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Impact of Big Data on financial inclusion in the context of Fintech companies

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Abstract
This article aims to shed light on the impact of AI in general and big data in particular on financial inclusion in the context of FinTech companies. Using a literature review based on articles of high scientific value and significant influence on the academic debate in research on the topic, we found that in the context of FinTech companies, big data represents a key tool to properly segment the mark& and provide more personalized and less expensive financial services by analyzing consumers' activities on various sites on intran& pages. It also helps FinTech companies analyze customer transaction data not only to assess their creditworthiness and reliability as customers, but also to offer more personalized and less expensive products and services that promote financial inclusion.
The use of big data analytics provides the opportunity for financial service providers to reach a larger base of beneficiaries who have been excluded by traditional financial service providers, creating more efficient and effective economic models.

Keywords: Big Data, Fintech, Financial Inclusion.

Introduction

Over the past decade, the financial technology (Fintech) sector has seen an accentuated use of Big Data, which is playing an increasingly crucial role (Mhlanga 2020, Mhlanga & Dunga 2020, Johnson & al. 2021, Allen & al. 2022). The term "Big Data" refers to the processing of extensive and complex data sets produced by organizations, governments and individuals. This information can come from a wide variety of sources, such as financial transactions, social media, websites, mobile applications...etc (George & al. 2014, Pappas & al. 2018). The ability to process and analyze these lakes of data in real time has the potential to completely revolutionize the way FinTech companies operate and engage with their customers (Yang & Li 2018, Mehrotra 2019, Ndhlovu & Mhlanga 2023).

Financial technologies and Big Data are converging in several key areas, creating a symbiotic relationship that benefits both service providers and consumers. As a result, it is becoming possible to optimize services and streamline customer experiences in the financial sector. The application of Big Data in financial technology supports companies in decision-making, the creation of new products and services, as well as risk management and compliance, by identifying potential risks and developing measures to reduce them. By analyzing large amounts of data in real time, FinTech companies are becoming able to make more accurate predictions, and identify highly developed models for predicting which customers need financial help, as well as which customers are most likely to default on their loans (Agarwal & al. 2020, Zhuo & al. 2020, Awotunde & al. 2021).

The use of Big Data also enables the creation of more personalized financial products and services, such as individualized investment portfolios and tailor-made insurance policies (Cohen 2018, Shirazi & Mohammadi 2019, Mhlanga & Ndhlovu 2023). Various studies, (Mariia & al. 2020, Abdulquadri & al. 2021, Chandra & al. 2022), have proven that financial institutions' revenues can increase from 5 to 15% if they apply personalization strategies.

Furthermore, Big Data acts as an input for the development of new technologies such as blockchain and artificial intelligence, which can be used by FinTech organizations to improve decision-making and automate operations.

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The role that Big Data plays in financial technologies (FinTech) has been the subject of several recent studies, such as Zhuo & al. 2020, Awotunde & al.2021, Eltweri & al. 2021, Meng & al. 2021, Wang & al. 2021 and Mhlanga 2024, these studies have focused on the potential benefits of Big Data for FinTech organizations, as well as the difficulties and constraints associated with using Big Data in FinTech, such as the need for specialized skills and infrastructure, and concerns about data privacy and security.

Although there is a growing number of research on the role Big Data plays in FinTech, it still remains an area that requires further investigation. A wide-ranging analysis of research studies on this topic has identified a distinct gap that persists in understanding the specific role of Big Data in advancing financial inclusion. In contrast to previous research that broadly examines the influence of FinTech on financial inclusion, this paper focuses on the impact of Big Data, as a core element of FinTech, on inclusion. We explore the different ways in which Big Data enables inclusive financial services, offering a contribution that crosses the fields of Big Data and financial inclusion. This research is interesting because of the current scarcity of studies on the subject. The main objective is to gain a clear understanding of the role of Big Data in the financial technology (FinTech) sector, particularly its impact on financial inclusion.

1- Conceptual framework

1.1- Definition of the "FinTech" concept

The term "FinTech" is a contraction of "Financial Technology". This concept refers to technologies associated with the financial sector (Ferdiana & Darma 2019, Baber 2020, Mhlanga 2020, Mhlanga 2022, Firmansyah & al. 2023). Fintechs refer to non-financial startups with a strong technological focus that target the financial sector (Kissell & Mack (2020)). The services offered by FinTech companies are diverse and varied, and evolve daily. Indeed, the Fintech concept is constantly evolving as it keeps pace with the development of new technologies. In the 90s, Fintechs represented archaic software in computers, then moved on to mobile applications after the advent of smartphones in the late 2000s, and finally to cutting-edge technologies such as Artificial Intelligence (AI) since the mid-2010s. To date, the four main banking and financial activities in which Fintechs are positioned are: account keeping, issuing and managing money, financing and savings, and investment management. Thanks to the use of innovative, connected technologies, these companies have demonstrated their strong development potential in recent years, to such an extent that some authors define the concept of Fintechs as a "financial innovation" in its own right. This is the case of Thomas Pushmann (2017), who links this concept to "the act of creating and then popularizing new financial instruments as well as new financial technologies, institutions and markets".

1.2- Financial inclusion

The financial reforms of the 80s and 90s that took place in most economies were intended to improve financial depth and the use of formal financial services such as loans, savings, payment services and other related services. However, the level of access to and use of formal financial services remains very low worldwide. One of the main causes of the gap between the theory of financial liberalization and the evidence is based on idealistic assumptions, such as perfect information, without taking into account the variety and complexity of countries' legal and institutional frameworks. However, after three decades of implementing these policies, the international community, represented by its governments, institutions and experts, has decided to relaunch the world of finance via financial inclusion, which is by its very essence a fight against financial exclusion, and is a major component of any development strategy.

According to the World Bank, Financial Inclusion is defined as the ability of individuals and businesses to access, at low cost, a range of useful financial products and services adapted to their needs (transactions, payments, savings, credit and insurance) offered by reliable and responsible providers[1]. The primary aim is to integrate into the conventional financial system people who have no, or only limited, access to banking services. In other words, financial inclusion is about giving individuals and businesses, particularly those who have been historically marginalized or excluded from the formal financial system, the opportunity to use a diverse range of financial services and products.

Financial inclusion is a strategy commonly employed by governments to facilitate the direct transfer of social benefits and subsidies to beneficiaries' bank or mobile money accounts.

It also facilitates the provision of investment opportunities, including stocks, bonds and mutual funds. The advent of online investment platforms has enabled access to investment opportunities, allowing individuals with limited assets to engage in financial activities. Another crucial factor to consider is the availability of credit. Financial inclusion plays a central role in facilitating access to credit facilities for individuals and small businesses, enabling them to obtain loans for a variety of purposes. The proliferation of online peer-to-peer lending platforms has facilitated access to credit for borrowers who do not meet conventional lending conditions.

Access to various insurance products, such as health insurance, life insurance and property insurance, is becoming available to a wide community thanks to financial inclusion.

Financial inclusion projects often aim to widen access to financial services in rural and remote areas where traditional banking infrastructure is limited. An illustration of this is the provision of financial services in rural areas using mobile banking agents, thereby extending access to previously underserved communities. In essence, financial inclusion goes beyond the simple possession of a bank account and encompasses a diverse range of financial services and products that enable individuals and businesses to actively engage with the formal financial system. The initiative facilitates economic growth, alleviates poverty and promotes financial resilience by giving everyone access to opportunities to improve their financial well-being.

1.3- Financial inclusion through FinTech

According to the theory of inclusion through technology,

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[1]https://www.banquemondiale.org/fr/topic/financialinclusion/overview

technological advances, notably the provision of digital financial services, can be used to broaden the scope of financial inclusion. This hypothesis proposes that digital financial services can help overcome barriers to access and reduce the costs of providing financial services, making them more accessible to underbanked populations. One of the most important things technologies can do to promote financial inclusion is to simplify individuals' access to various forms of financial assistance (Loubere 2017, Arner & al.2020, Mhlanga 2022).

For example, mobile banking and digital wallets can enable users to access financial services from their mobile devices, even in rural or underserved areas. In addition, digital financial services can be used to reach underbanked populations who lack access to traditional banking services, such as migrant workers or low-income earners. This is possible because digital financial services can reach more people than traditional banking services. Technology can also help promote financial inclusion by reducing the costs of financial services. For example, the cost of operating digital financial services can be lower than the cost of operating traditional branches, which can make these services more accessible. In addition, the use of digital financial services can help reduce the costs associated with financial transactions, while simplifying the sending and receiving of money by users. Compared with their analog counterparts, traditional financial services, digital financial services offer a higher level of security and transparency. For example, through the use of technology known as digital registers, digital transactions can be monitored and documented, which can help reduce fraud and improve transparency. In summary, the reality of financial inclusion in the context of Fintech has proven that technology can become a powerful instrument for promoting this strategy. This can be achieved by making financial services more accessible and less costly for the underbanked.

1.4- Big Data is the main lever for Fintech

The new financial landscape reinforced by financial inclusion and Fintech is characterized by a panoply of online financial and non-financial activities generating large data banks. Indeed, today, everything we use collects data on our habits, preferences and behaviors, whether it's smartphones, laptops or even household appliances. These endless lakes of data, or "Big Data", are becoming essential to the success of companies striving to master them (Vlassenroot & al. 2021, Rehman & al. 2022).

Big Data is a collective term that describes the act of collecting, storing, processing and analyzing an ever-growing, large, diverse, structured and unstructured and difficult-to-manage set of data, collected from social, machine and transactional sources, and increasing exponentially in volume, variety and velocity (Lv & al. 2019, Yang & al. 2020, Aho & Duffield 2020).

The term "Big Data" encompasses all the massive data sets emitted by users of Internet networks. When a user performs an activity on a web browser, website or mobile application, he or she emits data that can be harvested by companies to be exploited for commercial purposes. The particularity of Big Data lies in the fact that it is unstructured or poorly structured, i.e. it cannot be processed by basic data processing software (e.g. Excel). Some sectors, such as FinTech, are taking advantage of Big Data to generate valuable information and change the way they develop new business models. In addition, Big Data in Fintech can enable companies to provide better services and more user-oriented products to improve the way banks and financial technology companies operate. Indeed, these days, Big Data represents the focal point of technological innovation in Fintechs. After the advent of mobile technologies in the mid-2000s, which was the starting point for Fintech, Big Data represents the second technological revolution in Fintech.

2.   Methodological framework:

For the realization of this work, we based ourselves on a "documentary study". Thus, and using bibliographic management software, mainly "Zotero", articles of great scientific value and with a notable influence on academic discussion in research on the phenomenon of financial inclusion, Big Data and Fintech were identified as well as various reports from national and international institutions.

The research process was based on the method of Transfield and al (2003), which includes the following stages:
- Planning
- Searching
- Sorting
- Extraction
- Synthesis of results

Planning

At this stage, we have defined the research questions, namely:
- What are the main opportunities offered by Big Data to ensure financial inclusion within the FinTech industry?
- What are the main risks facing Big Data?

To ensure the coherence of these steps, and meet the research objective, we defined a set of inclusion and exclusion criteria for selecting articles and reports.

The research

To answer the research questions, we used the inclusion criteria described in the next table. Our searches were carried out on internationally renowned journals and magazines in the field of finance and management. We identified articles, editorials and analyses by placing the operator "AND" between the term "Big Data" and the following terms: "financial inclusion" and "FinTech".

Table 1 : Inclusion and exclusion criteria.

Criteria	Characteristics
INCLUSION	-The article is less than 10 years old (published after 01/01/2014). - The article contains the terms Big Data, Financial Inclusion which are cited simultaneously either in the title or in the summary of the article or as keywords. - The article contains the terms Big Data, Fintech which are cited simultaneously either in the title or summary of the article or as keywords. - The article contains the terms Big Data, Financial Inclusion, Fintech which are cited simultaneously either in the title or summary of the article or as keywords.

EXCLUSION	-The article was published before 2014. - The article is not written in French or English. - The article deals with issues other than Big Data. - The article deals with issues other than financial inclusion and Fintech. - The document does not meet the relevance criteria.

Sorting

Sorting took into account factors such as date, language, disciplinary field and relevance. Relevance was assessed on the basis of the number of citations and the recency of the articles and their issues. We limited the search to articles written in French and English. Given the topicality of the subject, the study conducted an in-depth review of online sources, journal articles and book chapters published between 2014 and 2024. Several databases, including Scopus, Web of Science, Google Scholar and Science Direct, were used to retrieve relevant academic works.

Extraction

A search was carried out to determine which concepts were most significant for the topics in question. These concepts were then grouped together to find "theoretical links/nodes" between the various studies. At the end of this stage, we were able to identify the impact of Big Data on financial inclusion in the context of Fintech, as well as the challenges and stakes of this technological development.

It is important to note that the research methodology followed in this work focuses on a desk study, drawing solely on existing literature. Although this approach provides valuable information and synthesizes existing knowledge, it is limited to the published works available. The main advantage of this methodology is its ability to analyze a wide range of sources and provide an overview of the impact of Big Data on financial inclusion in the context of Fintech companies.

3. Results and discussion

3-1 The role of Big Data in financial inclusion within the Fintech framework

FinTech have played a crucial role in the expansion of financial inclusion by offering services tailored to the needs of populations underserved by traditional financial institutions. This includes mobile payment services, micro-credits and investment platforms accessible from smartphones, helping to reduce gaps in access to financial services. In addition, Big Data is being used to this end, enabling FinTech to analyze customers' transactional data not only to assess their creditworthiness and reliability as customers, but also to offer them more personalized products and services.

In other words, by leveraging vast data sets, companies can extract important insights into customer behavior and preferences.

This enables them to optimize operations, reduce costs and improve the overall customer experience, leading to more efficient, customer-centric business models.

Based on the analysis of industry experience, and taking into account the financial literature, the influence of Big Data on financial inclusion in the context of Fintech can be summarized in the following facts:

- Improved customer segmentation
- Improved fraud detection and security protocols
- Better risk management
- Improved customer experience
- Improved decision-making
- Innovative products and services

3-1-1 Better customer segmentation and customized product offering

Customer service is one of the key factors in a company's success, and FinTech companies are no exception.

According to Li & al. 2021 and Casas-Rosal & al. 2023, customer segmentation involves dividing customers into groups based on common characteristics such as preferences, behavior or demographics. By segmenting their customer base, FinTech companies can better understand customer needs and tailor their products and services to them.

In the age of new technologies, delivering exceptional customer service requires the use of robust data mining and analysis techniques, powered by Big Data, which help to better segment customers. This, in turn, enables highly targeted marketing campaigns, tailored to the preferences of specific customer groups.

Since Big Data collects vast amounts of information about customers, such as age, gender, ethnicity, socio-economic status, location, preferences, purchases and purchasing power, FinTech can evaluate these datasets in real time and create more specific user profiles. For example, FinTech companies can highlight consumer habits and identify their relationship with age, gender and even social class to distinguish high-value customers who are most likely to make purchases, and decide to focus on them to increase sales and profitability.

What's more, real-time data can be used by FinTech companies to track changes in consumer behavior and modify their segmentation approach if necessary. For example, FinTech companies can modify their segmentation strategy to better target a consumer if they begin to notice new behaviors or preferences.

With these well-defined customer profiles, FinTech companies can establish solid, reliable customer segmentation strategies that enhance their ability to satisfy specific customer needs rather than general, common ones. In other words, Big Data takes the customer relationship from a traditional "same treatment for everyone" relationship to one of "customer engagement". Through this new type of relationship, FinTech companies are finding more effective and responsive ways to understand their customers and build a profile of them, enabling better, more individualized service. Also, FinTech that use information from Big Data for their segmentation strategies can tailor their service portfolios to different customer segments. What's more, they can also personalize their products to suit each customer's preferences. In this way, thanks to more effective and appropriate customer segmentation, FinTech companies can guarantee better customer loyalty and more robust customer service strategies that contribute to their positioning.

Finally, Big Data can be used to categorize customers based on their physical location. This can help FinTech companies better target regions with their goods and services. FinTech companies, for example, can provide goods and services tailored to the demands of customers in particular areas (e.g. rural and underdeveloped areas) or

organize location-specific promotions that encourage the spread of its financial services further afield. FinTech companies can also offer complementary products or services that may be of interest, for example, to a consumer who has already purchased a specific good or service.

3-1-2 Improving fraud detection and security protocols

For FinTech companies, fraud is a major concern, and as more financial transactions move to digital channels, the risk of fraud increases (Weichert 2017, Giudici 2018). Big Data is helping FinTech companies and startups create better fraud detection algorithms, more robust security protocols and impenetrable payment systems to withstand hacking attacks and fraud attempts.

On the one hand, Big Data's ability to prevent malicious attacks lies primarily in the information it provides about the transactions individuals typically make, when they make them, the geographical location from which they make them, and their habits when using the application or website. Using this information and combining it with Big Data analysis can help improve security protocols by identifying fraudulent behavior outside the user's usual patterns. What's more, this process is fully automated. It alerts the relevant departments to contact the user to see if it's him or someone else carrying out the transactions, thus preventing fraud and security threats.

On the other hand, several studies have shown the advantage FinTech companies can have in predicting payment defaults using data from their platform compared with banks that rely on credit register data. Björkegren & Grissen (2020) show that information from cell phone call records outperforms traditional credit bureau information in terms of predicting loan defaults. Frost & al (2019) prove that the loan default prediction model of "Mercado Libre" in Argentina, an e-commerce platform, is more effective than a model using credit bureau data. Using this information can also broaden the borrower population: if the credit decision process were based solely on information from local credit bureaus, 30% of Mercado Libre's target audience in Argentina would be assessed as "high-risk" and therefore excluded from the credit program. Big Data analytics can be used to track financial transactions in real time and look for trends or anomalies that can proactively signal fraud (Chu & Yong 2021, Habeeb & al. 2019). Fintech organizations are now able to detect and stop fraud in real time thanks to machine learning algorithms that can be trained to recognize suspicious patterns based on past data. As a result, FinTech companies can proactively identify and report suspicious activities such as money laundering or identity theft, and potentially stop fraud before it happens.

In conclusion, Big Data can be an effective tool for establishing robust security standards for FinTech organizations, as well as for detecting and preventing fraud. FinTech companies can better analyze customer behavior, spot potential fraud risks and create effective security protocols to guard against fraud and other cybersecurity hazards by using the power of Big Data. What's more, using Big Data analytics and AI-powered technologies to fuel fraud detection systems helps FinTech protect their customers' money. More importantly, it helps maintain any financial company's greatest asset: the trust of its users. As a result, the financial services of FinTech companies will be used by a wider population in complete security, promoting financial inclusion.

3-1-3 Better risk management

One of the main challenges facing FinTech companies is managing the risks associated with their products and services. These companies operate in a highly dynamic and competitive environment, where they have to deal with different types of risk such as credit risk, market risk, operational risk, regulatory risk and cyber risk. To manage these risks effectively, they need to harness the power of Big Data ta analytics.

First, FinTech companies can identify and quantify the risks to which they are exposed. By collecting and analyzing large volumes of data from various sources, such as customer transactions, market data, social networks and external databases, (Anshari & al. 2021, Kijkasiwat 2021, Wang & al. 2021). FinTech can obtain a comprehensive and granular view of their risk profile. They can use advanced techniques such as machine learning and sentiment analysis to extract meaningful information from the data and measure the impact of various risk factors on their performance and profitability. Big Data can be used, too, to study market movements, spot impending financial crises in advance and thus mitigate their adverse effects.

Chen 2020, Thommandru & Chakka 2023 see that Big Data can be used to ensure compliance with legal obligations, such as the fight against money laundering.

Secondly, Big Data can be used to monitor and mitigate the risks faced by FinTech. Using Big Data analytics, FinTech can monitor and evaluate the effectiveness of their risk management strategies and policies. They can also detect and react in real time to emerging risks and anomalies, such as fraud, cyber-attacks or market fluctuations. They can use predictive analytics and simulation models to forecast the potential outcomes of different scenarios and optimize their risk-reward trade-offs. Another concern is the use of Big Data by financial technology companies to monitor their compliance with legal requirements. Truby & al. 2020 and Fletcher & al. 2021 prove that FinTech companies have the ability to identify non-compliance and implement measures to ensure compliance with their legal and regulatory responsibilities through the use of deep data analytics. FinTech companies can, equally, use Big Data analytics to conduct customer surveys (Meng & al. 2021, Awotunde & al. 2021).

Finally, Big Data analytics enables financial institutions to simulate and model various risk scenarios. By analyzing historical data and market trends, FinTech companies can assess potential risks and their impact on the organization. This helps identify vulnerabilities and implement risk mitigation strategies to protect the institution against potential losses.

3-1-4- Improving the customer experience

Firstly, in the context of FinTech companies, Big Data provides access to real-time information that proves how users engage with their products, including the average time spent on their portal, website or mobile app and the most frequently used features. As a result, Big Data positively influences the customer experience in many ways, helping to increase revenues and improve customer acquisition and retention.

Thanks to these new technologies, the financial industry can detect misappropriations more quickly. Indeed, machine learning, along with Big Data, has proven its effectiveness in identifying suspicious activity. Deutsche Bank, for example, relies on Big Data analysis to delineate

money-laundering attempts, strengthen its know-your-customer protocols and guard against credit card fraud.

Secondly, by leveraging Big Data financial companies become able to better analyze consumer behavior to offer tailored services (Melnychenko & al. 2020, Awotunde & al. 2021).

FinTech companies can predict future financial demands and provide personalized suggestions for financial products and services by examining historical behavior and market patterns. For example, based on purchasing habits and credit history, FinTech companies can use predictive analytics to identify customers likely to need a loan soon. Based on each customer's specific financial needs and risk tolerance, they can then offer them tailor-made loan conditions and interest rates. What's more, since historical financial data enables companies to track changes in customer behavior, financial institutions can develop products and services that make banking much easier. One example is the Oversea-Chinese Banking Corporation (OCBC), which has invented a highly effective short-term marketing strategy based on the extensive collection of historical customer data.

Finally, Big Data can also help FinTech provide rapid solutions to common problems that users of financial services have been facing for years. Annoyances such as switchboards, operators, long queues at bank branches, paperwork and long hours waiting to speak to someone on the phone or in person are coming to an end thanks to FinTech, artificial intelligence and Big Data. Indeed, thanks to information derived from Big Data, FinTech companies can easily collect and analyze crucial information about their users' financial activities, target anomalies and errors, and react accordingly. This then leads to a substantial increase in the quality of customer service and the enhancement of technological service channels such as live chats.

For example, with live chat, instant personal front-line interactions take place between the FinTech Company and its users without the need for face-to-face meetings, branch visits or long queues. In addition, live chat agents can now access user data on which products the customer owns, which products they are most likely to buy, how they usually pay for their purchases, their purchasing power and their latest buying trends. This data enables agents to personalize FinTech experiences for users and solve their problems instantly. In addition to the rapid resolution of typical problems, customers also benefit from relevant product recommendations based on Big Data insights, improving the accuracy of marketing initiatives and advancing customer retention and loyalty programs.

3-1-5- Improved decision-making

In the context of FinTech organizations, Big Data represents a powerful tool capable of guiding better decision-making (Treleaven 2015, Hassani & al. 2018, Polak & al. 2020, Roszkowska 2021, Morales & al. 2022).

According to Talend (2022), Big Data in finance refers to the petabytes of structured and unstructured data that can be processed within an enterprise to derive key information for decision-making.

Big Data, reinforces the role of FinTech in self-protection as well as the protection of their customers' rights (Huang & al. 2020, Sheng 2021, Ennouri & Mezghani 2021, Nobanee & al.2021). On the one hand, information processed using Big Data can be used to predict the creditworthiness of current and potential borrowers, enabling lenders to identify high-risk customers and make better lending and investment decisions (Serrano-Cinca & al. 2015, Kshetri 2016). On the other hand, FinTech companies can prevent losses and protect their customers' financial information by quickly detecting and responding to fraud attempts by analyzing massive amounts of data in real time.

Machine Learning is revolutionizing trading and investment. Beyond the simple analysis of stock prices, Big Data is now capable of taking into account the political and social trends that are likely to affect the stock market and thus influence their operations. Machine learning makes it possible to track trends in real time, so that analysts can gather and exploit relevant data and arrive at well-founded decisions (Talend 2022).

In short, Big Data has become a powerful tool that FinTech organizations can use to make more informed decisions. Real-time analysis of huge volumes of data by FinTech companies enables a better understanding of consumer behavior, market trends and risk management. This information can be used to create competitive advantage on the one hand, and to retain existing customers and attract potential ones on the other. These new technologies reinforce the expansion of Fintech's field of activity.

3-1-6- Innovative products and services

The ability to gain a deeper understanding of customer behavior is another significant benefit of big data for FinTech. Large volumes of data can be analyzed by FinTech companies to find out how customers use their goods and services, what their preferences are and what influences their decisions (Hommel & Bican 2020, Dehnert & Schumann 2022). With this data, FinTech companies can create goods and services that more effectively meet their customers' needs, and tailor their offerings to specific customers. Big data analysis, for example, can help FinTech companies find trends in consumer spending and transaction history, which they can then use to provide individualized financial advice and personalized investment suggestions.

3-2 The reality of Big Data in the financial sector

A large number of companies have integrated Big Data into their financial activities and reaped its benefits. They have succeeded in tailoring their services to the preferences of existing customers, and thus attracting more new customers.

As an example, Ant Financial Services Group uses Big Data to assess credit and offer loans to SMEs and consumers with no traditional credit history. Their credit scoring technology, called Zhima Credit, analyzes data from a variety of sources to assess users' creditworthiness.

Similarly, Square, Inc. uses Big Data to offer loans to small businesses using its point-of-sale system. Square Capital assesses a company's financial health by analyzing daily transactions and sales patterns to decide whether it is eligible for a loan and to determine repayment terms.

Also, Credit Karma provides personalized recommendations for credit cards and loans by analyzing its users' credit data. They also use Big Data to help users monitor their creditworthiness and detect potential fraud risks.

These companies and others are testament to the innovative use of Big Data to deliver more accurate, personalized and efficient financial services, improving the user experience

and decision-making in personal and business finance and thereby promoting financial inclusion.

3-3 The financial risks of Big Data

As companies grow and digitize their processes and services, they are able to collect and generate more data. In addition to supporting the development of their activities, this mass of information can be exploited to support their risk management (financial, market, operational, compliance...). However, this evolution is likely not only to reduce the security of operations or facilitate cybercrime, but also to increase traditional risks and introduce new ones into the financial system. "Henceforth, globalized finance alone represents a complex and transnational ecosystem, engaging multiple stakeholders" states Gayraud (2014). According to Gayraud, this globalized world of finance presents five historically unprecedented aspects: dizzying volumes disconnected from the real economy, growing opacity, virtually impossible regulation and credible oversight, accelerated fragmentation across multiple marketplaces, and proven politics.

3-3-1 Transaction security

According to De Galhau (2016), with the digitization of financial services, central banks face a challenge in their mission to ensure the security of payment, clearing and settlement operations. With regard to payments, for example, the emergence of new players and new means of payment has led to changes in the sources of risk. Indeed, the development of e-commerce since the early 2000s has gone hand in hand with the use of remote payments, not only by means of electronic cards, but also via other innovative tools such as electronic wallets, payment solutions based on bank transfers, or from a bank account, or even payments integrated directly into mobile applications, enabling faster transactions on smartphones. On a more general level, it is conceivable, for example, that a major development in decentralized exchange systems, covered by the famous blockchain technology underlying bitcoin, would lead to an upheaval in the conditions under which central banks perform their security function. These exchange models are likely to replace the traditional way in which clearing houses operate, based on centralized aggregation and clearing of flows, which also affects collateral management systems and asset registration methods. Nevertheless, with the exception of bitcoin, the experimental phase of this technology is still very limited. In order to validate its development potential, a number of criteria need to be verified beforehand, notably in terms of security, cost, ability to process large volumes of transactions rapidly, and the economic interest of dispensing with a trusted third party to carry out certain tasks.

3-3-2 Cybercrime

The fact that finance has access to cyberspace means that it is also exposed to cybercrime, i.e. any type of crime perpetrated using information systems or computer networks with the aim of damaging institutions' systems or hacking into their data. This type of risk is already taken into account by traditional financial players, who are required by prudential regulations to reinforce their protection mechanisms against all kinds of shocks. In addition, financial regulators ensure that the IT security policies of financial institutions are well defined, such as strengthening expertise and raising staff awareness, taking part in regular crisis exercises, stepping up the security of internal systems via very rigorous access control, more advanced data encryption, introducing intrusion detection tools and carrying out periodic tests to verify their effectiveness (De Galhau, 2016). On the other hand, due to their exclusively Internet-based business models, Fintechs are particularly exposed to cybercrime. It is essential that Fintech take cyber risk seriously and develop IT security policies in line with market best practice. Managing these risks requires genuine cooperation between the relevant authorities at national level, as well as at international level. In addition to the financial and banking markets, the insurance market can be subject to just as many risks linked to Big Data as any other. Indeed, according to Deloitte (2014), the data stored electronically by insurers and other companies is often sensitive and confidential, exposing them to cyber-attacks such as theft of customer data or espionage. Digital technology has considerably increased the ability of companies to interact with customers, improve their offers and pricing, automate their administrative processes and establish partnerships, and has therefore promoted financial inclusion. However, it has also introduced additional levels of complexity and vulnerability, reinforcing organizations' dependence on digital infrastructures that they cannot fully control, posing challenges in terms of cyber resilience. In this sense Schimel (2016), was able to conclude that the digital challenge represents both strategic risks and opportunities for insurers. These include operational risk related to data and systems, as well as new risks to insure, with the challenges posed by an evolving market.

3-3-3 Crowdfunding's sensitivity to crises and credit risk

Although crowdfunding continues to attract entrepreneurs and confirm its role as an alternative source of financing, positioning itself as a complement to traditional financing methods, the worst pandemic crisis in history has highlighted the fragility of small and medium-sized enterprises (SMEs) in the face of this crisis. According to Sansri & Cheurfa (2021), these companies will not survive without appropriate monetary policy fundamentals. They are currently going through a particularly critical period, with risks of suspension of payments or mass bankruptcies, which could lead to increased mistrust on the part of savers.

3-3-4 High-frequency trading and liquidity risk

High-frequency trading has demonstrated its contribution to accelerating liquidity risk by jeopardizing market stability (Foucault, 2016). The galloping rise of high-frequency trading is disrupting the structure of equity markets and the business model of trading platforms. By providing liquidity to the market without being subject to regulatory requirements, high-frequency trading operators are able to marginalize traditional market makers. The latter are obliged to keep pace with current technology in order to maintain their business. What's more, these companies are not currently subject to any exchange or customer requirements. As a result, their liquidity can be suddenly reduced in times of stress. They resort to strategies that can be likened to new abusive practices or market manipulation. For example, disproportionately sending orders that are destined not to be executed, in order to slow down trading platforms and seize arbitrage opportunities more easily, contributes to distorting market information. What's more, the speed at which information can be used by this technology accentuates market volatility and contagion between asset classes. The fact that many high-

frequency trading strategies are highly correlated with each other leads to amplified shocks (De Galhau, 2016).

3-3-5 Modeling risk

Big Data technology enables financial organizations to use more data, and to carry out much more extensive and rapid methodical analysis, in order to minimize risk and keep pace with future fluctuations generated by different national and international economic conditions. However, this development is not only likely to affect operational security, it also poses a major challenge in terms of analyzing and modeling financial risks when forecasting the fluctuation of a financial product, or when making decisions at managerial level. Moreover, organizations are still confined to traditional methods of data analysis based on asymptotic approaches. Indeed, risk modelling accompanied by increased storage, calculation and analysis capacities leads to inadequate modelling and consequently poor financial risk management, one of the main reasons for the 2008 financial crisis. These conventional methods fail rapidly if certain technical postulates cease to be verified - intolerable assumption of normality, due to mega-observation data - which consequently limits the field of application. We therefore need to think of techniques that address both the problem of massive amounts of data, and the assumptions of unacceptable normality (Zaimi & El Moudden, 2023).

3-3-6 Systemic risk

We all agree that new technologies considerably increase the vulnerability of financial markets to certain types of catastrophic or operational events (power failures, cyber-attacks or computer server overloads), but it should be stressed that this new, purely digitized form of trading introduces far more worrying risks of systemic failure. First and foremost, this risk concerns the behavior of artificial intelligences. Insofar as these trading machines operate as part of a global, computerized financial system, they can, by coding error or chance, contaminate the entire system, triggering a series of chain reactions beyond human control. Another type of systemic risk is associated with automated data extraction and analysis systems. Since algorithms cannot analyze information in relation to investors' beliefs and psychology in order to determine asset prices, a systemic risk may arise due to errors of judgment. These errors of judgement, however small they may be, can have very damaging consequences, as they spread at lightning speed throughout the financial system, creating unfounded stock market panics leading to crashes.

Conclusion

Recent years have seen exponential growth in the volume and availability of data. This is mainly due to the emergence of a multitude of sources (computers, mobile devices, sensors or social networks) that continuously produce structured, semi-structured or unstructured data. This is the era of Big Data. For companies in general, and financial technology companies in particular, Big Data represents a new challenge, since it implies new requirements in terms of data storage, processing and visualization.

In this study we examined the impact of Big Data analysis by Fintech on financial inclusion. Our results proved that FinTech play a vital role in expanding financial inclusion by offering services tailored to the requirements of populations underserved by traditional financial institutions using analysis of their behaviors on digital platforms. Big Data is also being used to this end, enabling FinTech to analyze customers' transactional data not only to assess their creditworthiness and reliability as customers, but also to offer them more personalized and less expensive products and services. The analysis of large datasets in real time enables FinTech to optimize operations, reduce costs, improve the overall customer experience, and better manage risk, leading to more efficient business models aimed at a population previously excluded by traditional models.

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