LUISS ᛏ

Degree Program in Economics and Business

Course of Financial Markets and Institutions

THE IMPACT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ON THE BANKING INDUSTRY

Prof. Mirta Musolino

Gennaro Finaldi Russo, 271621

_____

SUPERVISOR

_____

CANDIDATE

Academic Year

2023/2024

ABSTRACT

This thesis explores the transformative role of Artificial Intelligence (AI) in the banking sector, focusing on its implementation, challenges, and the future trajectory of digital banking innovations. The objective is to clarify how AI technologies are integrated into banking operations and in their business model to determine the impact of such integration on banks, customers, and the wider financial ecosystem.

The document is divided into several key sections: first, an overview of AI, machine learning and deep learning is given to provide a basic understanding of these technologies. It then discusses the specific applications of AI in banking, highlighting the impact on improving operational efficiency, risk management and customer service. Subsequent chapters look at the dynamics between banks and fintech companies and how these partnerships are facilitating the adoption of AI technologies. This includes a look at different types of collaboration that help banks overcome technological and regulatory challenges while innovating their service offering. The thesis also discusses the potential barriers to AI integration that banks and their customers might encounter, from workforce adaptation to ethical and technical issues. This discussion forms the basis for exploring tactical measures banks could take to mitigate these difficulties, such as retraining employees and ensuring ethical use of AI.

In conclusion, this thesis will thoroughly examine the contribution of artificial intelligence to the modernization of the banking sector. It emphasizes the need for a methodical strategy to fully exploit the potential of AI while minimizing the associated risks. This synthesis of the applications, challenges and strategic importance of AI provides valuable insights into the future of banking as it is influenced by technological advances.

Table of Contents

1. Artificial Intelligence-Machine Learning-Deep Learning

The easiest way to think of the relationship between artificial intelligence, machine learning and deep learning is to visualize them as concentric circles, with AI, the idea that came first, being the largest, then machine learning which blossomed later, and finally deep learning which is driving today's AI explosion fitting into both.
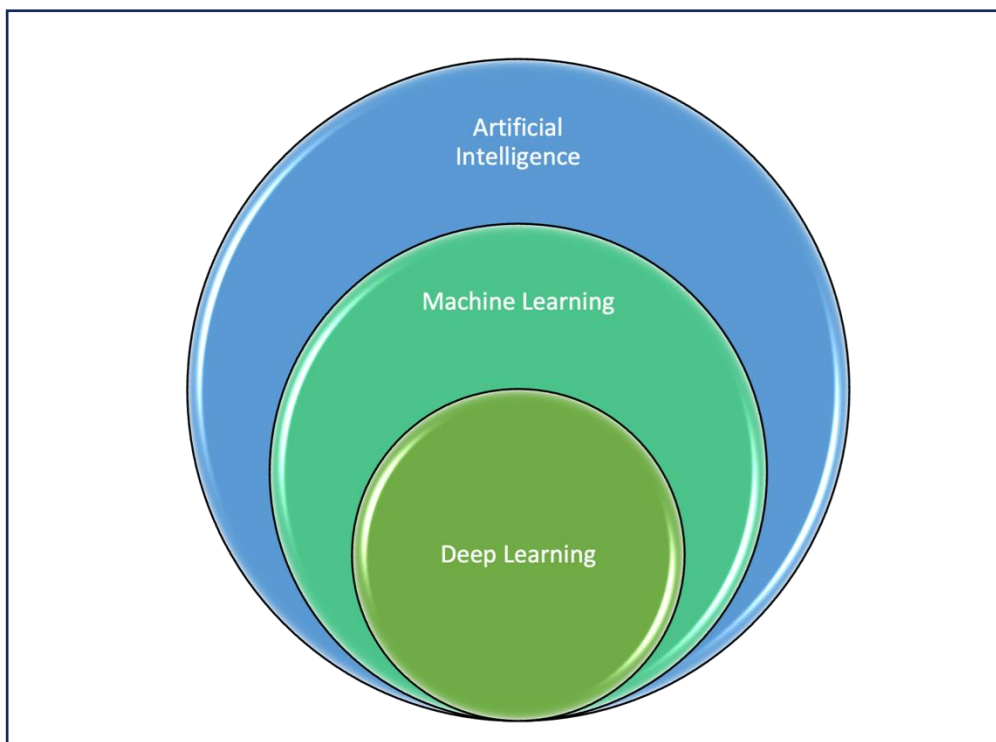
Figure [1]. [Artificial intelligence, machine learning and deep learning]
Source: Nadia Berchane (M2 IESCI, 2018)

The ability of computers to mimic cognitive human abilities like learning and problem-solving is known as artificial intelligence. With the use of artificial intelligence (AI), a computer system can mimic human decision-making and learning from new knowledge by using logic and math. Several people started working independently on intelligent devices after the Second World War. Alan Turing, an English mathematician, might have been the first.

In 1947, he delivered a lecture on the topic. He may also have been the first to decide that AI was best researched by programming computers rather than building machines. In the late 1950s, there were many AI researchers, and most of them based their work on computer programming. According to Alan Turing, a machine should be considered intelligent if it could successfully fool a knowledgeable observer into thinking it is human (Turing test). The aim of the pioneers of artificial intelligence was to use newly developed computers to build sophisticated machines with characteristics that resembled human intelligence. This is the idea of "General AI", whereas technologies that can perform certain tasks as well or better than humans are examples of "Narrow AI". This naturally leads us to the question of the origin of this intelligence, which brings us into the field of machine learning.

In its most basic form, machine learning is a process of analyzing data, learning from it and then making decisions or predictions about the outside world. The machine is therefore "trained" with huge amounts of data and algorithms that enable it to learn how to get the job done. For many years, computer vision was one of the best applications for machine learning.

Computer Vision (CV, also referred to as machine vision) is a branch of artificial intelligence and computer science that involves developing algorithms and models that enable computers to interpret and understand visual information from the real world. This field encompasses various tasks such as image recognition, object detection, image segmentation, and more. By utilizing computer vision technology, computers can analyze, process, and make sense of visual data, thereby enabling a range of applications across industries such as healthcare, retail, autonomous vehicles, robotics, and many others. A CV application interprets what it "sees" and makes predictions using machine learning models. Applications based on computer vision include fingerprint recognition, facial recognition and other biometric techniques for user identity verification.

A significant revolution in ML is Deep Learning, a model built on Artificial Neural networks (ANN). These represent another algorithmic method from the early machine learning community. The knowledge of the biology of our brain with all the connections between neurons served as inspiration for neural networks. These artificial neural networks have different layers, connections and directions of data transmission. Each

neuron assigns a weighting to its input — how correct or incorrect it is relative to the task being performed. The final output is then determined by the total of those weightings.

In 2012 at Google, Andrew Ng, along with his colleague, Jeff Dean, made a significant breakthrough in the field of machine learning with the development of a machine learning system called "Google Brain." This system was able to automatically learn to recognize higher-level concepts such as cats and human faces from unlabeled YouTube videos. This was a breakthrough because it demonstrated the potential for machine learning algorithms to learn and recognize complex concepts without being explicitly programmed to do so. Ng put the "deep" in deep learning, which describes all the layers in these neural networks (Nvidia Blog, 2016). Numerous real-world machine learning and AI applications have been made possible by deep learning. Tasks are broken down by deep learning in a way that makes a variety of machine assistance seem feasible.

The subsequent sections will explore various applications of Artificial Intelligence. However, it is essential first to identify some shared characteristics of these AI applications, which typically include the use of data, algorithms, and human feedback (Report on Artificial Intelligence in the Securities Industry, 2020). These common features are illustrated in Figure [2].

Whit the digital age the amount of data that has been collected during the years has grown exponentially. The big data revolution is reshaping the financial world and represents one of the main drivers of the increased interest and research in AI. Data are the input that machines receive and analyze to identify patterns and then make predictions. This is the main role that data plays in all AI applications.

Figure [2]. [Common Features of AI]
Source: Author

Algorithms are a set of rules or instructions designed to perform a specific task or solve a particular problem. In the context of Artificial Intelligence (AI), algorithms play a crucial role by enabling computers to process data, make decisions, and learn from outcomes. In AI applications, algorithms are essential in Learning and Adaption, in fact these algorithms improve with time as data they are exposed to growing amount of data. Moreover, Algorithms automate repetitive tasks by making decisions based on pre-defined rules. This can significantly increase efficiency and reduce the need for human labor in tasks like data entry, customer service through chatbots, and even in driving with autonomous vehicles. Algorithms are also fundamental in personalization, in fact after analyzing user behavior they are able to recommend products that are most likely to interest the user.

Every stage of an AI application's life cycle, from data preparation and algorithm development to output testing and model retraining, requires human intervention. Humans have to assess the output for relevance, accuracy, and usefulness once algorithms have sorted through the data and produced the output (such as classifications, outliers, and predictions). Stakeholders in business and technology usually collaborate to evaluate AI-based output and provide the AI systems with pertinent feedback so that the model can be improved. Lack of such human review and input could cause the AI systems to

produce findings that are irrelevant, inaccurate, or inappropriate, which could result in inefficiencies and missed opportunities.

Artificial Intelligence in finance enables corporations that operate in the financial sector to improve their efficiency, the accuracy and the quality of services they offer to their customers. The Financial Services Industry has entered the Artificial Intelligence (AI) phase of the digital marathon, a journey that started with the advent of the internet and has taken organizations through several stages of digitalization ("How Artificial Intelligence Is Transforming the Financial Services Industry," 2023). AI is revolutionizing the way financial institutions work, executing transactions with unprecedented speed and accuracy, using real-time market data to gain deeper insights and make investment decisions. By analyzing patterns in transaction data sets, AI solutions enable financial sector companies to improve risk management, which includes security, fraud, anti-money laundering (AML), know your customer (KYC) and compliance initiatives. AI is also changing the way financial companies interact with their customers by predicting their behavior and understanding their buying preferences. This enables more personalized interactions, faster and more accurate customer service, better credit scoring and innovative products and services. Table 1 lists the most common applications of AI in the financial sector, along with explanations of their main functions.

In the rapidly evolving landscape of finance, the advent and integration of Artificial Intelligence (AI) technologies have brought together a diverse array of stakeholders, each playing a pivotal role in shaping its future. From Chief Information Officer (CIO) and Chief Technology Officer that make key decisions about implementation, use and safety of AI, to developers who design AI algorithms and are responsible for the accuracy and efficiency of these. Ethics and diversity officer have an important role in this revolution, organizations mandate these individuals to fight prejudice, ensuring fairness and inclusiveness in the use of AI. Legal team and departments of large institutions cooperate with regulators to ensure that AI application comply with the laws.

Application	Description
Algorithmic trading	with the help of AI, trading algorithms can be developed that analyze market trends and historical data to make decisions and execute trades faster than humans.
Automation and efficiency	with the introduction of AI it is possible to automate routinary activities allowing financial institutions to work with huge amount of data in a more rapid and precise way.
Innovation	AI can help financial institutions innovate and stay at the forefront of technology, which can give them a competitive advantage
Regulatory compliance	AI can automate monitoring and reporting requirements to ensure regulatory compliance
Credit scoring	AI can analyze a variety of data, including social media activity and other online behavior, to assess customers' creditworthiness and make more accurate lending decisions
Customer service	by answering questions and completing routine tasks 24/7, AI-based personal assistants and chatbots can reduce the need for human intervention, provide personalized customer service such as real-time credit approval, and offer consumers greater protection against fraud and improved cyber security.
Data analytics	AI can analyze vast amounts of data and extract insights and trends that would be difficult for human data scientists to identify, enabling more informed decisions and a deeper understanding of market behavior
Fraud detection	AI algorithms can prevent financial crimes such as fraud and cyberattacks by recognizing unusual patterns in financial transactions. This improves the security of activities such as online banking and credit card transactions
Portfolio management	AI can analyze market conditions and economic indicators to help investors make better decisions and optimize their portfolios
Sentiment analysis	AI can analyze news sources, social media and other information to assess market sentiment, which can help predict market trends and influence decisions

Table [1]. [Applications of AI in the financial sector]

Source: Author

2. Artificial intelligence in Banking sector

2.1. Introduction

The banking sector comprises commercial banks, that can accept deposits and grant loans, and other non-bank institutions, which are licensed to conduct business of a financial nature. In general, in the banking industry the main players handle cash, credit, and other financial transactions for individual consumers and business alike. Banking plays a pivotal role in the economy by facilitating the flow of money and enabling economic activities.

As AI becomes always more relevant in the new financial landscape, big data together with AI technologies becomes the most valuable asset in a financial Institution. In the banking sector players are already implementing innovative and cost-efficient solutions achievable through the use of AI and are perceiving that although important asset size will no longer be sufficient on its own to build a successful business. It's the ability to develop and adapt new technology instead, that determines the success of the business. Together with the development of AI and AI technology, the quality of products and services in the banking sector is changing rapidly. In an article published by McKinsey ("How Can Generative AI Add Value in Banking and Financial Services?", 2023) three main field of application have been identified:

- Back-office operations;

- Risk management;

- Customer-facing.

As regards back-office operations, AI leverages large language models to automate workflows and reduce internal friction obtaining as a result a speed up and redefinition of traditional processes achieving ultimately a greater efficiency.

In the risk space, AI enhances risk management in banking by rapidly analyzing vast datasets to identify and mitigate potential risks, ensuring more precise and timely

decision-making. It revolutionizes the sector's ability to forecast financial trends and detect fraud, significantly reducing exposure to risk. We are going to see many specific applications on the customer-facing side aimed at improving the customer experience. Now more than ever, banks are aware of the innovative and cost-efficient solutions AI provides, and understand that asset size, although important, will no longer be sufficient on its own to build a successful business. Instead, the success of banks and other financial institutions is now measured by their ability to use technology to harness the power of their data to create innovative and personalized products and services.

2.2. Drivers of AI Disruption in Banking

The integration of artificial intelligence in the banking sector is driven by several key factors that are reshaping the industry. Understanding these drivers is crucial for banks to navigate the evolving financial landscape and leverage AI for sustainable growth and innovation. Figure [3] shows these key factors.

The explosion of Data (Big Data)

The availability of infrastructure (Fast computers, hardware, software, Cloud)

Regulatory requirements

Competitive pressure

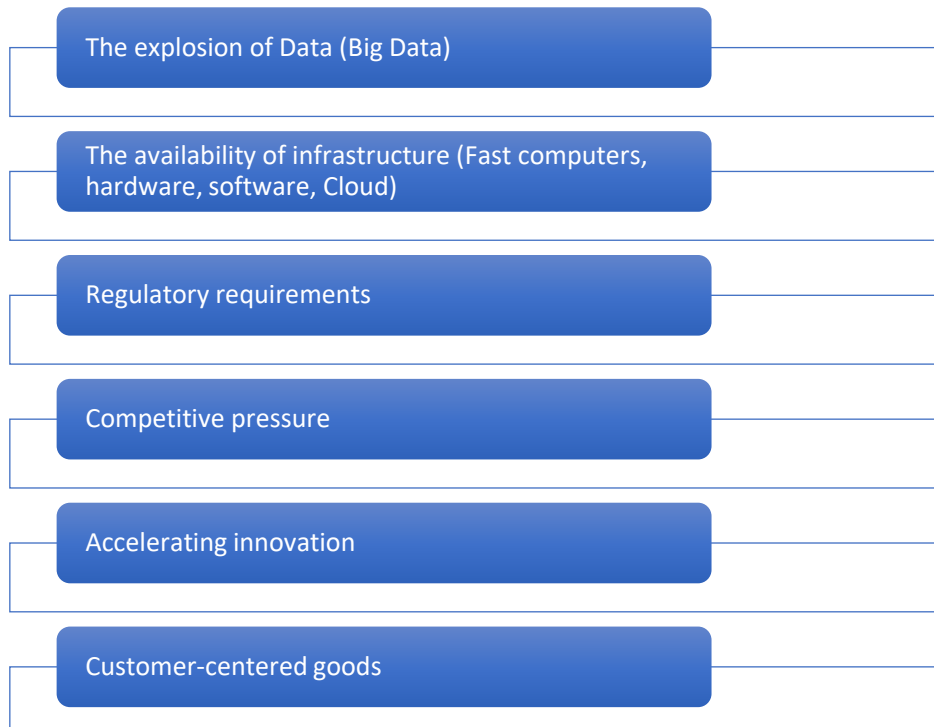Accelerating innovation

Customer-centered goods

Figure [3]. [Key Factors of AI]
Source: Author

Big data represents one of the main drivers of AI disruption in the banking sector. Big Data is what deep learning algorithms take as input to learn and improve: Moreover, such a large amount of data is what allows AI systems to identify patterns, trends, and correlations. In addition to the traditional structured data (transactional data) organizations nowadays collect large volumes of unstructured data such as emails, text and voice messages, images and videos via their customer service, social media platforms and other mediums of data collection ("How Artificial Intelligence Is Transforming the Financial Services Industry," 2023). This capability allows for more accurate predictions, personalized customer experiences, and improved decision-making. Essentially, big data fuels the engine of AI, enhancing its ability to automate complex processes, predict future trends, and offer insights at a scale and speed unmatched by traditional methods. This symbiotic relationship between big data and AI holds a great potential for transformative changes across industries, revolutionizing how businesses operate and interact with their customers.

The availability of advanced infrastructure, encompassing fast computers, specialized hardware, comprehensive software solutions, and cloud services, is a crucial pillar supporting the evolution and deployment of AI technologies. Fast computers and GPUs (Graphics Processing Units) have significantly accelerated the computational speed for training complex AI models, making it feasible to process large datasets in reasonable timeframes and at lower cost. Specialized hardware, such as TPUs (Tensor Processing Units) designed specifically for AI applications, further enhances performance and efficiency. Software development has kept pace, with solutions which provide an accessible platform for developers and researchers to innovate and bring AI applications to market more quickly. Cloud services, offered by giants like Amazon Web Services, Google Cloud Platform, and Microsoft Azure, democratize access to high powered computing resources. Cloud platforms facilitate the storage and analysis of big data, offer AI services and provide the agility needed to scale AI applications.

Data from different source systems must be collected for compliance. AI-driven solutions offer the opportunity to improve the speed and quality of decisions, automate data collection processes and improve the organization's ability to comply with regulatory requirements. Regulatory requirements are catalysts for innovation, driving the

development of new technologies and business models that align with ethical, legal, and social standards. By doing so, they significantly contribute to reshaping industries in a way that balances progress with responsibility.

In industries where innovation, customer choice and service quality are improved, competition is a key driver of disruption. To gain an advantage over their competitors, companies need to constantly develop and improve their products in the context of AI and technology. Here's how competition is driving disruption:

Companies are spending money on research and development in an effort to develop technologies that can evolve faster than their competitors and complete tasks more efficiently.

Companies facing stiff competition focus on the wants and needs of their customers. Companies that want to attract customers must offer products that are not only technologically up to date, but also closely linked to customer needs. This will lead to innovations that are more personalized and focused on the customer's needs. Competition leads companies to push the boundaries of what is possible, driving technological advancements and leading to disruptive innovations that can redefine entire industries.

In a nutshell, the drivers of AI disruption in banking are multifaceted, encompassing the need for improved customer experience, operational efficiency, risk management, data-driven decision making, regulatory compliance, competitive pressure, and cost reduction.

2.3. Need of AI in Banking and Challenge Before the Innovation

AI fills some gaps in the industry related to limited personalization, difficulties in fraud detection, reliance on historical data for risk assessment, suboptimal customer experiences, high operational costs and manual processes (Khalifa, 2023). To close this gap, the industry began to look for innovative solutions. Figure [4] below illustrates the main reasons that led to the use of AI and machine learning in finance:
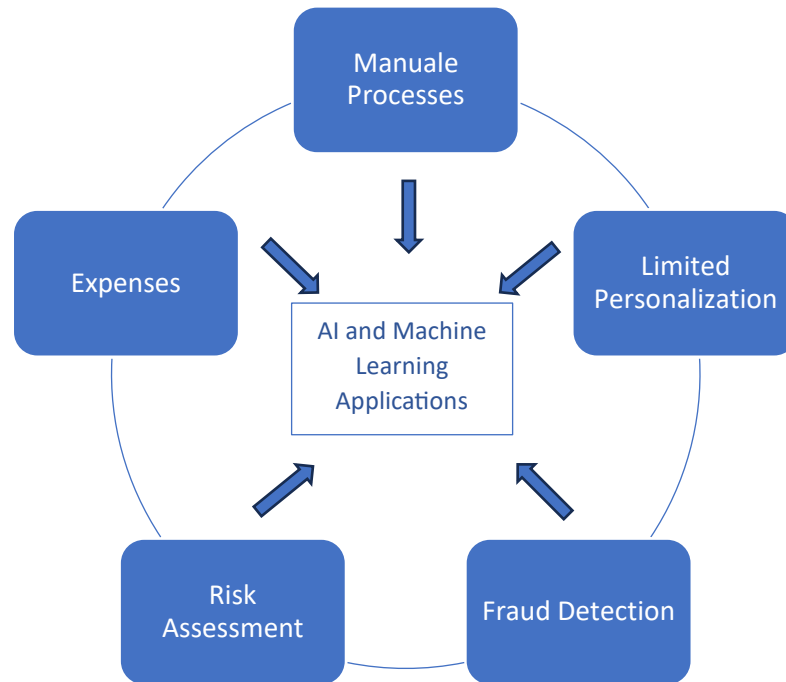
Figure [4]. [Main Motivation of AI Applications]
Source: Author

The heavy reliance of financial institutions on manual processes for a variety of operations was one of the biggest challenges before the introduction of AI. Manual labor was used for tasks such as checking documents, entering data into computer systems and reconciling transactions. This manual method was labor-intensive and error-prone, often leading to inconsistencies in financial records and displeased customers. It follows an example of a significant mistake in the Norwegian sovereign wealth fund that was caused by manual processes. Last year, Norway's $1.5tn sovereign wealth fund revealed that it had lost $92mn, on an error relating to how it calculated its mandated benchmark. The following declaration was released: "In February this year, a calculation error was discovered in the composition of the index we're measured against. This error led to a marginal overweight in US fixed income relative to global fixed income. When this was discovered, we immediately set about correcting it, but because the fund is so large, the return was 0.7 basis points. Due to this our previously reported positive relative return of NOK (Norwegian Krone) 118 billion was adjusted down to NOK 117 billion." Here's an

NBIM employee called "Simon" recounting the debacle to the report's author, Tone Danielsen. Alphaville's emphasis below: "My worst nightmare. It was a manual mistake. My mistake. I used the wrong date, December 1st instead of November 1st which is clearly stated in our mandate" (Wigglesworth, 2024).

The limited personalization in banking was a consequence of the inability to analyze large data sets efficiently. It was difficult for companies to fully capture the unique preferences and behaviors of each individual consumer, so they had to rely on broad segmentation. As a result, customers' expectations and the experiences they had often did not match, which affected their loyalty and enjoyment.

Identifying fraudulent activities was a major challenge, relying on manual processes and simple rule-based systems. Not only were these methods time-consuming, but they were also prone to high rates of false positives, which affected customer experience and operational efficiency. The lack of advanced analytics meant that it was difficult to detect sophisticated fraud schemes, leading to increased financial losses and vulnerabilities in security systems. This emphasized the urgent need for more sophisticated, dynamic solutions to effectively combat fraud.

Banks' main sources of information were historical data and traditional risk assessment techniques, which were slow to adapt to changing market dynamics and emerging risks. The ability to accurately predict and manage risk in real time was limited by these methods. Financial instability and bank losses could arise from a failure to react quickly to risk factors.

The labor-intensive nature of the banking business entails high operating costs resulting from manual data entry, document processing and personal contact with customers. These increased costs can have a very negative impact on profitability, which would make it difficult for banks to remain competitive and offer attractive interest rates and fees to their customers.

As it has already been explained, the use of AI in the banking sector is by now a key factor for the success of the business due to the potential to achieve higher efficiency, security

and customer experience. In this section we are going to analyze the main reasons why artificial intelligence is needed in the sector (Khalifa, 2023).

In the market analysis and investment strategy areas, thanks to its ability to process large amounts of financial news, market data and economic indicators, AI can recognize emerging trends and make investment decisions. To better understand the concept, we can imagine a software that receives financial news and social media feedback as input to assess market sentiment and then make investment decisions. Customer service activities can greatly benefit from AI through the implementation of chatbots and other advanced applications. By using natural language processing (NLP), AI-powered chatbots and virtual assistants can understand and respond to customer enquiries. They can access account information and perform actions such as transfers or checking balances. The value added by AI is the ability to learn from past interaction and improve over time.AI significantly improves personalized banking by analyzing vast amounts of internal data to generate predictive insights that enable tailored messaging and offers based on individual customer preferences. This not only improves the customer experience, but also increases sales, satisfaction and campaign conversions. Financial institutions using AI for personalization focus on building a relationship by using AI-powered algorithms for individualized customer interactions, which deepens relationships and strengthens loyalty. Also investment and portfolio management is being revolutionized by AI-driven robo-advisors that develop tailor-made solutions. These sophisticated algorithms create different portfolios that adapt to changing market conditions, taking into account each investor's risk tolerance and financial goals. For example, they might push younger, risk-tolerant users towards equities because of the potential for growth, while risk-averse investors approaching retirement might see a higher allocation to bonds. This strategy democratizes investing with tailored, targeted solutions by using AI for real-time market monitoring and trade execution.

AI can significantly optimize regulatory compliance across various industries by automating and enhancing the efficiency and accuracy of compliance processes. By leveraging AI, organizations can not only streamline their compliance operations but also gain strategic insights that contribute to more informed decision-making, ultimately fostering a more compliant and ethical business environment. AI contributes to optimizing regulatory compliance through different ways [Table 2].

Optimization	Description
Automated Monitoring and Reporting:	AI systems can continuously monitor and analyze vast quantities of data to ensure compliance with regulatory requirements. This includes monitoring transactions for suspicious activities in finance, ensuring data protection compliance, or tracking product quality in manufacturing. AI can automatically generate reports for regulatory bodies, reducing manual effort and the risk of human error.
Predictive Analysis for Proactive Compliance:	AI can predict potential compliance risks by analyzing patterns and trends from historical data. This allows organizations to address issues before they become violations, shifting from a reactive to a proactive compliance stance
Enhanced Due Diligence	In sectors like banking, AI enhances the due diligence process by quickly analyzing complex customer data to detect fraud, assess credit risk, and perform anti-money laundering checks more efficiently than traditional methods.
Document and Contract Management	AI-driven tools can manage and monitor the vast amount of documentation required for compliance. This includes reviewing contracts for regulatory adherence, tracking changes in regulations, and ensuring that all documents are up to date with current laws and regulations
Training and Compliance Culture	AI can tailor compliance training programs for employees based on role-specific requirements and learning progress. By analyzing engagement and effectiveness, AI optimizes training content to foster a stronger compliance culture within the organization
Regulatory Change Management	AI tools can track and analyze regulatory changes in real-time, helping organizations adapt their compliance strategies swiftly. This is particularly valuable in highly regulated industries like finance, healthcare, and pharmaceuticals, where regulations can change frequently

Table [2]. [AI for regulatory compliance]

Source: Author

2.4. AI Barriers for Banks and Customers

This section explores the barriers that AI poses to banks and their customers. Even though AI is very promising and it can bring valuable additions to the banking sector through improved efficiency, personalization, and security, its implementation is associated with certain obstacles.

2.4.1. Barriers for Banks

AI barriers refer to obstacles or challenges that banks may encounter in adopting and implementing artificial intelligence technologies. In a recently published academic paper these barriers can be broadly grouped into three categories: people-related issues, technology-related issues, and regulatory and compliance issues (Lazo & Ebardo, 2023). One of the important barriers related to AI people adoption in the banking sector is the problem of building a team with skilled workers. The main challenge is scarcity of AI talents; high demand for such employees from many industries makes the process of hiring such professionals quite hard and expensive. This feature is common to enterprises that operate in different sectors. In a study carried out for the European Commission (Kazakova et al., 2020) it has been assessed that the lack of skills amongst existing staff is a barrier common to 45% of EU enterprises and difficulties hiring new staff with the right skills 57%. Additionally, there's a notable gap in AI understanding among decision-makers within the banking sector. Some of the managers have remained skeptical about the utility of AI, they consider it an investment that is costly and has no proven value in return. This skepticism points to the need for sensitization and education on the actual benefits of AI to impact and create more pragmatic decision-making and uptake in the industry. The main technological barrier is the lack of standardization and interoperability. This barrier pertains to the absence of uniformity and compatibility among different AI systems and tools. It makes it challenging for banks to seamlessly integrate various AI technologies, leading to inefficiencies and complexities in their AI

implementation. The second tech-barrier is about time required and high costs. Apart from high wages of skilled workers, technology and AI solutions come with high infrastructure costs (cost of adoption 52% of EU enterprises, cost of adapting operational processes 49%.) (Kazakova et al., 2020). In addition, AI solutions require a considerable amount of time to develop and deploy. As regards regulatory and compliance issues, financial institutions have to navigate through a complex regulatory environment meant to protect data privacy, the interest of the consumer, and economic stability. Adoption of AI may be difficult and costly to comply with the regulations. And most of the time, it always creates a cloud of compliance uncertainties since the regulatory frameworks do not keep pace with such rapid technological changes. Issues related to data security and privacy pose substantial barriers to AI adoption in banks. Given the sensitive nature of financial data, ensuring robust security measures and strict adherence to data privacy regulations are paramount. Concerns around data breaches and misuse can hinder banks from fully leveraging AI technologies.

By addressing these barriers through strategic planning, investments in talent development, and robust cybersecurity measures, banks can navigate the challenges associated with AI adoption and maximize the benefits that AI technologies offer.

2.4.2. Barriers for Customers

As regards barriers that customers face in the interaction with banks, the main is surely trust and security issues. Trust plays a crucial role in customers' interaction with AI technology; in fact, as customers perceive a new technology trustworthy, they are more likely to embrace and use it. On the contrary, when AI technology is not trusted by customers, and this could happen due to disinformation, scarce knowledge or cultural reasons, they tend to avoid it due to concerns about its reliability, accuracy, or potential misuse. "A study conducted by Omoge et. al (2022) on the adoption of AI in the emerging market economy highlighted technology downtime (TDT) as a phenomenon that may

explain the lower acceptance of AI-enabled banking services among customers in the emerging economies as compared to the high adoption of AI-enabled banking services in the developed economies. TDT is a common occurrence in emerging economies, resulting in the unavailability and unreliability of AI-driven services and consequently leading to customer distrust of AI." (Lazo & Ebardo, 2023).

Technology Downtime refers to a scheduled or unforeseen interruption in the use of computer technology, such as server downtime or network outage. This can have a significant impact on businesses and organizations that rely on technology for operations, communication, and storage. Downtime can be caused by various reasons, including hardware failure, software glitches, cyber-attacks, and natural disasters. To mitigate the effects of downtime, businesses can implement backup and recovery strategies, preventative maintenance measures, and use cloud-based solutions.

2.5. AI Use Cases

The following examples show how far-reaching the possibilities of AI are and how it is now being used in two different banks: Bank of America and JP Morgan. These examples show the transformational potential of AI and how it can improve user experience and operational efficiency.

2.5.1. Bank of America

One of Bank of America's (BoA) primary growth drivers continues to be the investments it makes in digital solutions. The 2023 report from Bank of America states that the company's digital capabilities are expanding in all business areas. In the consumer segment, Boa ended the year with 75% of all households actively using its digital platforms. In addition, the bank recorded 2.2 million new active users of its retail digital banking business in the fourth quarter of 2023, bringing its total active users to a record 46 million. It also saw a record 3.3 billion digital sign-ups and 49% of its total consumer

sales through digital platforms. Erica is the virtual financial assistant based on artificial intelligence (AI) launched by BoA. Some key features of Erica are:

- Transaction management: Erica helps searching for account details, check account balances, search for previous transactions and even start transfers.

- Bill payments: to ensure bills are paid on time, Erica helps consumers schedule and manage their payments.

- Proactive information: Erica provides individuals with personalized financial information by using AI. For example, it can examine spending trends and make recommendations on how best to maximize savings or improve budgeting.

- Credit report updates: to help customers understand and improve their credit situation, Erica provides frequent updates on consumers' credit scores and the variables that affect them.

- Simple inquiries: to ask inquiries regarding their banking services, account details or assistance with banking transactions, customers can speak to Erica by voice or text.

Erica continues to increase customer engagement, partly because it enables the bank to provide important information and answer questions in real time. With over 40 million users, Erica has reached around 1.9 billion interactions since its launch five years ago.

2.5.2. JP Morgan Chase

JP Morgan has been using AI for more than ten years; the company first mentioned it in a letter to shareholders in 2017. Since then, the bank has significantly expanded its AI team, employing more than 2,000 data scientists and AI/machine learning specialists. With over 400 productive use cases in areas such as marketing, fraud and risk, JP Morgan has been using predictive AI and ML for years. These applications are gradually generating real business value for all departments. JP Morgan's organizational commitment to AI innovation is seen through its efforts to explore GenAI potential across software engineering, customer service and general operations. AI is therefore expected to affect almost all jobs in the organization at some point and has the potential to change

the composition of the workforce through changing existing job categories and generating new ones.

To ensure that employees are taken care of in the event that they are affected by the AI revolution, JP Morgan intends to retrain and redeploy their talent. As a global leader across multiple industries and geographical areas, the company has vast amounts of incredibly rich data that, when combined with AI, can provide deeper insights, improve risk management and optimize customer service.

The company has put robust mechanisms in place to support this technological development. This includes the creation of the position of Chief Data & Analytics Officer to integrate data and analytics into decision-making at all levels of the organization. This position emphasizes not only the technical aspects of AI, but also its practical application in all management practices.

In 2023, the Consumer and Community Banking (CCB) division alone invested more than $3 billion in technology, with a focus on developing products that better support customers in their daily banking transactions and enable sophisticated financial planning. These investments also support modernization efforts such as data center migration to a public cloud, which is necessary to maintain the competitive agility and operational resilience that can be expected from JP Morgan. At the same time, customers are increasingly engaging with advice-oriented digital and omnichannel experiences to meet their more complex needs, such as buying a home or planning for retirement. The bank's focus is not only on the technical aspects of AI, but also on how the entire management team can, and should, use it. Each of the business units has appropriate data and analytics capabilities, making it possible to share best practices, develop reusable solutions that solve multiple business problems, and continuously learn and improve as the future of AI unfolds.

According to the 2023 Annual report, JP Morgan will continue to focus on modernizing the core banking infrastructure to bring products to market faster, improve platform stability and reduce the cost of operating the bank over time. Originally, the bank's focus was on how artificial intelligence could be deployed in the most cost-efficient and least

risky way for the company. Now the strategic focus is on how AI will be the key enabler for revenue growth. Further investments are being made in emerging areas with high expected returns such as:

- Optimization of marketing: AI helps to refine the optimization of marketing so that the most profitable target group can be reached with great accuracy.

- Identification of unmet customer needs: digital incentives and personalized offers, enabled by the use of digital tools and AI, occur in real time so that unmet customer needs can be identified early enough. This then enables a well-timed digital nudge, a personalized offer to respond effectively when the customer has a need.

- Productivity of the sales force: AI-driven lead management in combination with propensity models increases the productivity and efficiency of sales force. This helps them to focus their efforts on high-value prospects by optimizing their sales strategies so that the maximum results are achieved in terms of revenue.

- Fraud detection: it involves the use of very powerful predictive models to assess the likelihood of fraud in real time. This in turn guarantees, through a preventative approach from the outset, that the protection of customers and the company is guaranteed with minimal losses.

These examples show how AI is being integrated into various aspects of operations to not only save costs and reduce risk, but also unlock new revenue opportunities and delight customers and employees. Operational transformation is realized through strategic applications of AI that lead to increased responsiveness and efficiency.

3. Partnership with Fintech Companies

Partnerships between banks and fintech companies represent a strategic response to the significant barriers in AI adoption within the banking sector. These collaborations can effectively address issues such as expertise shortages and complex regulatory compliance by combining the innovative agility of fintech company with the robust infrastructure and regulatory experience of established banks. Let's first define a fintech company: a fintech company refers to a business that leverages cutting-edge technology to enhance or automate financial services and processes. The term is a blend of "financial technology." Fintechs cover a broad spectrum of applications, these companies are known for their innovative approaches to traditional financial problems, offering faster, cheaper, and more accessible alternatives to established financial systems. Figure [5] illustrates the most important objectives for banks when entering a partnership with fintechs.

What are your organization's most important fintech partnership objectives?

Objective	Percentage
Loan volume	59%
Loan productivity	50%
New products/services	47%
Deposit account opening productivity	36%
Non-interest income	23%
Operational expenses	22%
Fraud losses	16%
Geographic footprint	14%
Deposit account volume	11%

Figure [5].[Fintech partnership objectives]
Source: Shelvin, (2022)

3.1. Types of Partnerships with Fintech Companies

A recent study by the Federal Reserve outlines three distinct types of partnerships between community banks and fintechs: operational technology partnerships, customer-

oriented partnerships and front-end fintech partnerships. The three partnership types may have several overlapping considerations, but in the study is highlighted how each type targets specific needs. Figure [6] below illustrates the specific needs, which we are going to discuss in detail (FED, 2023).
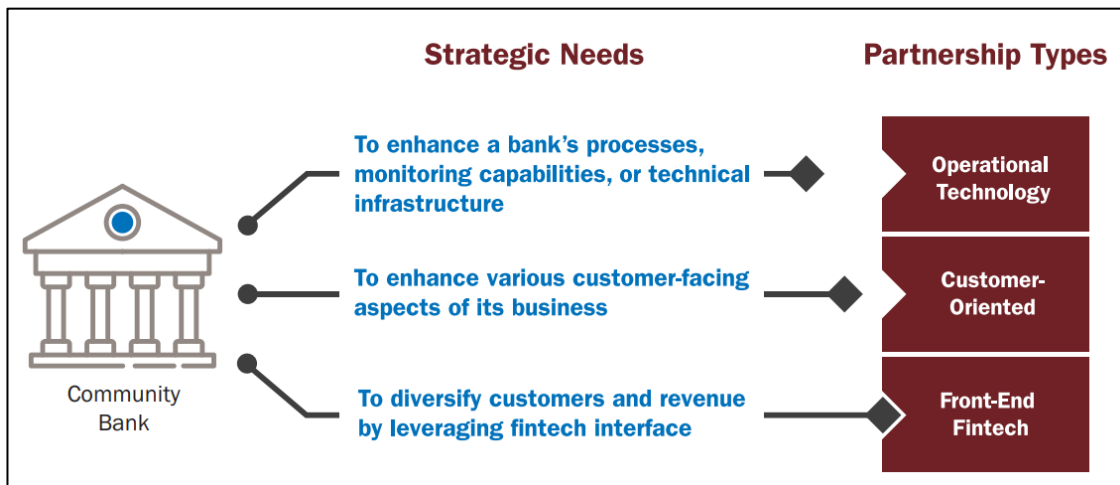

Figure [6]. [Partnership types]
Source: FED, 2023.

3.1.1. Operational Technology Partnerships

The objectives of operational technology solutions are to increase efficiency, lower the possibility of error, and free up resources. Since these collaborations usually call for less complicated integration with current technological infrastructure, they might also be easier to implement than other partnership kinds.

In general, operational technology partnerships are created to enhance a bank's processes, monitoring capabilities, and technical infrastructure. These kinds of partnerships do not impact the customer side in a direct way so that the customer might not be aware of these relationships as they entail enhancements to internal systems within the banks. Operational technology partnerships can be formed to increase the bank's capacity to comply with regulatory standards or to expedite current procedures. Some examples are technologies that automate aspects of the loan origination process and technologies that enhance fraud detection or provide more reliable customer authentication. From the study emerges that an increasing operational efficiency was achieved using software services

that aimed at simplifying just one business process. Subsequently, they started implementing these solutions to other bank's departments or functions. Below is presented an example from the study: one banker worked for a year to implement a workflow solution to automate tasks and processes. The workflow system, two years from the implementation, became crucial for decision-making and in managing employee workloads in the loan operations department of the bank. The result was the implementation of the workflow in many other departments of the bank. This example shows how a solution that requires some time to develop can pay off in the long run. Banks have been able to enhance workflow and customer relationship management, as well as operations related to their core business, through operational technology partnerships. Several bankers from the study talked about looking into automating the loan origination process. The successful implementation of these systems highlighted the necessity of managing various relationships as these arrangements may necessitate many third-party partners. Other bankers investigated the application of credit underwriting models created by fintechs. These products not only provide the possibility of acquiring new customers through the fintech partner, but they may also allow the bank to offer smaller retail loans by reducing the cost of underwriting.

As we have shown up to now, the benefits that operational technology partnerships with fintechs offer are numerous. Though, there are some challenges that bankers may face. They noted that the understanding of a new line of goods and services, along with their operational and security risks that come with them is required. In fact, bankers must comprehend and become familiar with the main factors influencing loan approvals and terms when integrating third-party technology into lending processes. Another challenge that may emerge when using such technology for loan origination is that space for human error may be increased when implementation requires manual loan entry to multiple systems. In the adoption of operational technology partnerships, a challenge that emerges from the study is that entering into a partnership may also require new types of expertise. When introducing software services to a company, it may be necessary to hire personnel with expertise of the software. After implementing new fintech solutions, a number of participants broadened their hunt for technology specialists outside of the banking industry. They acknowledged that when it comes to strategic technical recruits, technical expertise frequently takes precedence over a financial background. Others made training

and staff development investments to increase internal expertise with third-party solutions.

3.1.2. Customer-Oriented Partnerships

Many of the banks that participated in the research study have entered into partnerships with finthecs to improve various customer-facing aspects of their business. For example, several community banks shared that they are working with fintechs to explore online account opening tools, facilitate access to targeted savings programs, integrate apps that facilitate P2P (person-to-person) money transfers, or improve their current mobile deposit platforms.

"Customer-oriented partnerships can improve community banks' abilities to meet and exceed customer needs and expectations. In the 2020 Conference of State Bank Supervisors Survey of Community Banks, more than 63 percent of respondents said that adopting new or emerging technologies was important or very important for meeting customer demand." (FED, 2023).

Customer-oriented partnerships not only help community banks expand their core business, but they also increase their agility in providing client service, according to bankers. Considering the COVID-19 pandemic, almost all participants emphasized the significance of a user-friendly digital banking environment. Following the COVID-19 pandemic, numerous community bankers collaborated with fintech companies or their primary suppliers to promptly create and distribute Paycheck Protection Program (PPP) application modules for their customers. Many bankers stated that during the COVID-19 outbreak, they found value in technologies that they might not have thought of in the past. Several bankers highlighted that enhancing digital services has strengthened rather than weakened customer relationships. For instance, the COVID-19 pandemic increased digital engagement, but also amplified the demand for personal interaction. Notably, call center traffic soared by 700 percent during the pandemic, a trend that persisted into 2021. Bankers from digital community banks stressed the importance of personal touches like phone calls for loan approvals. Additionally, the adoption of videoconferencing, which became crucial during the pandemic, is expected to continue, as it has significantly improved customer interactions. The challenge for these types of partnerships arises when

adopting many third-party solutions are implemented. In this case, it is essential not to create many different systems that function independently of each other, leading to inefficiencies and communication barriers. For example, regardless of the quality of the digital platform, forcing bank customers to visit different digital platforms in order to obtain information about their credit card and mortgage can lead to an inconsistent customer experience. One banker from the study stated that the most important factor in deciding whether to connect with a fintech company is their ability to integrate solutions with the bank's current systems. He emphasized the importance of integrating the service inside the bank's own website without compromising functionality.

3.1.3. Front-End Fintech Partnerships

Front-end operations entail the tasks that occur on the client-side of a website or application. Differently from customer-oriented, front-end partnerships consist in a relationship where the fintech companies interact directly with clients. This kind of cooperation is less common than the others and represents an evolving business approach known also as "Banking-as-a-Service." Banking as a Service (BaaS) is a business model in which banks or banking institutions leverage their banking provision to enterprises and other organizations using application programming interfaces (APIs) and other technology platforms. This enables such businesses to provide branded banking services to their customers without having to build and maintain banking infrastructure. BaaS providers usually use different services such as account management, payment processing, and even lending services, among many others. Over the last few years, this has grown very popular, and more technology is steadily marching forward, while more businesses want to offer their customers financial services. Community banks may be able to access new or larger consumer segments through these collaborations that they might not have reached through conventional or established channels. These new customers could contribute to increased deposit volumes, diversification of loan portfolios and the development of new non-interest revenue streams such as transaction fees. These collaborations can also bring other intangible benefits. Community bankers have pointed to front-end fintech partnerships as a way to work with fintechs that have a growing digital customer base while enhancing the bank's current tech capabilities. When forming such partnerships new risks may arise.

Fintechs are effectively an extension of the bank and therefore require much more sophisticated risk management practices. Banks in this case react by introducing strict risk management for third parties and using existing credit risk identification programs to evaluate fintech partners. Moreover, banks incorporate regular and rigorous compliance checks and due diligence processes to ensure fintech partners adhere to banking regulations. Banks train fintech partners' employees and provide them with compliance toolkits. The aim is to ensure that fintechs do not make mistakes. Additionally, fintechs mirror the bank in the way they interact with customers. Banks should also take into account risks related to the sustainability of fintechs that require them to manage customer relationships in the event of a fintech failure and prepare for potential fintech failures by planning how to manage and unwind customer relationships smoothly. Finally, the series of technical interfaces with fintechs usually implies the creation of a series of new digital infrastructures.

3.2. Establishing an Effective Fintech Partnership

Data presented in the next few pages are from Cornerstone Advisors which surveyed in 2021 290 U.S.-based senior bank and credit union executives to understand their institutions' experiences and plans regarding fintech partnerships (Shelvin, 2022).

The prerequisites for developing an effective and successful partnership for a bank are:

- hybrid organizational structure with personnel dedicated to fintech partnerships.
- process for effective partner due diligence.
- highly integrated partnership structure.
- fintech partnership portfolio.

In the study cited above, half of the respondents stated that they do not have any employee working on the fintech partnership and as for the institution which employ resources on such projects, the average is 2.5 employee dedicated full-time to the partnership. The same respondents (executives in financial institutions) when interviewed pointed at fintech partnerships as a crucial driver of growth. It appears pivotal for banks and credit unions a change in the organizational structure that aim at building a strong partnership with a fintech company. The first step to execute towards this objective is to have a centralized team capable of discovering, vetting, and negotiating with possible partners as well as figuring out the specifications for technical integration. It must be highlighted

the significance of alignment in priorities and objectives as well as shared emphasis on collaboration; these partnership aspects enable banks to create comprehensive product development and clear execution roadmaps.

"Central to developing this competency is having an effective partner due diligence process. Mitchell Lee, head of risk at Synctera and former director of fintech at the Federal Reserve Board of San Francisco, recommends banks take the following actions: review the current due diligence process against proposed guidance, tailor the due diligence process to the maturity of the potential partner and have a clear understanding of when to say no" (Shelvin R., 2022). Figure [7] below shows the proposed dimensions along which a bank can assess the current due diligence process. As regards the tailoring of the due diligence process to the maturity of the potential partner, it must be considered that some financials of a pre-product fintech at seed stage would not carry the same determination weights as its business model, management team, funding sources, and burn rate. This differs from how this is done in the case of bigger fintechs which have reached the stage of having customers and income. For these more mature companies, existing financials and projections are generally found to be relatively more reliable, and insight into the historical control environment may be useful to those carrying out current risk and compliance strategies. Moreover, according to Mitchell Lee it is advisable for banks to establish guidelines and standards about the kinds of fintechs they are prepared to collaborate with. These standards may encompass variables like product categories, industry/sector, control complexity, and maturity.

Key Area	Description
Business experience and qualifications	Operational history, experience (e.g., client references, complaints), legal and regulatory actions, and strategic plans including for new products, arrangements, etc.
Financial condition	Financial analysis of the fintech's ability to remain as a viable business operation and market considerations (e.g., client base, competition, geopolitical risk)
Information security	Infosec framework including documented and enforced data security controls, incident response, breach notification processes, and information systems programs and design
Legal and regulatory compliance	Compliance and training for privacy, consumer protection, fair lending, anti-money laundering, etc.
Operational resilience	Business continuity planning, and incident response (disaster recovery, tolerances around downtime, failover data centers and replication sites) service level agreements
Risk management controls	Effectiveness of risk policies, procedures, process, training, reporting, and general ability to align with the bank's risk appetite, appropriate laws, and regulations

Figure[7]: [Dimensions to assess due diligence process]

Source: Shelvin, (2022)

To establish an effective partnership, banks should consider three critical perspectives when integrating with fintech partners:

- Technology
- Business processes
- Strategic vision

Priority is given to technologies that enable easy integration into the banks' existing systems. These are technologies that accelerate the market launch of the product so that the costs of integration can be recouped. The integration should also focus on merging the business processes of both partners, where transparency and openness of processes are crucial for successful collaboration. Eventually, when selecting partners, it is important to ensure that they are aligned with the strategic vision for the partnership and offer robust and scalable solutions as well as a shared commitment to a coherent customer experience and mutual trust within the team.

In Cornerstone's study from 2021, many banks' partnership strategies are overly focused on internal capability building—specifically regarding digital account opening—and not focused enough on new product deployment and revenue generation. Based on the latest

industry insights, the scenario described in Cornerstone's 2021 report seems to be shifting. Recent trends indicate that banks are now placing greater emphasis on meeting customer demands for digital-first, personalized, and secure financial experiences. This shift is partly driven by the need to address the impact of digital disruption and to enhance data confidence through modern intelligence engines that allow for extreme customization at scale. Banks are recognizing the importance of balancing internal capability development with outward-facing innovations that directly contribute to revenue generation. They are increasingly adopting AI and data analytics to refine customer engagement and drive business growth. Furthermore, the integration of open banking is fostering greater innovation and personalization, which is also influencing banks to prioritize customer-centric product offerings and services.

3.3. Deutsche Bank and Nvidia

Deutsche Bank strategic, multi-year partnership with NVIDIA is aimed at integrating advanced AI and ML technologies across bank's services. Through the partnership the bank wants to improve its financial products leveraging NVIDIA's expertise in AI, accelerated computing, and machine learning. The goal was to boost efficiency, improve risk management, and enhance customer service by developing a range of AI-driven applications. Key areas of focus include:

- Risk Management: The partnership leverages NVIDIA's advanced computing capabilities to enhance Deutsche Bank's risk management processes. By employing accelerated computing, the bank can perform risk evaluations faster and more efficiently, enabling traders to run multiple scenarios at scale. This technological advancement supports not only faster decision-making but also contributes to greater energy efficiency in processing large data sets.

- Cloud Transformation: The collaboration supports Deutsche Bank's cloud transformation journey by employing AI and machine learning technologies to streamline and accelerate decisions related to cloud migration. This integration will simplify complex cloud migration processes, making them more manageable and less time-consuming.

- Customer Service Innovation: Deutsche Bank plans to utilize NVIDIA Omniverse Enterprise to create and deploy virtual avatars that can interact dynamically with

customers and employees. These avatars are intended to enhance user experience by providing personalized and interactive service options, transforming how customer service is delivered in the financial sector.

- Data Management: A significant challenge in financial services is managing and extracting valuable insights from unstructured data. Deutsche Bank, with NVIDIA's assistance, is focusing on developing AI models, specifically tailored to understand and process financial language effectively. These models, referred to as Financial Transformers, aim to improve the accuracy and speed of data processing and are crucial for detecting early warning signs, improving data retrieval, and ensuring high data quality.

The two parties will further develop an Internal AI Center of Excellence at Deutsche Bank. The initiative shall focus on promoting the adoption of transparent, responsible, and ethically aligned AI technologies in financial services. The collaboration marks an important step in the technology transformation of Deutsche Bank, with the aim of placing the bank at the forefront of financial innovation through strategic applications of AI and accelerated computing solutions.

This kind of partnership will be a model through which traditional banks can partner with fintechs to derive contemporary innovation, bring efficiency in their operations, and implement ingenious solutions for their customers. Such collaborations are crucial as they allow established banks to navigate digital transformation challenges more effectively and remain competitive in the digital age.

## 3.4. Focus on Italian Banks' Partnerships with Fintechs

This section focuses on the evolving landscape of partnerships between Italian banks and fintech companies, emphasizing strategic collaborations aimed at enhancing digital transformation within the financial sector. The insights and data presented here are derived from a comprehensive report by the Bank of Italy (Banca d'Italia, 2024).

From the report emerges that in Italy, 51% of intermediaries have at least one relationship with fintech companies (it was 46% in 2021); a total of 470 agreements (140 more than in 2021) with 274 separate companies (75 more than in 2021); in 72% of cases, the

agreements are related to specific initiatives developed by the intermediary; in the remaining cases, they have nothing to do with the direct implementation of a project.

Partnerships mainly involve the areas of operations, payments and credit, accounting for 19, 16 and 13% of the total volume respectively. In the area of operations, partnerships for back-office support predominate, in the credit area, partnerships for the development of credit scoring models and, to a lesser extent, for credit crowdfunding platforms. In the payments area, partnerships for digital wallets prevail.

In the areas of risk management and investment, partnerships are less common, accounting for 8 and 7% of total collaborations respectively (Figure [8]). Finally, there are some partnerships that do not fall into the traditional areas but still have considerable importance: those for the development of services (8%), open banking (7%) and digital identities (7%).
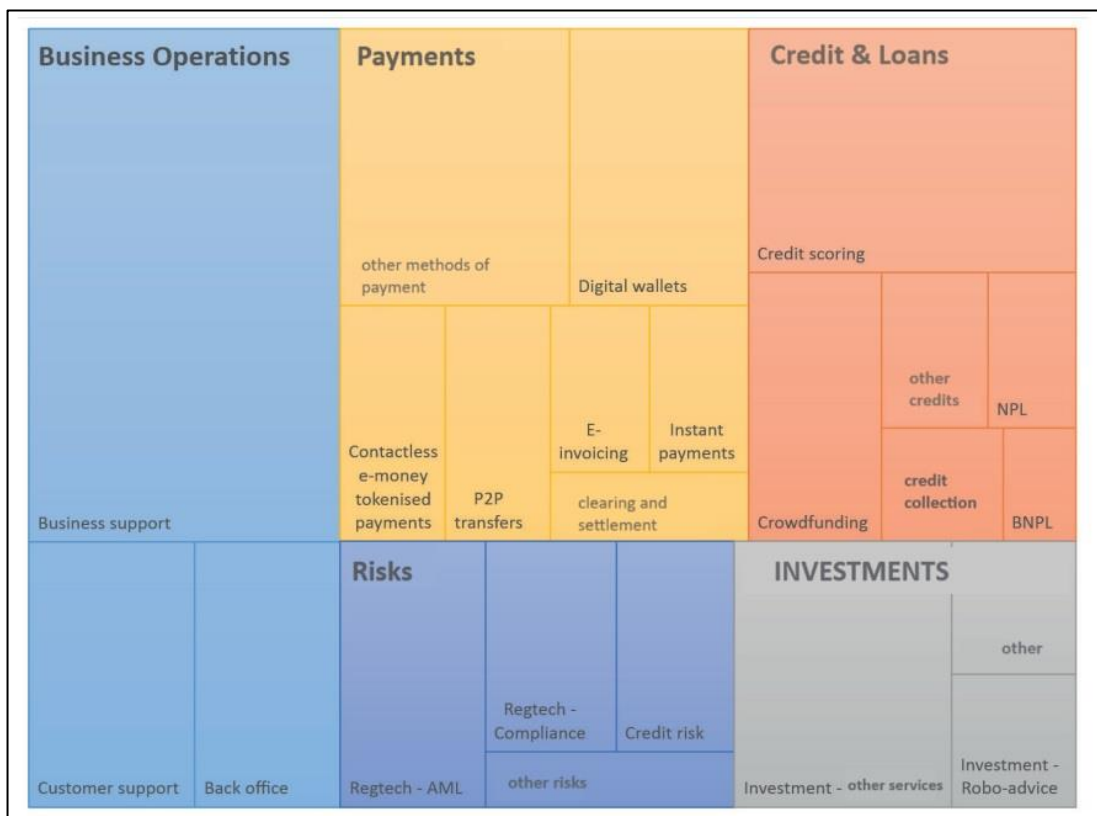
Figure[8]. [Incidence of partnerships on intermediaries'business areas]
Source: Banca d'Italia, (2024).

In most cases, fintechs offer IT services to intermediaries (52% of cases); less common, but significant, are partnerships involving the sale of the fintech company's products to the intermediary's customers (14 per cent) and the ones involving the growth of R&D activities (13%); rarer (7%) is the licensing of the partner company's services and products.

Among all the partnerships we are considering the one we must not take into account are those where it is the bank that provides services to the fintech company. The number is negligible in relation to the type of partnerships we are analyzing. Partnerships that have a major focus on AI today in Italy, are only 14% and mainly are in the field of credit & loans and risk management; however, an exponential growth is expected in the next few years given the big steps and large investment that have been made in the last year.

4. Conclusions

As mentioned earlier, AI applications have been used in banking for years to improve risk, fraud prevention, customer interactions and overall efficiency. For the same reason, the next step in the digitalization of the banking sector is the integration of generative AI into banking operations. The introduction of such technology is very promising as it opens up new opportunities to increase revenue and reduce costs. Most AI use cases in banking have so far focused on automating tasks or generating forecasts. AI-powered automation has mainly helped banks save costs and simplify operations by identifying manual and mechanical processes, replacing employees with computer-based solutions that are less prone to malfunction and more cost-effective. The integration of generative AI (GenAI) into the banking sector marks a pivotal shift towards more dynamic and personalized financial services. While traditional AI applications have streamlined operations and improved predictive analytics, GenAI opens up a new dimension in the creation and customization of banking products. This technology, which is able to analyze and generate content from huge data sets, will revolutionize the way banks interact with and serve their customers. The transformative potential of GenAI in banking is demonstrated by its ability to create hyper-personalized services quickly and cost-effectively. The application of GenAI in areas such as customer service through AI-driven chatbots or in back-end operations such as IT modernization shows that it is capable of improving both the customer experience and operational efficiency. Furthermore, the emergence of GenAI is giving fintech companies a powerful tool to disrupt traditional banking models, forcing banks to accelerate their own AI innovation to remain competitive. As we look to the future, continued collaboration between traditional banks and fintech firms, discussed in Chapter 3, will be critical to pushing the boundaries of what is possible with GenAI. Such partnerships not only promote technological advancement, but also ensure that these innovations are based on real-world applications that benefit consumers and strengthen the financial ecosystem. The development of AI in banking, particularly through GenAI's capabilities, will redefine the landscape of the industry and make financial services more accessible, efficient and tailored to individual needs. Commitment to responsible adoption and integration of GenAI will determine how strongly and positively banks will change in the coming years. Generative AI in the banking sector points to a significant and gradual transformation of the sector. According to the International Data Corp (IDC),

global investment in artificial intelligence is expected to reach 450 billion dollars by 2027, underlining the growing importance of these technologies (IDC, 2023). These investments underline the expected development and potential expansion of the role of AI in banking and point to a shift towards more sophisticated and far-reaching applications.

The introduction of generative AI in banking will develop over the next few years. In the initial phase, AI models are likely to be extensively tested and refined, with a focus on incremental innovations that meet specific business needs. This phase of experimentation and investment is critical as banks prepare for wider deployment and aim to leverage AI for significant efficiencies and operational improvements. Despite these cautious steps, the potential impact of generative AI on the banking sector is profound. McKinsey & Co. estimates that fully implemented use cases of generative AI could add between USD 200 and 340 billion in value annually and boost up to 15% of banks' operating profits (McKinsey & Company, 2023). This transformative potential is driven in particular by generative AI's ability to process and generate natural language, making it ideal for tasks that require high levels of education, communication and analytical skills. Development strategies for generative AI capabilities in banks will vary depending on the size and resource availability of each institution. Some choose to outsource to leverage third-party expertise, while others pursue in-house development or take hybrid approaches that modify existing AI systems. As banks go through this digitization process, they must also consider the associated risks, costs and operational challenges posed by rapidly advancing AI technologies. In fact, the path to fully realizing the benefits of GenAI is not without its challenges. Banks must grapple with the complexity of implementing a technology that is still in the development stage, taking into account both the technical and ethical implications of its use. In this context, it is necessary to speak of AI-related ethical issues that are not specific to the banking sector but apply to many industries that are gradually approaching AI. However, it is possible to identify some biases that can affect banks and lead to customer discrimination and financial inclusion issues (S&P Global, 2024). These are interaction biases, latent biases and selection biases. The former occurs when AI systems learn from user interactions and absorb biases from them. Latent biases are due to correlations within the data, which can lead to distorted results. Selection bias occurs when the data used to train an AI model does not adequately represent all parts of the

population, leading to discriminatory decisions against certain groups. In this rapidly changing environment, the balance between innovation and regulation is critical as banks seek to harness the benefits of GenAI while ensuring compliance and protecting customer interests. AI models in banking often face the problem of explainability, commonly referred to as the "black box" problem (S&P Global, 2024), where it is difficult to discern how or why a particular decision was made by an AI system. This opacity can make it difficult to comply with regulatory standards and undermine trust in AI applications. As the recently introduced AI regulatory framework evolves, concerns may arise as regional differences in requirements and oversight may arise. This may impact a wide range of industries, but is particularly important for the highly regulated banking sector, which is more vulnerable to reputational, conduct and systemic risk. Banks could face fines or the suspension of certain business if AI becomes more regulated and new regulations cover larger geographical areas. The introduction of AI in the banking sector brings with it significant workforce implications, particularly the risk of job displacement in positions that rely heavily on mathematical and verbal skills. As AI technologies streamline and automate these functions, banks face the challenge of ensuring an effective transition of their workforce. This change will require significant investment in employee retraining programs to equip them with the necessary skills to work with AI (2.4.2 JP Morgan Chase) and leverage these technologies to improve decision-making and job performance. In addition, maintaining a human-centered approach to AI development is critical. AI systems must be inclusive, diverse and incorporate human judgment to support a balanced workforce dynamic.

"We can only see a short distance ahead, but we can see plenty there that needs to be done" - Alan Turing

The quote expresses very well the cautious yet hopeful approach that the banking sector needs to take to move forward with AI technologies. It acknowledges the inherent challenges in precisely forecasting AI's long-term impacts, emphasizing the importance of vigilance and thoughtful progression in this dynamic field.

References

Papers

- Kazakova, S. S., Dunne, A. A., Bijwaard, D. D., Gossé, J., Hoffreumon, C., & van Zeebroeck, N. (2020). *European enterprise survey on the use of technologies based on artificial intelligence*. ULB--Universite Libre de Bruxelles.
- Khalifa, M. (2023). *AI Revolution in the Banking Industry: A Case Study*. Medium.com
- Lazo, M., & Ebardo, R. (2023). *Artificial Intelligence Adoption in the Banking Industry: Current State and Future Prospect*. Journal of Innovation Management, 11(3), 54-74.
- Li, X., Sigov, A., Ratkin, L., Ivanov, L. A., & Li, L. (2023). *Artificial intelligence applications in finance: a survey*. Journal of Management Analytics, 10(4), 676–692.
- Madhura, K., & Panakaje, N. (2023) *Bank for Tomorrow: Role of Artificial Intelligence (AI) in banking Sector*. Emergence and Research in Interdisciplinary Management and Information Technology61-76
- Smith, J. (2021). *Artificial Intelligence in Banking: A Comprehensive Review*. Journal of Banking Technology, 15(2), 45–62.
- Srivastava, A., & Kumar, A. (2023). *Reshaping Banking with Digital Technologies*. Fintech and Cryptocurrency, 35-57.

Reports

- *Indagine FinTech nel sistema finanziario italiano* (2024). Banca d'Italia.
- *Community bank access to innovation through partnerships* (2023). Board of Governors of the Federal Reserve System
- *Report on Artificial Intelligence (AI) in the Securities Industry* (2020). Finra.org. https://www.finra.org/rules-guidance/key-topics/fintech/report/artificial-intelligence-in-the-securities-industry
- *IDC's Worldwide Artificial Intelligence Spending Guide Taxonomy, (2023):* Massey, K., Glennon, M., Jyoti, R., Schubmehl, D., Elshewy, E., Ghildiyal, K., Guo, N., La Croce, C., Manabe, T., Roman, H., & Venkatesh, V. Release V2. International Data Corporation.
- *The State of the Union in Bank-FinTech Partnerships (2022).* Synctera. Shelvin, R). https://www.synctera.com/post/the-state-of-the-union-in-bank-fintech-partnerships

Web sites

- *AI in Banking: AI Will Be An Incremental Game Changer. S&P Global (2024) Fernández.* https://www.spglobal.com/en/research-insights/special-reports/ai-in-banking-ai-will-be-an-incremental-game-changer

- *How Artificial Intelligence is transforming the financial services industry*. Deloitte (2023). https://www.deloitte.com/ng/en/services/risk-advisory/services/how-artificial-intelligence-is-transforming-the-financial-services-industry.html

- *How can generative AI add value in banking and financial services?. (2023). McKinsey & Company.* https://www.mckinsey.com/featured-insights/lifting-europes-ambition/videos-and-podcasts/how-can-generative-ai-add-value-in-banking-and-financial-services

- *The Difference Between AI, Machine Learning, and Deep Learning? NVIDIA Blog. Copeland, M. (2016*). https://blogs.nvidia.com/blog/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

- *The Norwegian sovereign wealth fund's $92mn Excel error (2024, February 9). Financial Time Wigglesworth, R.* https://www.ft.com/content/db864323-5b68-402b-8aa5-5c53a309acf1