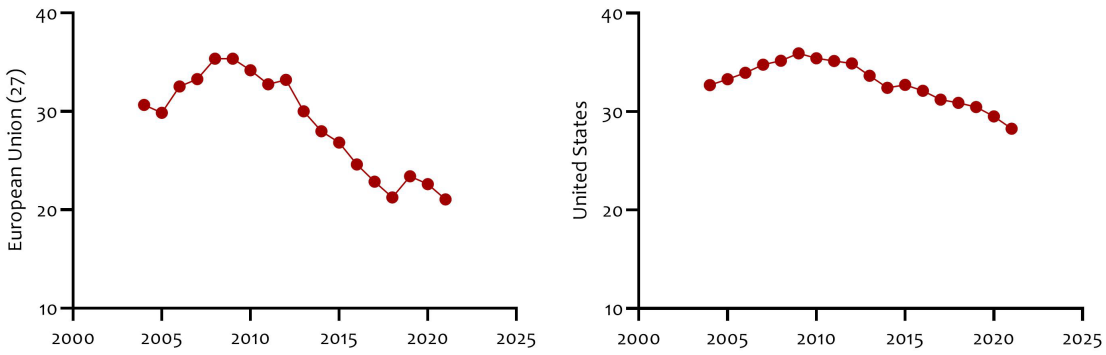
Digital transformation in banking involves leveraging technology to enhance customer experience, streamline operations, and improve efficiency. This includes adopting digital banking platforms, implementing artificial intelligence (AI) and machine learning (ML) for risk management and customer service, and strengthening cybersecurity measures. Digitalisation is reshaping how banks create and deliver financial services to their customers while also introducing new institutions into the financial services landscape. The most recent wave of financial innovation, spurred by digitalisation and its potential for new products and services, has largely emerged from outside the established banking system. The arrival of fintechs and big tech companies in the financial intermediation landscape has led to questions regarding the potential long-term impact on the banking sector (Frost et al., 2019; Boot et al, 2021; Beck et al., 2022). Fintechs, often small and specialised, provide niche financial services, including lending and payment processing, exploiting digital platforms to reach underserved markets. In contrast, big tech firms such as Google, Amazon, and Alibaba leverage their large data ecosystems and technological expertise to offer integrated financial services, blurring traditional sectoral boundaries. Their data-driven models enable superior customer targeting and risk assessment, undermining the incumbent banks' competitive edge in data-based services (Frost et al, 2019).

Cuadros-Solas et al. (2024) examine the impact of fintech on traditional banking institutions, highlighting how digitalisation and technological innovation are transforming the financial services landscape. They conclude that while fintech presents opportunities for

collaboration and growth, it also requires banks to adapt quickly to maintain relevance and competitiveness in a rapidly evolving financial ecosystem. Based on a sample of Chinese commercial banks, Hu et al., (2025) uncover a positive relationship between digitalisation and bank soundness, driven by improvements in risk management and increased diversification.

As the COVID-19 pandemic significantly disrupted economic structures, it may also have accelerated digital transformation within the banking sector. Faced with the dual challenge of supporting the economy during the crisis and adapting to a rapidly changing environment, many banks may have been compelled to fast-track and strengthen their digital transformation efforts. Technologies like AI, blockchain, and big data have streamlined processes, improved risk management, and enabled personalised services. The increased use of smart phones apps, the development of Application Programming Interfaces (APIs) and the rise of cloud computing have enabled new delivery channels. Digitalisation is also reshaping customer experiences, leveraging not only mobile banking apps but also chatbots and other digital interfaces. This has resulted in a large decrease in bank branches (see Figure 5). Cappa et al. (2022) highlight how these changes are also driving the wave of mergers between banks and fintech firms and might trigger further consolidation in the sector.

Figure 5: Number of bank branches per 100,000 adults (2004 – 2021)



Source: data.imf.org

In addition, structural vulnerabilities in the banking sector, a legacy of the crises and the COVID-19 pandemic, hinder banks' ability to respond quickly to emerging technological challenges. In this context, digitalisation emerges as a double-edged sword: it promises operational efficiency and better customer service but also poses existential threats to traditional banking models through intensified competition and the erosion of longstanding revenue streams. The competitive dynamics introduced by fintechs and big techs are reshaping the financial ecosystem (Vives and Ye, 2025). Banks face disintermediation risks as these tech-driven players encroach on high-margin services like payments and lending. Moreover, the scalability of big tech platforms, combined with network externalities, raises concerns about market concentration and the potential emergence of new too-big-to-fail entities (Doerr et al, 2023). Such developments could heighten systemic risks while reshaping existing ones, including credit, liquidity, and operational risks.

The digitalisation wave also brings a range of non-financial risks (Beck et al., 2022; BIS, 2024). These include heightened cybersecurity threats due to the expanded digital footprint of financial services, increased reliance on third-party technology providers, and vulnerabilities stemming from algorithmic biases in AI-driven models. The growing dependence on cloud services further centralises operational risks, while the potential obsolescence of specific technologies poses strategic challenges. In addition, integrating new data sources or techniques into existing risk management frameworks can pose compatibility challenges, necessitating substantial modifications to legacy systems (BCBS, 2024)

5. The twin transition and the future of banking

The concept of the *twin transition*—the simultaneous pursuit of sustainability and digitalisation—represents a paradigm shift in the banking sector. This dual focus addresses the

interconnected challenges of climate change and technological disruption, both of which demand transformative approaches to banking practices, strategies, and policies. Achieving this transformation requires a fundamental rethinking of traditional banking models, regulatory frameworks, and cultural practices to ensure alignment with global sustainability goals and the ethical deployment of technology.

On one side of the transition, sustainability focuses on aligning economic activities with environmental and social objectives. Banks are instrumental in financing the transition to a low-carbon economy, supporting investments in green technologies, renewable energy, and sustainable infrastructure. Their role in promoting ESG principles positions them as key actors in the global effort to achieve net zero and fulfil the United Nations' Sustainable Development Goals (SDGs).

On the other side, digitalisation transforms the banking landscape by integrating advanced technologies to enhance efficiency, accessibility, and innovation. Digital banking platforms, artificial intelligence (AI), and blockchain technology enable banks to streamline operations, reduce costs, and personalise customer experiences. Furthermore, digital solutions like data analytics and predictive modelling empower banks to assess risks more accurately and make informed investment decisions.

The twin transition offers great potential, but it also brings significant challenges. The rapid adoption of digital technologies must be harmonised with sustainability goals to avoid unintended consequences, such as the environmental impact of data centres or the inequities exacerbated by algorithmic bias. Similarly, while sustainability efforts focus on reducing the carbon footprint of financial activities, they require digital tools for accurate measurement, reporting, and accountability.

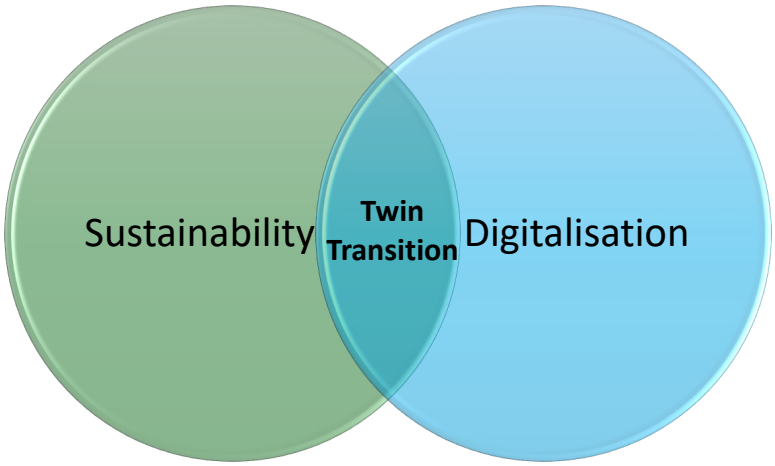
The impact of digitalisation on the green transition remains controversial (Bianchini et al., 2023). Some scholars are optimistic, arguing that digitalisation enhances the availability of data, enabling the optimisation of production processes, monitoring of environmental impacts, and reductions in industrial waste (Muench et al., 2022). Others adopt a more cautious view and warn that digitalisation may encourage environmentally unsustainable practices (Guandalini, 2022). The concept of *eco-digital transformation* seeks to align banking practices with environmental imperatives while leveraging digital technologies to enhance efficiency and inclusivity. As the sector assumes a central role in addressing these challenges, it must navigate the complexities of balancing profitability, ethical responsibility, and technological progress to remain resilient in a rapidly evolving global economy.

The twin transition presents significant challenges and opportunities for the banking sector also in terms of labour market dynamics and skill requirements. The green transition necessitates a workforce proficient in sustainability reporting, climate risk management, and the development of sustainable financial products. However, the rapid evolution of sustainability frameworks has resulted in pronounced skills shortages, with demand for specialised expertise outpacing supply. This underscores the urgent need for targeted training and reskilling programmes to equip financial professionals with relevant sustainability competencies.[10] Similarly, the digital transition requires banking institutions to expand their talent base in areas such as data analytics, cybersecurity, and digital platform development. The fast-paced nature of technological advancements has intensified competition for IT specialists, particularly from the tech industry. To address these challenges, banks must invest in continuous professional development and support lifelong learning initiatives.

[10] https://op.europa.eu/webpub/empl/esde-2023/chapters/chapter-2-3-1.html

The Venn diagram in Figure 6 illustrates the twin transition by showing the intersection between digitalisation and sustainability.

Figure 6 The twin transition



Digitalisation encompasses better data analysis, risk management, and sustainable investment strategies. Sustainability focuses on guiding responsible tech development and aligning economic growth with environmental and social goals. The intersection represents the twin transition, that is, the integration of digital tools for sustainable development. In other words, digital tools can support the transition to a low-carbon economy through better data analysis, risk management, and sustainable investment strategies. Conversely, sustainability goals can guide the responsible development and deployment of digital technologies, ensuring that economic growth aligns with environmental and social imperatives.

6. Conclusions

In the past few decades, the banking sector has undergone a profound transformation, driven by deregulation (and re-regulation), technological advancements, and changing societal expectations. This paper has explored the sector's strategic evolution from deregulation and efficiency-driven competition to the challenges and opportunities presented by the twin transition of sustainability and digitalisation.

This review highlights how the deregulation era fostered competition and efficiency but also contributed to systemic risks and a culture of excessive risk-taking, culminating in the global financial crisis of 2007-09. This event exposed fundamental weaknesses in the banking sector, including governance failures and misaligned incentives, prompting calls for stronger regulatory oversight and ethical reforms. More recently, and in response to growing environmental and social challenges, sustainability has emerged as a critical priority for banks. Institutions are increasingly integrating ESG principles into their operations, driven by global initiatives such as the Paris Agreement and the United Nations Principles for Responsible Banking. However, significant challenges remain, including defining sustainability metrics, ensuring transparent non-financial reporting, and combating greenwashing practices.

Digitalisation has simultaneously reshaped the banking landscape by enabling operational efficiencies, enhancing customer experiences, and expanding access to financial services. Yet, the rise of fintech and big tech companies has intensified competition, while technological risks such as cybersecurity threats and data privacy concerns have become pressing regulatory issues. The forces of digitalisation and sustainability led to the so-called twin transition, which leverages the integration of digital tools for a low-carbon economy while ensuring responsible technology deployment.

Looking ahead, the success the twin transition will depend on a coordinated response involving regulators, financial institutions, and other stakeholders. This includes fostering a culture of innovation, strengthening regulatory frameworks, and ensuring that technological progress supports global sustainability objectives. Only through such an integrated approach can the banking sector fulfil its dual role as a driver of economic growth and a steward of societal well-being in a rapidly evolving global economy.

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Appendix -Table 1 Timeline of key economic and financial events (1980s-2020s)

Timeline	Selected key events
1980s–1990s	• Deregulation and Technology: Expansion of financial markets with fewer regulatory constraints and the rise of new technologies. • Financialisation: Increasing dominance of financial motives, financial markets, financial actors, and financial institutions in shaping the economy, society, and culture.
2000s	• 2007-09 Global Financial Crisis: Worldwide economic downturn caused by the collapse of financial institutions and subprime mortgage market failures. • Loss of Trust: Recognition of the need for change in banking culture. • The launch of the first iPhone in 2007 enables to growth of mobile banking, via apps.
2010s	• 'Culture Crisis': Episodes of misconduct in the financial sector. • 2012 Libor Scandal • Euro-Sovereign Debt Crisis: Financial instability across European countries due to high national debt levels. • Climate Crisis Awareness: Growing understanding of environmental sustainability in finance. • Re-regulation Process: Introduction of stricter financial regulations globally. • UNSDGs: A set of 17 Sustainable Development Goals adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. The UNSDGs aim to address a wide range of global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice. • Paris Agreement: Landmark international treaty adopted in December 2015 at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC). Its primary aim is to combat climate change by limiting global warming and enhancing global efforts to adapt to its effects. • Brexit (UK, 2016): Economic and political impact of the United Kingdom's decision to leave the European Union. • Principles for Responsible Banking (PRB): A set of guidelines launched in 2019 that provides a broad framework for aligning banking practices with global sustainable goals. • Emergence of Fintech providers • Big Tech players entrer the provision of financial services • Emergence of cyptocurrencies and alternative coins • Distributed Ledger Technology (DLT) and smart contracts
Early 2020s	• COVID-19 Crisis: Economic and social disruptions caused by the global pandemic. • Net Zero Banking Alliance (NZBA): Launched in 2021, it is a global coalition of banks committed to aligning their lending and investment portfolios with net-zero greenhouse gas emissions by 2050 or sooner. • Geopolitical Tensions: Increased uncertainty from global conflicts. • High Inflation: Economic instability due to inflationary pressures. • Interest rates increases and monetary policy tightening • Increased digitalisation of financial products and services • Increased focus on ESG • Emergence of private credit providers • Growth of stablecoins • Artificial Intelligence (AI), cloud computing and big data technology • Open Banking and API Integration • Central Bank Digital Currencies (CBDCs)