U.PORTO
FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

IMPACT OF FINTECH FIRMS ON THE PERFORMANCE OF TRADITIONAL BANKS

Filipa Raquel da Silva e Barbosa

Dissertation

Master in Economics

Supervised by
Carlos Francisco Ferreira Alves
Sujiao Zhao

2022

Acknowledgements

Firstly, I would like to thank my supervisors, Professor Carlos Alves and Professor Sujiao Zhao, for guiding me through this process. Their expertise and availability to help throughout the past months were of immense value.

I would also like to show my eternal gratitude to my parents, Adelina and Fernando, and my brother, Mário, for always being there for me, available to listen and support me in everything I do through the ups and downs.

Lastly, I would like to express my gratitude to my grandparents, other family members, and friends for accompanying me on this journey.

Abstract

The rise of a new era of information technology and digital banking following the 2007-09 Global Financial Crisis has created new competitive pressures in the financial markets. With FinTech firms now becoming market players along with traditional banks, it is highly relevant to understand the former's effect on the latter. This is the primary goal of this dissertation.

In particular, the present work proposes to investigate how the stock prices of publicly listed traditional banks react to the announcement of FinTech funding deals. To this effect, I adopt the event study methodology based on a single-factor model, the Market Model (MM). Furthermore, I perform two statistical tests: the parametric t-test and the non-parametric generalized sign test to study whether traditional banks exhibit any abnormal performance when faced with FinTech funding events. Data is collected on the 174 FinTech funding events (types and timing) and 70 traditional banks (stock prices) from ten European countries for the period between 2010 and 2019.

The main findings suggest that, when analyzing the FinTech industry, traditional banks do not exhibit significant abnormal performance for any of the event windows considered. Although the parametric test employed reported significant negative results, these were rejected due to the non-normality of the data. Additionally, the analysis conducted by sub-sampling the events into different types of FinTech categories showed that the stock returns of traditional banks react negatively to Digital Lending funding events, suggesting a substitution effect, and positively to the funding of Digital Payments firms, suggesting a complementary effect. The findings for Digital Capital Raising firms suggest that banks' stock returns initially react negatively to these events but that this result is reversed in the following days, suggesting an overall complementary effect.

JEL codes: C12; G14; G20; G21; G23

Keywords: FinTech; Banks; Financial Technology; Bank Performance; Competition; Bank Strategy; Disruptive Innovation; Event Study

Resumo

O surgimento de uma nova era de tecnologia de informação e de banca digital após a Crise Financeira Global de 2007-09 criou novas pressões competitivas nos mercados financeiros. Com as FinTechs a tornarem-se players de mercado juntamente com os bancos tradicionais, torna-se altamente relevante entender o efeito das primeiras sobre os últimos. Este é o objetivo principal desta dissertação.

Em particular, o presente trabalho propõe investigar como os preços das ações dos bancos tradicionais cotados reagem ao anúncio de eventos de financiamento de FinTechs. Para tanto, adotou-se a metodologia de estudo de eventos baseado no modelo de fator único, o Modelo de Mercado (MM). Ademais, realizaram-se dois testes estatísticos: o teste paramétrico t e o teste não paramétrico de sinal generalizado para estudar se os bancos tradicionais apresentam alguma performance anormal diante de eventos de financiamento de FinTechs. Dados são recolhidos para 174 eventos de financiamento de FinTechs (tipos e timing) e 70 bancos tradicionais (preços das ações) de dez países europeus para o período entre 2010 e 2019.

Os principais resultados sugerem que, ao analisar a indústria de FinTech, os bancos tradicionais não apresentam performance anormal significativa para nenhum dos intervalos considerados. Embora o teste paramétrico empregado tenha apresentado resultados negativos significativos, estes foram rejeitados devido à não normalidade dos dados. Adicionalmente, a análise realizada por subamostragem dos eventos em diferentes tipos de categorias de FinTech demonstrou que os retornos das ações dos bancos reagem negativamente aos eventos de financiamento de "Empréstimos Digitais", sugerindo um efeito de substituição, e positivamente ao financiamento de "Pagamentos Digitais", sugerindo um efeito de complementaridade. Os resultados para as empresas de "Angariamento de Capital Digitais" sugerem que os retornos das ações dos bancos inicialmente reagem negativamente a esses eventos, mas que esse resultado é revertido nos dias seguintes, sugerindo um efeito geral de complementaridade.

Códigos JEL: C12; G14; G20; G21; G23

Palavras-Chave: FinTech; Bancos; Tecnologia Financeira; Performance Bancária; Competição; Estratégia Bancária; Inovação Disruptiva; Estudo de Eventos

Table of Contents

List of Tables

List of Figures

1. Introduction

With the continuous and exponential growth of the FinTech industry, characterized by firms that apply technology to the provision of financial services, research on this subject becomes more and more pressing. CB Insights (2021) reports that global FinTech funding up to the third quarter of 2021 was 94.7 billion dollars, surpassing 2020's funding amount by 96% and 2015's by 434%. As this value continues to grow, understanding the position of traditional banks in financial markets, in the context of the entrance of FinTech firms as new players into the consumer provision scene, becomes increasingly relevant. As both types of entities seemingly offer the same type of products and services, albeit with significantly different business models, and as FinTech firms seem to be paving their way to become better and more efficient substitutes to pre-existing banking institutions, does the theoretical hypothesis of FinTech firms serving as substitutes to traditional banking institutions translate empirically? Should FinTech firms even be considered substitutes for traditional banks, or complements?

Whilst several authors have concluded that FinTech firms will never be able to fully replace traditional banks, given the latter's competitive advantages and already established client database (Navaretti, Calzolari, & Pozzolo, 2017; Vives, 2019), they do concede that some of their market share may be eroded, as FinTech firms initially target niche markets but progressively establish new market footholds, attracting both new consumers that were not captured by the traditional banking system, and also some already-existing clients, a process identified by literature as disruptive innovation(Akkizidis & Stagars, 2015; Anagnostopoulos, 2018; Christensen, Raynor, & McDonald, 2015). Also, noting that although the FinTech industry, as a whole, is often discussed when referring to its possible impact on traditional banks, there are some important distinctions between the types of activities developed by FinTech firms that would lead to different and even opposing assertions (Knewtson & Rosenbaum, 2020).

In this context, with the rise of a new era of information technology and digital banking after the Global Financial Crisis of 2007-09, and where a relatively novelty phenomenon can affect one of the most important types of institution in our economy, traditional banks, the topic of this dissertation proves itself as extremely relevant to better assess the current state of the financial industry and for our economy's stakeholders to make more updated and informative decisions. Thus, with the upsurge of new entrants in the banking industry as technology-based financial corporations, it is of utmost importance to understand if traditional incumbent banks have the ability to handle these newfound competitive pressures and how they are impacted by them. In this context, the present work proposes investigating how the stock prices of publicly listed traditional banks are affected by the news announcement of FinTech funding deals.

Given the background described above, this dissertation investigates the following research questions: how does the presence of FinTech firms in the financial markets impact the financial performance of traditional banks?; is FinTech funding an alternative to that of traditional banks?; does the traditional banking system's stock prices exhibit abnormal behavior when faced with the announcement and completion of FinTech funding events?; do traditional banks' stock returns react differently when faced with funding events by different types of FinTech categories?.

To address the previously mentioned questions, the present work uses the event study methodology with a single-index market model to estimate predicted returns, combined with two significance tests: the parametric t-test and the non-parametric generalized sign test proposed by Cowan (1992). This analysis is applied to the European market, where data relating to the performance of traditional banks and FinTech funding events was collected for 2010-2022. This methodological procedure allows for identifying significant abnormal performance (either positive, negative, or null) exhibited by traditional banks after the announcement of funding receivement from a FinTech firm.

When evaluating the FinTech industry as a whole, the findings do not attest to the existence of a positive or negative impact on the stock returns of traditional banks when faced with a FinTech funding event. Although one of the significance tests employed does find evidence of abnormal performance, its conclusions were rejected due to the non-normality of the data. When evaluating FinTech funding events by the types of activities the firms involved in these events develop, it was found that traditional banks show signs of significant negative abnormal performance for "Digital Lending" funding events, suggesting the existence of a substitution effect between the firms and traditional banks, and significant positive abnormal performance for "Digital Payments" funding events, suggesting the existence of a complementary effect. The analysis for the "Digital Capital Raising" category reported overall significant positive performance, except for the actual event date, where traditional banks' stock returns exhibit a strongly significant negative reaction. This initial reaction seems to be reverted the following days after the event day.

The work presented in this dissertation differs from others on the subject in several ways. First, as the FinTech industry is prevalent in the United States and China and is lagging in Europe, where the sector is mainly concentrated in the United Kingdom, most papers looking to study the subject apply their investigation to the former two countries. Also, as FinTech has an important gap-filling role in developing economies, many empirical studies also focus on these regions. Thus, this dissertation builds on previous research by expanding it geographically by focusing on European countries. Second, while most empirical studies focus on an analysis of accounting-based financial performance, the present work analyzes market-based performance measures, in this case, the stock market returns of publicly-listed traditional banks. Third, the authors that do opt for the study of these later measures all take a traditional econometric approach. In contrast, the present work is the first to introduce the use of the event study methodology for the study of the same subject.

The present report is organized as follows. In chapter 2, a literature review on the concepts of FinTech, traditional banks, and their characteristics is presented. A critical review of the various contributions to the literature on the competitive relationship between financial institutions and the interaction between the former and latter concepts is also displayed. This chapter also presents empirical literature on the impact of FinTech firms on the financial performance of traditional banks, as well as other complementary empirical studies. Chapter 3 presents the identification and description of the empirical method adopted to answer the previously described research questions (subsections 3.1 and 3.2) and the data used to conduct the study (subsection 3.3). Chapter 4 entails the presentation and critical discussion of the achieved results. Finally, chapter 5 reports on the main conclusions and limitations of the dissertation as well as future avenues of research.

2. FinTech, Traditional Banks and Coopetition: A Literature Review

This chapter reviews the literature on the relationship between FinTech firms and traditional banks. First, the different concepts of FinTech are presented and discussed, along with a brief historical background of the industry, a categorization of its activities, and a dual-sided perspective of reasons for its adoption and development. Then, the concept of traditional banking is explored, investigating whether banks still maintain a special role in the current economy. Next, theoretical hypotheses on how FinTech firms affect traditional banks are presented. Lastly, empirical evidence on these hypotheses, evaluating the financial performance of banks, is displayed and discussed.

2.1. FinTech Concept and Historical Framework

FinTech is the result of the amalgamation of "Financial" and "Technology". Even though the first introduction of this term can be traced back to 1972 (Bettinger, 1972), and that there have been multiple attempts to define it since then, there is still a lack of consensus on its concrete definition, given its high degree of applicability. It has been stated that it is impossible to reach a definition of FinTech that is not so broad that it includes other types of organizations and not so restrictive that it excludes those institutions commonly associated with the expression (Dorfleitner, Hornuf, Schmitt, & Weber, 2017; Schueffel, 2016). The consensus is that it refers to applying technology to the financial sector. However, more detailed characterizations vary amongst scholars. Furthermore, the suggested definitions can be divided into two categories: FinTech as financial innovations and FinTech as companies. A few of these propositions are summarized in Table 1, below.

Table 1 – Proposed definitions of FinTech in scholarly literature

Author	Definition
Bettinger (1972, p. 62)	Defined as "an acronym which stands for financial technology, combining bank expertise with modern management science techniques and the computer."
Schueffel (2016, p. 45)	Defined as "a new financial industry that applies technology to improve financial activities."

Macchiavello (2017, p. 664)	Defined as "start-ups resorting to new technologies to more efficiently offer financial services and products, therefore often in competition with mainstream providers but without being subject to the same strict rules."
Gomber, Koch, and Siering (2017, p. 540)	Defined as "innovators and disruptors in the financial sector that make use of the availability of ubiquitous communication, specifically via the Internet and automated information processing."
Nicoletti (2017, p. 12)	Defined as "initiatives, with an innovative and disruptive business model, which leverage on [Information and Communications Technology] in the area of financial services."
Financial Stability Board (2017b, p. 2)	Defined as "technologically enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services."
Ryu (2018, p. 543)	Defined as "innovative and disruptive financial services by non-financial companies, where [Information Technology] is the key factor."
Leong and Sung (2018, p. 75)	Defined as "any innovative ideas that improve financial service processes by proposing technology solutions according to different business situations, while the ideas could also lead to new business models or even new businesses."
Das (2019, p. 981)	Defined as "any technology that eliminates or reduces the costs of financial intermediation."
Stulz (2019, p. 86)	Defined as "financial innovation that is based on the use of digital technologies and big data."
Knewtson and Rosenbaum (2020, p. 1048)	Defined as "technology used to provide financial markets a financial product or financial service, characterized by

	sophisticated technology relative to existing technology in that market."

The numerous definitions presented show the multiple dualities in the authors' propositions (Knight & Wojcik, 2020). First, while some authors consider that FinTech encompasses every type of financial technology, others refer only to innovations (e.g., Knewtson and Rosenbaum (2020) and Das (2019), respectively). Second, while some authors acknowledge both incremental[1] and disruptive innovations[2], others refer only to the first (e.g., Schueffel (2016) and Nicoletti (2017), respectively). Lastly, while some authors consider that the referred concept applies to both incumbent financial institutions and start-up companies, others focus mainly on the latter (e.g., Ryu (2018) and Macchiavello (2017), respectively).

Additionally, even though the term first emerged in 1972[3], interest from consumers, regulators, investors, and academics has only been directed at this topic since 2014 (Alt, Beck, & Smits, 2018; Arner, Barberis, & Buckley, 2017; Schueffel, 2016). This newly found interest in the sector and the lack of consensus on the delimitation of its activities also reflects the current lack of specific international industry classification for firms operating in the FinTech sector.

Following the broader, more consensual definition of FinTech as the application of technology to financial activities, its historical course and consequent evolution (up until the current time) can be divided into three main eras (Arner, Barberis, & Buckley, 2016; Hendershott, Zhang, Zhao, & Zheng, 2021)[4].

The first era, FinTech 1.0, started around 1866 and lasted until 1967. This period was characterized by the first successful completion of the transatlantic telegraph cable and the fast technological development stemming from World War I and World War II. These

---

[1] Incremental innovations refer to gradual and regular minor improvements applied to a firm's already-existing product or service catalog in order to sustain or boost their competitive position.

[2] Subsection 2.5.1. provides further details about this concept.

[3] Although it is commonly and erroneously suggested in the literature that its introduction can be traced to the early 1990s, in a project led by Citigroup. See, *e.g.*, Romanova and Kudinska (2016), Gimpel, Rau, and Roglinger (2018) and Iman (2019).

[4] While Arner et al. (2016) classify the FinTech eras numerically and sequentially, i.e., FinTech 1.0, FinTech 2.0 and FinTech 3.0, Hendershott et al. (2021) opts to delineate the different eras as "+tech", "tech+" and "tech^2", respectively. The first classification is adopted for the purpose of this dissertation.

developments led the path to the emergence of the FinTech 2.0 era, which started with the Automated Teller Machine (ATM) launch in 1967 and lasted until 2008. This period was characterized by the extensive use of computers and digital technology to perform financial activities, such as the processing of transactions and payments and securities trading, the establishment of the Society of Worldwide Interbank Financial Telecommunications (SWIFT) in 1973, and the first introduction of online banking in 1995. Additionally, the stock market crash of 1987, commonly known as "Black Monday," highlighted the relevance of these technological developments and FinTech innovations in the financial sector. The introduction of online consumer banking and the creation of the Internet during the FinTech 2.0 era served as a baseline for the FinTech 3.0 era, which started in 2008 and has lasted until now. This period is characterized by the rate at which technology is developing, with the aid of growing mobile/smartphone penetration and evolving application programming interfaces (APIs). These advances reflect the growth of companies involved in the FinTech sector, which went "from 'too small to care' to 'too large to ignore' to (…) 'too big to fail" (Arner et al., 2017, p. 7). Also, the mentioned developments were further leveraged by the Global Financial Crisis of 2007/08, which caused an environment of distrust among consumers towards traditional financial institutions. In addition, they triggered changes in the reigning regulatory framework.

Although the definition suggested by the Financial Stability Board (2017b) is (one of) the most commonly used in academic literature to characterize and delineate the FinTech sector and its activities, it indirectly suggests that the ending of FinTech 1.0 and the beginning of FinTech 2.0 eras were the peak of FinTech development (Stulz, 2019), which is not in the interest of the present work. Therefore, the most suitable definition for this dissertation is the one Ryu (2018) provided, displayed in Table 1, as the proposition advanced by the author allows for the focus of the analysis to be in the FinTech 3.0 era, when FinTech firms began to assemble and develop into the form they are currently known to have, in which they have the potential of posing a threat to the traditional banking system.

2.2. Categorization of Fintech Activities

Along with the lack of consensus on the definition of the FinTech term, which has resulted in a blurry attempt at determining the boundaries that delineate the scope of the FinTech sector, there is also a discrepancy in the categorization of the activities developed by firms in this industry.

Some authors find it most appropriate to group FinTech firms and their operations into six different categories, also known as verticals or vertical segments: digital payments services, lending/financing, banking, and investment/asset management and personal finance; blockchain technology/cryptocurrency; InsurTech, which is the term used to describe the application of FinTech to the insurance industry (Darden, Dixit, & Mason, 2018; Gomber et al., 2017; Lee & Shin, 2018). Alternatively, other authors prefer categorizing into four broader verticals (Brandl & Hornuf, 2020; Knewtson & Rosenbaum, 2020; Leong & Sung, 2018; Thakor, 2020). While aggregating FinTech activities into the financing, asset management, and payments categories is consensual among the referenced authors, their opinion diverges on the fourth. While Brandl and Hornuf (2020) state the last category to be "Other", in representation of FinTech firms that offer services and products such as application programming interfaces (APIs) and infrastructures, Thakor (2020) suggests it to be "Insurance", and Leong and Sung (2018) propose "Compliance", which includes RegTech (the application of FinTech to improve regulatory procedures). On the other hand, Knewtson and Rosenbaum (2020) present a different alternative by arranging the vertical sectors into monetary alternatives, capital intermediation, InvestTech, and infrastructure.

In addition, other more complex categorizations are also proposed (Eickhoff, Muntermann, & Weinrich, 2017; Haddad & Hornuf, 2019; Imerman & Fabozzi, 2020) but are less commonly found in academic literature.

Still, while some authors consider crowdfunding to be included in the "Financing" vertical sector (Brandl & Hornuf, 2020; Leong & Sung, 2018; Thakor, 2020), others consider that it should have its own category (Imerman & Fabozzi, 2020; Lee & Shin, 2018; Liu, Li, & Wang, 2020).

To further detail what the operations developed by firms in the FinTech sector entail, an adaptation of the categorization proposed by Knewtson and Rosenbaum (2020) will be adopted, as it allows for a better establishment of a parallel between these activities and those developed by organizations belonging to the traditional financial sector[5].

[5] The "Infrastructure" category was omitted due to it not being relevant to the present work as these only "fill auxiliary roles related closely to financial services" (Knewtson & Rosenbaum, 2020, p. 1056). Other subcategories were also omitted for the same reason.

Monetary Alternatives

The Monetary Alternatives category includes FinTech firms that provide cryptocurrency (investing and trading), domestic and international peer-to-peer (P2P) payments services, that is, consumer and retail transactions, and business-to-business (B2B) payments services, that is, wholesale and corporate transactions (Knewtson & Rosenbaum, 2020; Lee & Shin, 2018).

As a blockchain-based asset, cryptocurrency constitutes a digital alternative to physical money. Briefly, a blockchain is a type of distributed ledger technology, that is, a decentralized database that is used to record the transactions made with the cryptocurrency in question (*e.g.,* the bitcoin blockchain, one of the most commonly known) (Gomber et al., 2017). Furthermore, the information stored in the blocks that make up the blockchain is immutable and publicly accessible (Stulz, 2019). Though this type of digital currency has seen exponential growth in popularity, it does not constitute a threat to traditional banking institutions (Knewtson & Rosenbaum, 2020; Stulz, 2019). Instead, FinTech firms that develop their activities in this realm compete with the currency issued by central banks (Stulz, 2019), also known (in most cases) as fiat currency.

The P2P and B2B payment services business models adopted by FinTech firms are one of the most challenging for the traditional banking system, as they mostly replace the need for individuals and businesses to resort to the latter for the processing of transactions, whether it be national or internationally, offering a more efficient and cheaper way to fulfill their transactional needs (Knewtson & Rosenbaum, 2020). Regarding P2P payment services, although traditional banks have since developed their own technologies to face the competition from FinTech firms in this sector, the latter have gained market share by targeting previously underserved agents, who now have access to these services (Elsaid, 2021).

Capital Intermediation and Digital Financing

The Capital Intermediation and Digital Financing grouping comprises digital banks, InsurTech (the application of technology to the insurance sector), and LendTech firms (Knewtson & Rosenbaum, 2020). However, as insurance FinTech firms are competitors to traditional insurance organizations rather than banking institutions, its description will not be developed as it is not relevant to the present work.

FinTech firms operating as digital banks, which include both mobile banking and its infrastructure, can be divided into two categories: neo-banks and challenger banks (Imerman & Fabozzi, 2020; Knewtson & Rosenbaum, 2020; Petralia, Philippon, Rice, & Véron, 2019). While the two terms are often used interchangeably to describe the same business model, a few differences are relevant. First, while the former focuses on mobile banking, developing its activities on a digital-only basis, and relying heavily on cloud-based technologies and web platforms, the latter uses a hybrid model where technology is also at the forefront of its operations. Still, a physical location is also relied on. Second, whilst neo-banks do not possess a baking license, meaning they are legally not allowed to provide for some services offered by traditional banking institutions (such as accepting deposits) and, therefore, need to form partnerships with the latter institutions to conduct their business, challenger banks, on the other hand, do hold a banking license (England, 2020). Thus, as neo-banks rely on traditional incumbent banks to offer licensed services, as opposed to challenger banks, the primary source of competition from the digital banking sector comes from the latter. In fact, KPMG (2016) reported that challenger banks outperform traditional banking players.

Also acting as capital intermediators, there are FinTech firms that offer alternative financing options to consumers (either individuals or businesses), known as LendTech firms (Knewtson & Rosenbaum, 2020). One of the most popular types of FinTech firm in this sector adopts the P2P business model (also known as crowdlending or marketplace lending) (Lee & Shin, 2018). This service is described as "the loaning of money (…) through online services that directly match lenders with borrowers without using an intermediating bank" (Thakor, 2020, p. 3). Whilst this process is frequently classified in the literature as one of disintermediation (Das, 2019; Elsaid, 2021; Navaretti et al., 2017; Nicoletti, 2017), it has also been referred as to being one of reintermediation (Akkizidis & Stagars, 2015; Imerman & Fabozzi, 2020; Knight & Wojcik, 2020; Langley & Leyshon, 2021). This debate has arisen because P2P FinTech firms have shifted the way in which they operate from how they initially did. Currently, most of the lenders present in these platforms are institutional investors, that is, traditional financial institutions such as commercial banks, insurance companies, and hedge funds, as opposed to how it was during the foundational period of these types of companies, where the primary source of credit came from retail investors (Balyuk, Berger, & Hackney, 2020; Dermine, 2017; Saiedi, Mohammadi, Broström, & Shafi, 2020). As such, P2P lending platforms are increasingly viewed as reintermediators rather than disintermediators, as they take on the role of investment management traditionally performed by banks (Balyuk & Davydenko, 2019; Imerman & Fabozzi, 2020).

Once again, this category is considered a potential threat to the traditional banking system as its business model allows for an offering of personalized products and services according to consumers' specific wants and needs. In this way, FinTech firms can position themselves in a niche market, looking to, once again, provide for underserved market segments (Basole & Patel, 2018; Knewtson & Rosenbaum, 2020).

InvestTech

The main type of FinTech business model included in the InvestTech category is crowdfunding, which is divided into three categories: rewards-based, where the lender is promised a reward in exchange for their contribution; donation-base, where there are no exchanges made other than the investment; equity-based, where a stake in the borrower's business is offered in exchange of an investment (Lee & Shin, 2018).

When describing what the InvestTech grouping entails, Knewtson and Rosenbaum (2020) only mention equity-based crowdfunding, also known as crowdinvesting. Although the author does not classify these firms as neither complementing nor displacing to traditional financial services, crowdfunding plays a critical role for start-up companies and small and medium-sized enterprises as these tend to have a lower chance of obtaining a traditional banking loan (Gomber et al., 2017), thus being considered an "effective tool (…) to bridge the funding gap between earliest stages of funding and later growth of capital" (Leong & Sung, 2018, p. 76).

2.3. The Drivers of FinTech Adoption and Growth: A Dual-Sided Perspective

The emergence of the FinTech industry and the subsequent adoption of its offerings by consumers is the result of a set of external drivers. Depending on where they originate, these may be divided into demand-side or supply-side factors. In conjunction, these made for the optimal environment for FinTech firms to appear as a new type of participant in financial markets.

2.3.1. Supply-Side Factors

Concerning the supply-side factors attributed to the exponential growth of the FinTech industry, technological advancement has been noted as the main factor that enabled the emergence of FinTech firms (Bollaert, Lopez-de-Silanes, & Schwienbacher, 2021; Elsaid, 2021). As described in section 2.1., rapidly evolving technologies are what made it possible for the development of the FinTech 1.0 era and its evolution into the consequent periods, introducing new business models, products and services, and leveraging off of increased connectivity (Financial Stability Board, 2017a). The technological advancements include, but are not limited to, cloud computing, blockchain technology, artificial intelligence, application programming interfaces (APIs), and big data (Elsaid, 2021; Vives, 2019).

Furthermore, the high costs of the services provided by traditional financial institutions as well as their infrastructure are also mentioned as supply-side drivers of FinTech adoption (Harasim, 2021), as FinTech firms often present lower transactional costs (given that their operational and compliance costs are also relatively lower when compared to those of banks) and rely on a more flexible and responsive infrastructure that allows them "to move through the system development life cycle in a fast and agile manner" (Financial Stability Board, 2017a, p. 36). Unlike the business models adopted by traditional banks, which are primarily focused on providing products and services and frequently work on top of legacy systems, the ones adopted by FinTech firms are more geared towards the customer, their expectations, and their needs. Thus, FinTech firms cannot only undercut costs but also offer a more well-adjusted experience to customers (Anagnostopoulos, 2018). Additionally, Teixeira and Piechota (2019) note that the technology used by disruptive companies, such as FinTech firms, is not the source of disruption itself but rather how the technology is employed in the enablement of their innovative business models. This subject is further developed in section 2.4., where it is discussed if traditional banks still maintain a special role in the current financial market.

Additionally, the fact that FinTech firms provide their services in an unbundled way is also considered a supply-side factor of growth (Anagnostopoulos, 2018; Dermine, 2017; Lee & Shin, 2018; Vives, 2019). This means that unlike banks, which offer multiple types of products and services and do not specialize in any, FinTech firms can solely concentrate on one type of product or service, therefore offering the possibility for consumers to choose which service to acquire from each firm. As described by Ahmed (2015, para. 1), by unbundling FinTech firms look to "inflict death by a thousand cuts" by targeting a specific part of the business model of traditional banks to compete with and offering more accessible and efficient alternatives.

Moreover, regulation has also been pointed out as a critical factor driving FinTech growth and adoption. Whilst the theory that the FinTech industry is favored by regulatory arbitrage[6] is frequently mentioned (Anagnostopoulos, 2018; Buchak, Matvos, Piskorski, & Seru, 2018; Financial Stability Board, 2017a, 2017b), empirical evidence on the impact of the regulatory environment on FinTech growth achieves heterogeneous results. Whereas some authors find that the stringency of bank regulation is positively related to the volume of alternative finance (a category which the FinTech industry falls under) (Rau, 2017), others find that countries with a more permissive or more adequate regulatory environment present both higher investment in FinTech and higher volumes of alternative finance, contradicting the idea that a key driver of FinTech adoption is related to regulatory arbitrage (Claessens, Frost, Turner, & Zhu, 2018; Navaretti et al., 2017; Ziegler et al., 2019). As noted by Frost (2020), though, while the latter empirical evidence might disprove that FinTech growth is driven by regulatory arbitrage when considering the industry as a whole, it does not mean that this factor does not positively impact the adoption of activities developed in particular categories (such as the ones described in a previous section).

2.3.2. Demand-Side Factors

Regarding the demand-side drivers of FinTech growth, a shift in the needs and expectations of consumers is often named as one of the critical factors (Anagnostopoulos, 2018; Elsaid, 2021; European Banking Authority, 2019; Financial Stability Board, 2017a, 2017b; Nicoletti, 2017; Vives, 2019). With the development of new technologies, such as the ones described previously, and their introduction into the financial system, customer expectations of how services and products should be delivered have gradually shifted from what they originally were, when traditional banks were the main providers (Vives, 2019). Teixeira and Piechota (2019) note that disruption of incumbent companies is not caused by startup firms and the technologies they use, but rather by how customers shift their behavior to satisfy their growing needs and desires, causing a shift in demand. This change was further exacerbated with the advent of COVID-19 pandemic, wherein consumers became more dependent on the more convenient, cost, and user-friendly digital solutions being offered by alternative

[6] In the present context, regulatory arbitrage may be defined as "shifting activities from a heavily regulated financial sector to an unregulated or lightly regulated financial sector with the aim of maximizing profits by taking advantage of regulatory differentials" (Nabilou, 2017, p. 563) with the first corresponding to the traditional banking sector and the latter to the FinTech sector.

companies such as FinTech firms, as opposed to relying solely on the traditional banking institutions (Elsaid, 2021).

Related to the described shift in the expectations and needs of consumers is an alteration of demographic and economic factors that drive demand (Anagnostopoulos, 2018; Financial Stability Board, 2017a, 2017b; Harasim, 2021; Vives, 2019). The average profile of the consumer has seen radical alterations, with Generations Y (individuals born between 1981 and 1994) and Z (individuals born between the years 1995 and 2012), who are characterized as being more tech-savvy and who tend to value easily accessible digital-based solutions, becoming a growing (both in volume and importance) influence in the financial markets, as the opposite is observed for Generation X and prior (individuals born before 1980), who traditionally present different preferences than the newer generations mentioned (Anagnostopoulos, 2018; Financial Stability Board, 2017a). Empirical evidence supports the theory that changing demographics is a key demand-side driver of FinTech adoption and growth, as it is possible to conclude from studies performed by EY (2017, 2019) that FinTech adoption is positively associated with countries with a smaller consumer age average, such as China, India, and Russia, and that the average rate of FinTech adoption is also greater for younger individuals.

The evolution of the demographic profile of financial market agents leads to another demand-side driver of FinTech growth and adoption: shifting consumer preferences. As younger cohorts are more tech-aware and mobile-friendly, their priorities rest in selecting the financial institution that can provide them with faster, more convenient, more accessible, and more cost-effective services (Financial Stability Board, 2017a; Harasim, 2021). In theory, this prioritization favors the offerings of FinTech firms to the detriment of those of traditional banks, given that the first rely on more agile and flexible business models and modern technology that allows for better accommodation of the ever-changing customer preferences, whilst the latter relies on stiffer business models and legacy technology systems (Vives, 2019).

Additionally, economic factors that drive FinTech demand are especially relevant for emerging markets and developing economies (EMDEs), as the traditional banking system often underserves these but they exhibit a high mobile and internet penetration and a fast rate of technology adoption (Anagnostopoulos, 2018).

The referred economic factors relate to another demand-side driver of FinTech adoption and growth: unmet customer demand. Once again, this factor is particularly relevant for EMDEs, as proven by empirical evidence that shows that unmet customer demand (which, in the context of EMDEs, can be attributed to a lack of financial inclusion) in these countries is a driver of FinTech activities such as mobile transactions and payments (Demirgüç-Kunt, Klapper, Singer, Ansar, & Hess, 2017; Frost, 2020) and credit (Hau, Shan, Huang, & Sheng, 2021). Moreover, this demand-side driver has also been proven to have a role in the demand for FinTech lending and credit in advanced economies (AEs) such as the United States of America (Jagtiani & Lemieux, 2018) and Germany (de Roure, Pelizzon, & Tasca, 2016).

2.4. The Changing Role of Traditional Banks: Are They Still Special?

2.4.1. Traditional Banks: Definition and Functions

A traditional bank is commonly defined by regulators and others alike as an "institution whose current operations consist in granting loans and receiving deposits from the public" (Freixas & Rochet, 2008, p. 1). In doing so, they also delve into asset transformation (turning short-term, safe liabilities into long-term, risky assets), providing payment services (offering liquidity by pooling funds from customers), and gathering and processing data (Navaretti et al., 2017). Besides, the operational activities conducted by traditional banks also entail managing investment portfolios and providing financial advice, security underwriting, and brokerage (Elsaid, 2021).

There are a few types of banking institutions that are worth mentioning to better define the concept of a traditional bank, namely: commercial banks, which offer services that fall under the definition provided above; savings banks, which only offer services related to deposits; mortgage banks, which specialize in real estate loans; cooperative banks, which provide the same type of services as commercial banks but are owned and operated by their customers; investment banks, which mainly deal with capital raising (underwriting) and financial advisory.

Ever since the creation of modern banking in the seventeenth century, and with the process of globalization that ensued, which made the interconnection of the banking system evolve even further as the engagement in international-wide transactions became normalized, the traditional banking industry has been regarded as having special characteristics that make it irreplaceable in the global economy, whether it be because of its core business model or the possible consequences stemming from the interruption of its operations (George, 1997).

That way, the use of the word "public" in the definition of traditional banking presented above relates to the reason why these institutions are considered special in the services they provide (Freixas & Rochet, 2008), as it is in the best interest of the consumers of said banking products that these institutions continue to function regularly and effectively. The specialness demonstrated by traditional banks is what has made it possible for the industry to grow, as they managed to align the incentives of rulers, such as regulators and governmental entities, lenders, and creditors (Petralia et al., 2019). Using corporate terminology to describe the role of these parties in the current global economy, they would be considered stakeholders, seen as they can both affect and be affected by the economic development that ensues.

Along with the process of globalization briefly mentioned before, one of modernization also began its course. With this, traditional banks saw increased competition from other types of depository, non-depository, and non-bank financial institutions (Petralia et al., 2019). In this context, it seems relevant to pose the following question: are traditional banks still special in an ever-modernizing banking system that now offers other types of intermediaries to customers (*e.g.,* FinTech firms)? Several authors have pondered this question, with the main conclusion being that although traditional banks are not as special as they once were, they remain so in several aspects (Benston, 2004; George, 1997).

To answer this question, it must be understood where the specialness attributed to traditional banks stems from. In this regard, Benston (2004) proposes categorizing the products and services provided by traditional banking institutions into money, loans, collateral services, and deposit accounts.

Money and Payment Services

The first (and, arguably, the most important) product listed relates to the role of traditional banks as payment services providers and managers. While these institutions have always had the upper hand over other currency suppliers as they offered a more efficient and safer way for consumers to access their funds by allowing the public to transform their deposits into money[7] with ease, this advantage was called into question with the emergence of blockchain-

[7] As in a centralized commodity that is generally accepted as a medium of exchange in an economy.

based digital assets, such as cryptocurrencies and tokens, and electronic money[8] (Benston, 2004). Even so, it was found that neither had a tangible impact on the role of traditional banks as the primary source of money supply. Regarding the first, and as mentioned previously, cryptocurrency is not a competitor to traditional banking institutions but instead to central banks (Schich, 2019; Stulz, 2019). Regarding the second, traditional banks have adopted issuing both credit and debit cards, handling both physical and electronic money. As such, the role of traditional banks as money providers and managers is found to remain special and, in fact, almost impossible to replace (Benston, 2004; Bossone, 2000; George, 1997).

Credit Supply

The second source listed, loans, relates to the fact that banks have been regarded as having comparative advantages relative to individual lenders in gathering information about their customers for the purpose of loan provisioning and monitoring (Petralia et al., 2019; Stulz, 2019). These supposed informational advantages stem from the nature of the information collected by the traditional banking industry and on which their activities rely. This sector operates on a *soft* information basis, that is, qualitative and non-verifiable information that accrues from long-term customer relationships with the bank. On the other hand, FinTech firms have created a new way of operating whereby they work on a *hard* information basis, that is, quantitative and verifiable information for the processing of which firms rely on machine learning technology, big data, and cloud computing (Navaretti et al., 2017). As such, while the specialness of banks in this regard has not been completely erased, it has been eroded by the advent of FinTech firms, offering an alternative information collection process that may be considered valuable for some consumers (Jagtiani & Lemieux, 2018).

Collateral Services

The third source referenced, collateral services, relates to the offering of products and services by banks in a bundled way, therefore having the possibility to profit from both economies of scope and scale (Benston, 2004; Stulz, 2019). As mentioned in subsection 2.3., this special characteristic has been counteracted by the unbundling of financial services by FinTech firms, allowing for greater specialization and personalization (Anagnostopoulos,

---

[8] See Rotman (2014) for further details on the difference between cryptocurrencies, in specific, Bitcoin, and electronic money.

2018). Moreover, it has been proven that traditional banks have not been favored by the mentioned advantages, possibly because of a lack of infrastructural organization (Stulz, 2019).

Deposit-Taking

Lastly, the maintenance of deposit accounts is also considered to be one of the sources of specialness for the traditional banking industry. This stems from the fact that the deposit-taking role attributed to traditional banks is a source of fragility, meaning that the failure of one bank may become contagious, leading to the failure of another or multiple other banks out of worries by the public that the problem that originated the failure will not be contained within one institution (Stulz, 2019). Thus, for banks to operate economically securely, they rely on two factors: regulation and trust (Bossone, 2000; Stulz, 2019). Thus, while banks have remained special in the midst of the creation of alternative financial firms such as FinTech firms, the mentioned factors that make up this specialness have also contributed to the uprise of said firms, therefore having a dual effect on both types of companies.

2.4.2. The Global Financial Crisis and the Regulatory Framework Shift

Following years of excessing risk-taking, increasing lending, and regulatory errors, a housing market bubble that had come to form in the US finally popped. That, in conjunction with the collapse of the global financial services firm Lehman Brothers, initiated what came to be known as the Global Financial Crisis of 2007-09. As mentioned previously, due to the special characteristic of banks in that the failure of one may contaminate another, potentially leading to the demise of an entire system, this crisis that initially started in the US quickly spread to international markets, in particular, to the European markets. Stemming from this, the banking system saw the introduction of a new, tighter regulatory framework, such as Basel III, and a loss of trust from the public (Nicoletti, 2017). While determining the impact of the mentioned regulatory shift on the development and adoption of the FinTech industry presents ambiguous results, as described in section 2.3., the same cannot be said for the mistrust in banking institutions that the public developed during that time.

The newfound mistrust in the banking system manifested itself in two ways, depending on the consumer and the investor's point of view. Regarding the first, after the Global Financial Crisis, as FinTech startups were considered a novelty in the financial markets, thus presenting a favorable track record (compared to banks), the customer demand for these types of firms grew rapidly (C. Haddad & Hornuf, 2019). From the point of view of the investor, the mistrust translated itself into an increase in the funding amount allocated to FinTech firms (Anagnostopoulos, 2018). In fact, according to a report by Accenture (2014), from a global investment amount of 930 million dollars in 2008, by 2013, the funding activity in the FinTech industry had seen an increase of 219,6% from that amount, with Europe accounting for 13% and the US for approximately 70%. Additionally, when performing a study on the role of distrust in banks in P2P lending in the US, Saiedi et al. (2020) concluded that trust in banking institutions is negatively and significantly associated with the probability of an investor participating in a P2P listing and with the amount of funding provided for loans.

2.5. Competition: How FinTech Firms Challenge Traditional Banks

Two main theories have been advanced by scholarly literature when postulating if FinTech firms could either substitute or complement the traditional banking sector and, therefore, be considered threats or beneficial to incumbent banking institutions: the disruptive innovation theory and the consumer theory.

2.5.1. The Disruptive Innovation Theory and the Innovator's Dilemma

The term *disruptive technology* was first proposed by Bower and Christensen (1995), when describing how technology[9] changes impacted the hard-drive-disk industry, and was later further explored by Christensen (1997) while developing what the Innovator's Dilemma entails and refuting the technology mudslide hypothesis, which he also developed himself. The mentioned term was later modified to *disruptive innovation* since the authors concluded that the disruptive character does not originate from the technologies applied but from the business model adopted (Christensen & Raynor, 2003).

According to Christensen (1997), the *Innovator's Dilemma* relates to the fact that rational and logical managerial decisions contribute to both the success and the downfall of leading incumbent firms when dealing with technological change. To further develop this argument, the author introduces the *technology mudslide hypothesis*, comparing the way incumbent firms cope with technological change to evade falling behind as "trying to climb a mudslide raging down a hill" (Christensen, 1997, p. 23), and argues that the reason why these firms fail is due to the difficulty in keeping atop the metaphorical hill. This theory is later refuted as Christensen (1997) notes, while studying the disk-drive industry, that technological change

[9] Technology as in "the processes by which an organization transforms labor, capital, materials, and information into products and services of greater value" (Christensen, 1997, p. 9).

is not uniform in that there is a distinction to be made between *sustaining* and *disruptive innovations* (at the time, referred to as *technologies*) and their impacts.

The first type of technological change, *sustaining innovations*, applies to innovations that improve the performance of existing products/services in dimensions that existing customers value. These innovations may be either incremental or radical in nature (depending on their level of difficulty), so long as the rate of historical performance improvement expected by customers is maintained (Bower & Christensen, 1995; Christensen, 1997). This way, the enhanced products/services are sold for higher gross margins to upscale customers (Christensen, 1997; Zalan & Toufaily, 2017).

On the other hand, disruptive innovations, the second type of technological change, applies to innovations that add a different value proposition to the market, introducing novel products/services with attributes that existing customers do not usually value. In this way, these innovations tend to perform worse than existing products/services amongst existing customers, but some of their attributes are appreciated by new customers (Akkizidis & Stagars, 2015; Christensen, 1997).

Thus, the disruptive innovation theory encompasses a process in which a smaller firm (with limited resources compared to its competitors) can successfully challenge the market position of established firms. They attempt to do so by targeting the market footholds overlooked by incumbents, whether at the bottom of the market, where there are comparatively lower gross margins and a significantly smaller customer base, or even new markets (Christensen et al., 2015).

When targeting the low-end market segments, disrupters offer the same products and services as incumbent firms but make them more affordable, accessible, and less complex. This market loophole, primarily made of underserved customers, stems from one of the innovator's dilemmas, whereby incumbent firms choose to stay close to their already-existing customers. In this way, established firms prioritize investment in the products and services that upmarket customers want, ignoring the demand from customers at the bottom of the market. While this strategy allows them to keep atop technological changes stemming from sustaining innovations, the same is not applied to disruptive innovations, as existing/upstream customers tend to (initially) downplay them and are resistant to change to the new offering (Akkizidis & Stagars, 2015; Christensen, 1997). When targeting new markets, disrupters create entirely new products and/or services, finding "a way to turn non-consumers into consumers" (Christensen et al., 2015, para. 10).

The fact that established firms do not try to seek leadership in commercializing disruptive technologies is explained by two factors: the closeness between them and their customers and the perceived incentives of upstream/downstream market mobility (Christensen, 1997).

First, as previously explained, existing consumers of established firms tend to ignore disruptive innovations at the beginning. As these firms maintain a close relationship with their customers, there is a false sense of security when they decide to pursue the demands of their more profitable customers, ignoring the possible disruptive impact of the smaller firms and their new offerings (Akkizidis & Stagars, 2015).

Second, the way incumbent and entrant firms view market segments is asymmetrical. While the former looks at the bottom of the market (where disruptive innovation starts) as unattractive, offering lower gross profit margins and a smaller customer pool, the latter found the opposite when looking upmarket (Christensen, 1997).

As such, the process continues with smaller firms continuously climbing the market ladder while improving the quality of their products/services (through sustaining innovations). Once the mainstream, more demanding customers belonging to the established markets find that the quality of these new offerings is up to their standard and fully satisfying their needs, they will eventually choose to adopt the new, cheaper products. As Akkizidis and Stagars (2015, p. 71) stated, "disruptive innovation may underperform today, but it will outperform tomorrow." In this way, the entrant firms can take over the customer base initially detained by incumbents while preserving their initial advantages and possibly supplant established businesses (Christensen et al., 2015). A visual representation of the process of disruptive innovation is represented in Figure 1, below.

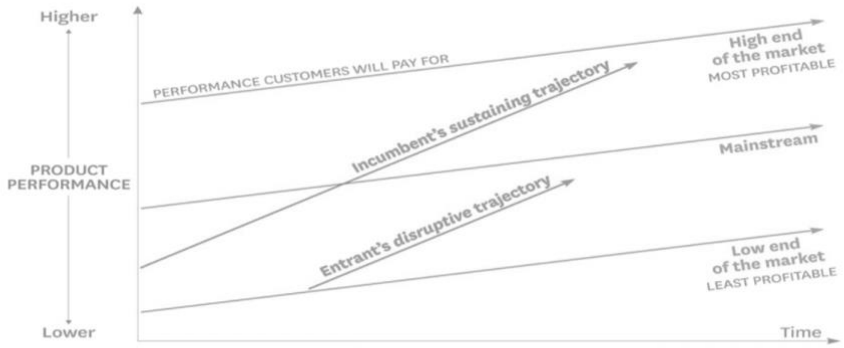

Figure 1 – Disruptive innovation process. Adapted from "Fintech and regtech: Impact on regulators and banks," by I. Anagnostopoulos, 2018, Journal of Economics and Business, 100, p. 8.

The case of the FinTech industry has been frequently pointed out as a prime example of the application of the disruptive innovation theory (Almulla & Aljughaiman, 2021; Anagnostopoulos, 2018; Elsaid, 2021; Milian, Spinola, & de Carvalho, 2019; Najaf, Subramaniam, & Atayah, 2021; Zalan & Toufaily, 2017) and the innovator's dilemma (Akkizidis & Stagars, 2015). In this process, FinTech start-up firms would constitute the smaller firms, which initially form in small niche markets by offering more efficient and better quality (or new) products and services to unbanked and underbanked[10] segments (Li, Spigt, & Swinkels, 2017). This disruptive potential is especially present in LendTech firms (Akkizidis & Stagars, 2015). As traditional, established banking institutions mostly choose not to seek leadership in the commercialization of disruptive technologies, focusing on delivering products and services with high gross profit margins to their already-profitable customers, FinTech firms entering the market are able to find a foothold in the smaller, less profitable nascent markets. This is possible because traditional banking institutions are victims of the Innovator's Dilemma, whereby they cannot afford and have no interest in pursuing innovations that are deemed as irrelevant by their customers (even as this only applies to the beginning of the product/service launch) (Christensen, 1997). According to the proposed theory, FinTech firms would ultimately displace traditional incumbent banks, proving that the first should be considered a competitive threat to the latter.

[10] Unbanked is a term used to describe individuals or businesses who lack a bank account, while underbanked is a term used to describe individuals and businesses whose access to conventional financial services is restricted but do possess a bank account (Nicoletti, 2017).

Navaretti et al. (2017) and Brandl and Hornuf (2020) argue that FinTech firms will not be able to completely replace traditional banking institutions in the long run, pending towards the services offered by both types of companies being complementary. As stated previously, the disruptive innovation theory involves a process. That is, there is no immediate effect on the market position of traditional incumbent banks. As this process develops, the latter have the opportunity to adapt and incorporate the innovations brought about by FinTech firms into their business models. Though traditional banks are generally slower at innovating (given their complex infrastructure), as long as they continue to react to FinTech's innovation advances, larger banks' positions will not only be safe but also strengthened, as these will probably be able to "converge towards a new type of operator where many financial services, FinTech and not, are offered together" (Navaretti et al., 2017, p. 24). This argument is equally supported by Bergara and Ponce (2017). Also, as pointed out by Brandl and Hornuf (2020), while studying the German FinTech market, almost all FinTech firms are bank-dependent given the fact that they don't own a banking license, which is fundamental to conduct the core banking activities, therefore not being able to replace traditional banking institutions in their main operations. Furthermore, FinTech startups have usually refrained from obtaining banking licenses to avoid paying compliance costs, which can weigh heavily when new firms enter the financial market (Vives, 2019). In this case, FinTech firms seek to establish strategic partnerships with traditional banking businesses, benefiting both entities (Brandl & Hornuf, 2020; Vives, 2019).

While the previously referred literature undermines the threat posed by FinTech startups to the traditional banking sector, considering that the former only impact the latter when they first enter the market (and a convergence then ensues), other authors also put forward the idea that traditional incumbent banks are indeed wary of new FinTech entrants and potential disruption that accompanies them. To that avail, Bunea, Kogan, and Stolin (2016, p. 130), by performing a statistical analysis of the United States banking sector for the period of 2015 to 2016, suggest that one of the reasons why traditional banks fail to recognize the danger brought about by FinTechs is that if they were among the first to do so, they would "signal to investors that they are particularly defenseless on that front".

2.5.2. The Microeconomic Theory of Consumer Choice

While less common, the microeconomic theory of consumer choice has also been mentioned as one of the theories advanced by which FinTech firms may supplant traditional banking institutions (Almulla & Aljughaiman, 2021; Elsaid, 2021; Haddad & Hornuf, 2021; Li et al., 2017; Najaf et al., 2021; Phan, Narayan, Rahman, & Hutabarat, 2020).

The main aim of consumer choice theory is to determine the impact on observable demand for products/services of how rational consumers choose to spend their expenditures, given their preferences and budget constraints, to maximize their utility (Barten & Böhm, 1982). Hence, this theory also allows for the determination of whether goods are substitutes or complements.

According to the proposed theory, that are two components that explain consumers' rationale when faced with a change in the price of the commodities belonging to their bundle of goods: the income effect and the substitution effect. The first is related to the budget constraint mentioned earlier, which is determined by the amount of income received (or the total amount of wealth possessed) by the consumer. As income varies negatively with a price increase, and vice-versa, the income effect negatively determines the impact of a price change in consumer demand (Barten & Böhm, 1982). The second, the substitution effect (or the income compensated price effect), is what allows for determining the relationship between different commodities (L. R. Christensen, 1975).

One commodity is considered a substitute for another commodity if the former can equivalently satisfy customer needs as the latter within the same context of application. If not, the former commodity can also be used alongside the latter as a complement (Aaker & Keller, 1990).

In the context of consumer choice theory, the degree of substitutability between these different commodities is measured by how the consumer demand reacts to a price change in the commodity that belongs to its bundle of goods, given that the individual's income level remains unchanged. For example, considering the alternative[11] commodities A and B, in which the first belongs to the bundle of goods chosen by the consumer, subject to his preference and budget constraint, if there were to be a positive price shock affecting commodity A, meaning that the latter becomes more expensive than the alternative, commodity B, then, the substitution effect would mean that the consumer would now include the cheaper commodity in its bundle of goods instead of the original, more expensive commodity A (Frank & Glass, 2000).

[11] As in both commodities equally satisfy the consumer's demands, needs and preferences.

Thus, the application of consumer theory allows for the postulation of the relationship (complementarity of substitutability) between the products and services offered by FinTech firms and traditional banks. Assuming that the original bundle of goods chosen by the consumer includes the commodities offered by traditional banking institutions, as it makes the most sense given the relative novelty of the FinTech industry, if both alternative offerings are considered to be substitutes, then traditional incumbents would be negatively affected as consumer demand for the cheaper alternatives offered by FinTech firms would increase. On the other hand, if the products and services offered by FinTech firms and traditional banking institutions are considered to be complementary, then the latter would be positively impacted as an increase in demand for FinTech products and services would equate to an increase in demand for traditional products and services offered by banks (Li et al., 2017).

2.5.3. The Reaction of Traditional Incumbent Banks: Defining Strategies

The relationship between FinTech start-up firms and traditional banks is often described as coopetition, meaning that competition is prevalent in some market segments. In contrast, in other business areas, collaboration is more suitable (Portugal Fintech, 2020).

Following Vives (2019), when faced with FinTech start-up firms entering the market in which traditional incumbent banks operate, the latter can decide between accommodating the entry, which is coined as the *fat cat* strategy, or trying to prevent it, known as the *top dog* strategy, depending on the market segment the FinTech startups are trying to gain access to. This set of actions carried out by traditional incumbent banks so that a profit increase is assured, and taking into account the potential reactions of FinTech firms, is known as strategic behavior (Huyghebaert & Gucht, 2004). The undertaking of the first strategy suggests that both financial market players are strategically complementary, meaning both firms reinforce one another. In contrast, the *top dog* strategy insinuates the opposite, meaning both types of firms offset each other (Harasim, 2021).

For example, whilst traditional incumbent banks might opt for the fat cat strategy to accommodate the entry of a FinTech startup in the payments segment because it could be beneficial to form a future partnership to integrate that new technology into the business model of the traditional bank in question, the adoption of a top dog strategy might be the one chosen by incumbent banks for the lending sector, given the substitutability of the peer-to-peer lending services offered by FinTech firms and the ones offered by traditional banks (Tang, 2019).

Simultaneously, FinTech firms must also define their strategic behavior when entering the financial markets, opting between a *puppy-dog ploy* strategy, which is a non-aggressive strategy usually chosen for market segments in which FinTech firms and traditional banks are said to be strategic complements, and a more aggressive strategy whereby FinTech firms opt for acquiring a bank license and compete directly with traditional banks (Harasim, 2021; Vives, 2019). FinTech startups have usually refrained from obtaining bank licenses to avoid paying compliance costs, which can weigh heavily when new firms enter the financial markets (Brandl & Hornuf, 2020; Vives, 2019).

The nature of the competitive interaction, defined by Burlingame (1999) as a dynamic process made of actions and reactions (*e.g.,* accommodating or preventing), between both types of financial firms, affects not only their profitability but also share valuation, meaning that when either party announces new strategic initiatives, a share price reaction should be expected according to the competitive relationship exhibited by both types of firms on the market segment in question (Sundaram, John, & John, 1996).

2.6. Influence of FinTech Firms on Bank Performance: Empirical Evidence

Most empirical literature that looks to study the impact of FinTech on the traditional banking industry focus on the demand side, that is, the behavior of consumers.

The relationship between FinTech firms and traditional banks, as in how the presence of one in financial markets affects the other, can be studied by evaluating the impact of the emergence of the FinTech industry on the financial performance of traditional incumbent banking institutions (Almulla & Aljughaiman, 2021).

The financial performance of banks reflects how the latter utilize their resources to achieve their previously defined strategic goals. According to the European Central Bank (2010), to execute this measurement, four key drivers should be taken into account: earnings, efficiency, risk propensity, and leverage (debt to equity ratio). Besides, the set of performance measures employed for this assessment can be divided into three categories: traditional, which includes the study of the return on assets, return on equity, and net interest margin variables; economic, which looks towards the economic value added and the risk-adjusted return on capital; market-based, which include the total share return, price-earnings, and price-to-book value ratios.

The empirical literature on the influence of FinTech firms over the financial performance of traditional banks (and, indirectly, the nature of their relationship), whether it be by using traditional, economic, or market-based measures, is not very vast. Even though the subject in question is relatively recent, and considering its newfound interest stemming from the Global Financial Crisis, most literature theoretically explains why FinTechs threaten (or not) the traditional banking sector. Even so, a few studies are particularly relevant for studying the topic in question. These can be divided into three categories: those that analyze accounting-based measures (*e.g.*, Phan et al. (2020), Almulla and Aljughaiman (2021), Sari (2020)); those that analyze market-based measures (*e.g.*, Li et al. (2017), Abdurrahman (2019)); and those that analyze both (*e.g.*, Haddad and Hornuf (2021)).

The relevant empirical literature reviewed and the results obtained by the respective authors are summarized in Table 2, below.

Table 2 – Effect of FinTech firms on the financial performance of traditional banks

Author	Country	Period	Overall Effect	Category
Li et al. (2017)	United States of America	2010-2016	+	Digital Banking
Abdurrahman (2019)	European Union	2013-2018	Nonsignificant	General
Singapurwoko (2019)	Indonesia	2014-2018	Nonsignificant	General
Sari (2020)	Indonesia	2015-2019	–	P2P Lending
Phan et al. (2020)	Indonesia	1998-2017	–	General
Low and Wong (2021)	6 countries belonging to the Association of Southeast Asion Nations (ASEAN)	2012-2018	+ (Singapore and Phillipines); nonsignificant (Indonesia and Vietnam); no effect (Malaysia and Thailand)	General

Haddad and Hornuf (2021)	87 countries	2006-2018	+	General
Almulla and Aljughaiman (2021)	Gulf Cooperation Countries	2014-2019	–	General

Of the mentioned authors in Table 2, only Li et al. (2017), Haddad and Hornuf (2021), Abdurrahman (2019), and Low and Wong (2021) have studied the impact of FinTech firms on traditional banking institutions through market-based performance measures. An aspect to note is that these authors have either found evidence of a positive effect or have achieved nonsignificant results. This could be related to the variable chosen to study the impact of FinTech firms on traditional banks. While all of the authors who analyze this impact through accounting-based measures use the number of FinTech firms founded per year as a variable, those who analyze market-based measures, in specific stock returns, mostly use variables related to allocated funding to the FinTech industry. Since the focus of the present work is also to analyze market-based performance measures associated with the occurrence of funding events, a more detailed description of the mentioned authors' work and results may be found in Table 3, below.

Table 3 – Detailed effect of FinTech firms on the stock market performance of traditional banks

Author	Variable	Effect
Li et al. (2017)	FinTech funding volume	Nonsignificant
	Number of FinTech funding deals	+
	FinTech funding volume growth	
	Number of FinTech funding deals growth	
Abdurrahman (2019)	FinTech funding volume	Nonsignificant
	Number of FinTech funding deals	
Low and Wong (2021)	FinTech funding volume	+ (Philippines and Singapore)

	Number of FinTech funding deals	+ (Philippines and Singapore) – (Thailand)
	FinTech funding volume growth	+ (Philippines and Singapore)
	Number of FinTech funding deals growth	+ (Singapore)

Through the tables displayed above, it is possible to infer that empirical literature achieves heterogeneous results: evidence shows that there are both positive, negative, neutral, and nonsignificant effects registered on the financial performance of traditional banks derived from the rise of the FinTech industry. According to the literature, these differences could be attributed to: the countries under analysis and their degree of development, as Harasim (2021) concludes that the role of FinTech firms and their adoption as an alternative to traditional financial services is more prominent for EMDEs; the period under study, as the emergence of the FinTech industry and its relevance can be attributed to the Global Financial Crisis of 2007/09; the FinTech category being analyzed, as it has been argued that some categories are more probable of being disruptive to the traditional banking system than others, even in EMDEs (Zalan & Toufaily, 2017).

Additionally, as noted by Li et al. (2017), results where no effect is observed could suggest that there is evidence of the presence of a two-way relationship between FinTech firms and traditional banks in that there may be both complementary and substitution effects that can cancel each other out.

Outside of the scope of bank performance, the conclusions of authors who have studied the subject through different measures are also worth mentioning. These works revolve mainly around the study of the consumer credit market.

When analyzing the US unsecured consumer loan market for 2009-2015, Cornaggia, Wolfe, and Yoo (2018) find that P2P lenders compete with traditional commercial banks, with high-risk P2P loans substituting for bank loans. This conclusion is also supported by de Roure et al. (2016) when analyzing the German credit-granting system for 2011-2014 (specifically, Auxmoney, a German P2P lending platform). Furthermore, basing her investigation on data retrieved from LendingClub (the largest P2P lending platform in the US) for 2009-2012, Tang (2019) achieves heterogeneous results, concluding that P2P loans substitute banks' for lower-quality borrowers but complement them for a small loan amount. Lastly, for the specific case of Small and Medium-sized Enterprises (SMEs), Eça, Ferreira, Prado, and Rizzo (2022) have reported that the long-term financing provided by FinTech firms is a competitor to that provided by traditional banks, following an analysis of Portuguese FinTech lending platform Raize for 2016-2019.

Thus, although theoretical literature tends to downplay the threat FinTech firms pose to the traditional banking sector, highlighting their complementary relationship and the difficulty in surpassing the latter's competitive advantages, the results retrieved from the reviewed empirical literature and displayed in the aforementioned tables do not completely attest to those conjectures.

3. Methodology and Data

The current chapter aims to empirically assess the impact of FinTech firms on traditional banks through an evaluation of the latter's financial performance when faced with news relating to the funding of FinTech firms. For this purpose, the adopted methodology for the study of market-based performance measures is presented and detailed in subsection 3.1. Then, subsection 3.2. describes the procedure for the assessment of the significance of the results obtained. Subsection 3.3. introduces and explains the data collected for the study to be implemented.

3.1. Event Study Methodology: Model Definition, Normal and Abnormal Returns

The event study methodology, first proposed by Ball and Brown (1968), is a statistical tool used to assess the impact of an exogenous factor (either economy-wide or firm-specific corporate events) on the stock market value of listed firms through the analysis of the abnormal returns of the purportedly affected companies. The application of this methodology is based on the assumption of the efficient market hypothesis (EMH), a term first coined by Roberts (1967, as cited in Blume and Siegel, 1992) and further developed by Fama (1970), which argues that current stock market prices reflect all available information, both public and private, meaning that assets are fairly priced and that overperformance when trading is considered an anomaly. Thus, the impact of an event can be studied by analyzing the stock prices of the companies at the time of the event or within a short-time interval wherein the event happened. Thus, the event study methodology has been regarded as an useful tool "for understanding the (…) nature of competition in the marketplace" (Frunza, 2016).

In order to perform an event study, it is first necessary to define ex-post abnormal returns ($AR_{i,t}$). These are obtained by deducting the normal returns ($E(R_{i,t})$), that is, the returns that the firm would have expected to receive had the event not happened, from the stock return actually observed ($R_{i,t}$), for entity-event *i* at each day *t* of the event window, as described in equation 3.1, below.

3.1. $$AR_{i,t} = R_{i,t} - E(R_{i,t})$$

For the purpose of this dissertation, some adaptations were made as the event study methodology will be applied to a multi-country setting, purporting to study the impact of FinTech funding-related announcements on traditional banks in Europe.

Instead of assessing the existence of abnormal returns for each entity-event, these were calculated for each country-event *k* at each day *t* of the event window, as in equation 3.2, where *k* represents an average of that country's publicly listed traditional banks' stock returns.

3.2. $$AR_{k,t} = R_{k,t} - E(R_{k,t})$$

While the actual stock returns of publicly listed traditional banks are empirically observable and available for collection at various databases, the normal/expected returns need to be estimated through a benchmark model, either statistical or economic. The market model (MM) is the most frequently used. Despite its weaknesses and criticisms, it is also considered the best out of the available alternatives (Armitage, 1995; Dyckman, Philbrick, & Stephan, 1984). Thus, the market model, as portrayed in equation 3.3., will be adopted as a baseline.

3.3. $$R_{k,t} = \alpha_k + \beta_k R_{m,t} + \varepsilon_{k,t} \Rightarrow E\left(R_{k,t}\right) = \alpha_k + \beta_k E(R_{m,t})$$

3.4. $$R_{k,t} = \frac{1}{L}\sum_{i=1}^{L} R_{i,t}$$

The market model establishes a linear relationship between the normal returns of the traditional banks of country *k* on day *t* of the estimation window and the market return on that same day, $R_{m,t}$. The normal returns of country *k* for day *t* are obtained by averaging the stock returns of every bank *i* belonging to that country on that same day, as in equation 3.4. where *L* represents the number of banks in country *k*. The sensitivity of the expected stock return of the traditional banks belonging to *k* to changes in the market return is explained by β_k, the value of the stock returns explained by non-market factors is represented by α_k, and the stochastic error (an unsystematic component) is represented by $\varepsilon_{k,t}$.

While most published literature that uses the event study methodology and, particularly, the market model, only analyzes the impact of corporate events in single countries, applying the referred model to a multi-country study must be dealt with more carefully. Whilst some authors suggest that the use of a single-index market model may lead to problems in estimating the firm's abnormal performance and to biased results, thus suggesting the incorporation of foreign currency exchange rates and a world market return into the model (Eden, Miller, Khan, Weiner, & Li, 2022; Park, 2004), others find that, for markets excluding the United States, the use of the original market model, with the market return proxied by local market indices, is sufficient to obtain good results (Campbell, Cowan, & Salotti, 2010). When performing an event study on the market reaction to a change in European regulation on business agreements from 1990 to 2000, Aktas, Bodt, and Roll (2004) found that both the conversion of local currencies to a common currency and the use of a world market index is unnecessary, with both types of models achieving the same results. As such, the single-factor model as presented in equation 3.3. will be the one used to obtain the expected market returns for each country, considering home-market returns instead of world-market returns to account for geographical differences.

The application of the aforementioned model requires that a few assumptions be asserted, namely: the stochastic error ($\varepsilon_{k,t}$) is independent of both the normal stock return ($R_{k,t}$) and the local market return ($R_{m,t}$), meaning, $Cov(R_{k,t}, \varepsilon_{k,t})=Cov(R_{m,t}, \varepsilon_{k,t})=0$; it is not significantly autocorrelated, meaning, $\sigma_{\varepsilon_k \varepsilon_j}=0$: $\forall$ $k \neq j$; it is homoscedastic and normally distributed, meaning, $\varepsilon \sim N(0,\sigma^2)$. The establishment of these assumptions is necessary for the execution of an Ordinary Least Squares (OLS) estimation that provides Best Linear Unbiased Estimators (BLUEs) (Coutts, Mills, & Roberts, 1994).

Further, in order to evaluate the overall total impact of the event in question over the event window t_2 to t_3 (number of days around the event date, that is, $t_2<0<t_3$), it is necessary to determine the cumulative abnormal returns for each country (CAR_k) as in equation 3.5. In particular, this dissertation purports to investigate how the European traditional banking industry reacts to announcements from FinTech firms, specifically funding-related announcements. Thus, it is necessary to perform an average of the cumulative abnormal returns registered, adding all of the cumulative abnormal returns computed and dividing it by the number of country-events N, obtaining the cumulative average abnormal returns ($\overline{CAR}$), as in equation 3.6.

3.5. $$CAR_k = \sum_{t=t_2}^{t_3} AR_{k,t}$$

3.6. $$\overline{CAR} = \frac{1}{N}\sum_{i=1}^{N} CAR_k = \sum_{t=t_2}^{t_3} \overline{AR}_t$$

As displayed through the previous equations and represented in Figure 1, two different timeframes need to be established for the execution of an event study analyzing short-term stock performances: an estimation window (t_0 to t_1), also known as the control period, and an event window (t_2 to t_3). Additionally, a post-event window would also need to be established if the aim were to investigate long-term stock performances. However, the present dissertation will look only to assess the short-term impact on the performance of traditional banks from funding-related information originating in FinTech firms as it has been reported that inferences taken from long-horizon event studies can be unreliable and even incorrect due to misspecification of test statistics (Kothari & Warner, 1997) arising from the use of a market index to perform the calculation of abnormal returns (Barber & Lyon, 1997).

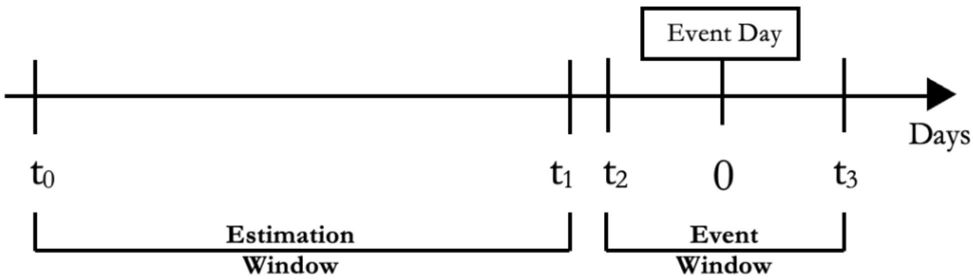

Figure 2 – Event study timeline following the market model

First, the event window must be established. The determination of this time interval is discretionary, varying widely within literature and the type of study at hand. Following the proposition of Campbell et al. (2010) for the execution of multi-country event studies, three-day and eleven-day windows centered symmetrically around the event day will be analyzed. Additionally, the results for windows [-1;0], [0;0], [0;1], [0;3] and [0;10] are also presented.

Second, the most suitable time length for the estimation window must be determined, as it is also not standardized. Following the suggestion that the estimation window should have at least 100 days (Armitage, 1995), and as the MM does not account for structural breaks, meaning that it assumes parameters remain constant over time, the observation period is set to start 136 trading days and end six days before the event day.

With the estimation window established, the model parameters α_k and β_k can then be estimated by OLS through equation 3.3. According to Henderson (1990), the normal returns for each bank *i* and for its local market, necessary for the estimation, can be calculated as described in equations 3.7. and 3.8., respectively.

3.7.
$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$$

3.8.
$$R_{m,t} = \ln\left(\frac{I_{m,t}}{I_{m,t-1}}\right)$$

In equation 3.7., the stock price of bank *i* on day *t* and *t-1* of the estimation window is represented by $P_{i,t}$ and $P_{i,t-1}$, respectively. As for equation 3.8., $I_{m,t}$ and $I_{m,t-1}$ represent the home-market index value on day *t* and *t-1* of the estimation window, respectively.

3.2. Statistical Significance Tests

Once the abnormal returns have been determined and, consequentially, the cumulative average abnormal returns have also been calculated, it is then necessary to test for the significance of the values obtained, looking to assess if the results achieved are due to the influence of the event under study. For all of the different event windows, the null hypothesis reflects that the FinTech event has had no impact on the stock prices of traditional banks ($\overline{CAR}=0$). The alternative hypothesis is that the FinTech event has had a statistically significant impact on the stock prices of traditional banks ($\overline{CAR}\neq 0$).

Assuming that the abnormal returns, which together make up the cumulative average abnormal returns, follow a normal distribution such that $AR_{k,t} \sim N(0, \sigma^2)$ and that they are independently and identically distributed over time, then the significance of the results may be checked via a parametric test such as the t-Student, represented in equation 3.9., where for N>30 the test statistic approximately follows a standard normal distribution (Jong, 2007).

3.9.
$$t_{stat} = \sqrt{N} \cdot \frac{\overline{CAR}}{S_{\overline{CAR}}} \approx N(0,1)$$

An estimator of the standard deviance of the cumulative average abnormal returns ($S_{\overline{CAR}}$) can be obtained as in equation 3.10.

3.10. $$S_{\overline{CAR}} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(CAR_k - \overline{CAR})^2}$$

Additionally, following the suggestion of MacKinlay (1997) that parametric tests should be supplemented by their non-parametric counterparts, the significance of the cumulative average abnormal returns will also be tested via an adaptation of the Cowan (1992) generalized sign test. The choice of this particular test to attest to the robustness of the previously mentioned parametric test is based on the fact that this non-parametric test has been proven to be more powerful than the standard t-test when performing an event study on a multi-country, non-US setting (Campbell et al., 2010).

The generalized sign test statistic proposed by Cowan (1992) is represented in equation 3.11. The purpose of this non-parametric test is to investigate if the number of stocks that exhibit positive cumulative abnormal returns during the event window, w, is greater than the number that would be expected had the event not occurred, $\hat{p}$. The estimation of $\hat{p}$ is based on the number of positive abnormal returns relative to all abnormal returns registered during the estimation window, as displayed in equation 3.12. where M_k represents the number of registered returns in the estimation period for country-event k, and $S_{k,t}$ is a dummy variable that takes a unit value if the abnormal return of country k on day t of the estimation window is positive and a null value otherwise, as in equation 3.13. The generalized sign test statistic follows a unit normal distribution as an approximation of a binomial probability distribution

3.11. $$t_{sign} = \frac{w - N\hat{p}}{\sqrt{N\hat{p}(1-\hat{p})}} \approx N(0,1)$$

3.12. $$\hat{p} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{M_k}\sum_{t=t_0}^{t_1} S_{k,t}$$

3.13. $$S_{i,t} = \begin{cases} 1, AR_{k,t} > 0 \\ 0, AR_{k,t} < 0 \end{cases}$$

3.3. Data

The present work proposes to investigate the impact of FinTech firms on the traditional banking industry, also looking to assess if both entities coexist as competitors (substitutes) or potential partners (complements). This study is only aimed at European markets, as referenced in the introduction, for January 2010 until December 2019. This timeframe was chosen because of the relative novelty of the FinTech industry and because it allows for the analysis to be isolated from two events that could bias the results, the Global Financial Crisis of 2007-09 and the Covid-19 pandemic, which unfolded in 2020 in Europe.

As previously mentioned, there is currently no specific industry code that defines the FinTech sector, making the data collection process and establishing a robust database more complex. Thus, a previously established database of FinTech firms, created by the Cambridge Centre for Alternative Finance (CCAF), was used to circumvent these difficulties. The Cambridge FinTech Ecosystem Atlas is a public data repository that provides a comprehensive overview of the FinTech industry, categorized by geographies and market segments.

The first step was to filter the dataset only to contain information pertaining to FinTech firms whose operational headquarters are situated in Europe, leading to a total of 954 firms. Then, the remaining FinTech firms were filtered according to the type of activities developed. The CCAF divides these into the following vertical segments: "Digital Lending", "Digital Capital Raising", "Digital Banks", "Digital Savings", "Digital Payments", "WealthTech", "Alternative Credit Analytics", "Digital Custody", "InsurTech", "Cryptoasset Exchange", "RegTech", Digital Identity", "Enterprise Tech Provisioning" and "Consensus Services". The FinTech firms that only fall into the last seven categories (i.e., "Digital Custody", "InsurTech", "Cryptoasset Exchange", "RegTech", "Digital Identity", "Enterprise Tech Provisioning" and "Consensus Services") were dropped from the sample[12], as this are not considered to be potential rivals to traditional banks, leading to a sample of 722 firms.

In order to gather funding event-related information, the Bureau van Dijk's Orbis Europe database was used. A batch search of the firm sample obtained from the CCAF was performed, wherein Orbis was able to match approximately 87,3% of the firms. The sample obtained from this search was then filtered to only contain firms with SIC codes 60 – "Depository Institutions", 61 – "Non-Depository Credit Institutions", 62 – "Security and Commodity Brokers, Dealers, Exchanges, and Services", 67 – "Holding and other

[12] As FinTech firms develop activities in more than one category, a firm was only removed from the sample in the case that all of its business activities are encompassed in the seven-category group. For example, Revolut, a FinTech firm acting in the "Cryptoasset Exchange", "Digital Custody", "Digital "Banks" and "Digital Payments" segments was kept in the sample.

Investment Offices", 87 – "Engineering, Accounting, Research, Management, and Related Services", 89 – "Miscellaneous Services", 7371 – "Computer Programming Services", 7374 – "Computer Processing and Data Preparation and Processing Services", 7379 – "Computer Related Services, Not Elsewhere Classified" and 7389 – "Business Services, Not Elsewhere Classified", allowing for the correction of some mismatches and for the exclusion of irrelevant firms, creating a final sample of 592 firms. This sample was then scanned in Orbis for completed funding events, namely, for capital increase and minority stake type of deals where the word "funding" is mentioned in the headline of the news source, from 2010 until 2019. After accounting for confounding event dates, a final sample of 174 events was achieved for the countries listed in Table 4.

The Orbis Europe database was also used to collect information on traditional publicly listed banks. A search was performed in order to collect a list of publicly listed entities of type "Bank" with the NACE Rev. 2 code 6419 – "Other Monetary Intermediation", which led to a sample of 92 European banks. The entities that were not listed for the whole 2010-2019 period under study and those that were listed for that interval but not for the estimation window were removed from the sample, leaving a total of 70 banks for analysis. Then, stock data for each individual bank was collected for 130 trading days preceding the event dates via Yahoo Finance.

Lastly, as most of the countries in the sample use EUR as a currency, this was the adopted common currency for this study. Thus, data on daily historical GBP/EUR, SEK/EUR, DKK/EUR and CHF/EUR exchange rates were garnered via Yahoo Finance. When available, this tool was also used to collect daily historical market index returns. When not available, Google Finance was used.

Table 4 – Summary of the data

Country	Banks	Funding Events	Currency	Market Index
Denmark	19	3	DKK	OMXC20
Finland	1	6	EUR	OMXH25
France	15	19	EUR	CAC40
Germany	5	28	EUR	DAX
Italy	13	16	EUR	FTSEMIB

Netherlands	1	7	EUR	AEX
Spain	6	18	EUR	IBEX35
Sweden	3	13	SEK	OMXS30
Switzerland	4	5	CHF	SMI
United Kingdom	3	59	GBP	FTSE All-Share

4. Results and Discussion

Considering the eight different event windows and the two different significance tests presented in the previous section, the CAARs for traditional European banks are obtained through the application of the event study methodology to the collected sample. Different subsamples based on the type of activity developed by the FinTech firm involved in the funding event are also presented in order to obtain a more detailed analysis of the sample in question. A complementary analysis of country-related subsamples is presented in Appendix 2. For each event window, the CAAR is reported as a percentage. This result is presented along with the standard error or the fraction of positive CARs in parentheses, depending on whether the t-student (Tables 5, 7 and 9) or the generalized sign tests (Tables 6, 8 and 10) are applied, respectively.

4.1. FinTech Industry

The application of the t-student test to assess the significance of the CAARs for all events grouped, as displayed in Table 5, shows that the results are statistically significant for the 7-day and 11-day event windows at a 95% and 90% confidence level, respectively. This suggests that stock prices dip on average 0,386% for the [-3;3] event window and 0,447% for the [-5;5] event window.

Although not all significant, every event window purports a negative CAAR, with the lowest value reported by the event window [-5;5]. The results reported in Table 5 also suggest that stock prices start to recover after the event date as CAARs start to increase after the event window [0;0]. Also, although negative, the CAAR for the event window [-1;0] is not significant for any of the three confidence levels, meaning there is no evidence of information leakage or insider trading[13] before the event date.

Table 5 – CAARs of all events, application of t-student test

Event Window	**[-5;5]**	**[-3;3]**	**[-1;1]**	**[-1;0]**	**[0;0]**	**[0;1]**	**[0;3]**	**[0;5]**
All Events	-0.447*	-0.386**	-0.213	-0.255	-0.127	-0.0856	-0.0954	-0.0793
	(0.00245)	(0.00192)	(0.00133)	(0.00155)	(0.00117)	(0.00101)	(0.00140)	(0.00173)

Note: N=174. CAAR values in percentage and robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed t-student test.

13 Insider trading refers to the trading of a company's stocks by individuals with access to private or confidential information about the company.

Unlike the t-student test, applying the generalized sign test to evaluate the significance of the CAARs of all events grouped together, presented in Table 6, shows no evidence of a market reaction to the grouped FinTech funding events. Table 6 also reports that the event windows with the highest percentage of negative CARs, although not significant, are [-1;1] and [-1;0].

Table 6 – CAARs of all events, application of generalized sign test

Event Window	[-5;5]	[-3;3]	[-1;1]	[-1;0]	[0;0]	[0;1]	[0;3]	[0;5]
All Events	-0.447	-0.386	-0.213	-0.255	-0.127	-0.0856	-0.0954	-0.0793
	(0.471)	(0.46)	(0.454)	(0.454)	(0.5)	(0.494)	(0.489)	(0.506)

Note: N=174. CAAR values in percentage and fraction of positive CARs in parentheses.
*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed t-student test.

Whilst parametric tests, such as the t-student test, tend to be more powerful than non-parametric t-tests, such as the generalized sign test, the first is based on several assumptions related to the distribution of the sample's population, like the normal distribution of the data, which is are not always applicable when dealing with daily stock returns. Upon further analysis of the data, it was found that this was the case, being that the cumulative abnormal returns for event windows [-5;5] and [-3;3] are moderately negatively skewed and fat-tailed (Appendix 1).

Thus, the findings of Table 5 are considered to be misspecified, and the results in Table 6 correctly specified. As such, the hypothesis that FinTech funding events have no impact on the stock prices of traditional banks cannot be rejected.

4.2. FinTech Category-Related Events

When subdividing the FinTech funding event sample into the type of activities each FinTech firm develops, the results reported in Table 7 are achieved. Each subsample is only composed of FinTech firms that solely develop activities in one of the categories of interest because, as mentioned in the previous section, FinTech firms can be categorized into multiple vertical segments. If funding events where the FinTech firm develops activities in multiple categories were considered, it would not be possible to assess the effect of each individual category[14].

[14] Out of the 174 FinTech funding events considered, 119 are found to be related to FinTech firms categorized into a single vertical segment (out of the seven categories of interest, i.e., "Digital Lending", "Digital Capital Raising", "Digital Payments", "WealthTech", "Alternative Credit Analytics" and "Digital Banks"; firms could still be categorized into one of the other seven categories mentioned in subsection 3.3). The FinTech firms related with the other 55 events are found to be categorized into a minimum of 2 and maximum of 4 vertical segments (out of the ones of interest).

This subsample restriction means that the analysis of the impact of "Digital Savings" funding events will not be possible because none of the FinTech firms are solely attributed to this vertical segment.

Considering the application of the t-student test (Table 7), the only category that presents significant CAARs is "Digital Capital Raising" for event window [0;1] with a confidence level of 95%, and event windows [0;3] and [0;5] with a confidence level of 90%. All of the significant CAAR values have a positive sign, meaning that the FinTech funding events have a positive effect on the stock prices of traditional European banks. Specifically, the results presented in Table 7 suggest that, on average, the highest increase of traditional European banks' stock returns is 0.585%, when stockholders hold their investment for five days after the event date.

Also, excluding the "Digital Lending" category (which has a sufficiently large sample size for the t-student test's conclusions to be valid), although neither of the other four categories present significant CAAR values for neither of the event windows, these results are better evaluated with the application of a non-parametric test given its small sample size.

Table 7 – CAARs of FinTech category-related events, application of t-student test

Event Window	[-5;5]	[-3;3]	[-1;1]	[-1;0]	[0;0]	[0;1]	[0;3]	[0;5]
(1) Digital Lending	-0.49	-0.532	-0.254	-0.199	-0.0368	-0.0919	0.0434	-0.016
	(0.00502)	(0.00339)	(0.00241)	(0.00182)	(0.0011)	(0.00175)	(0.00246)	(0.00321)
(2) Digital Capital Raising	0.326	0.425	0.208	-0.57	-0.405	0.372**	0.566*	0.585*
	(0.00469)	(0.00369)	(0.00185)	(0.00798)	(0.00687)	(0.00167)	(0.00281)	(0.00319)
(3) Digital Payments	0.111	-0.21	0.312	0.237	0.166	0.242	0.0889	0.0282
	(0.00452)	(0.00386)	(0.00278)	(0.00215)	(0.00144)	(0.00228)	(0.00334)	(0.00402)
(4) WealthTech	-1.089	-0.468	0.102	0.141	-0.0423	-0.0812	-0.386	-0.53
	(0.00726)	(0.0057)	(0.00442)	(0.00458)	(0.00253)	(0.00246)	(0.0034)	(0.00443)
(5) Alternative Credit Analytics	-2.291	-1.396	-2.104	-2.086	0.0102	-0.0079	0.533	0.0639
	(0.02857)	(0.02924)	(0.02304)	(0.02018)	(0.00215)	(0.00548)	(0.01276)	(0.01352)
(6) Digital Banks	2.233	-1.46	-0.88	-0.775	-0.535	-0.641	-1.22	2.629
	(0.02502)	(0.01417)	(0.00686)	(0.00669)	(0.00333)	(0.00329)	(0.01626)	(0.02605)

Note: n_1=46, n_2=26, n_3=19, n_4=20, n_5=4, n_6=4. CAAR values in percentage and robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed t-student test.

Some of the results reported in the previous table are robust to the application of the generalized sign test. In fact, the "Digital Capital Raising" category presents significant positive CAAR results for event windows [-1;1], [0;1] and [0;3]. In particular, the generalized test shows evidence of a strongly significant negative impact on the funding event date, showing that traditional banks' stock returns dip 0,405% for event window [0;0] at a confidence level of 99%. These results suggest that the stock market reacts negatively to the information when first learning about the news of a "Digital Capital Raising" funding event, followed by an adjustment towards a positive value over the next few days. A visual representation of the described situation is represented in Figure 3, below. Additional visual representations for the other categories and the events grouped together can be consulted in Appendix 3.

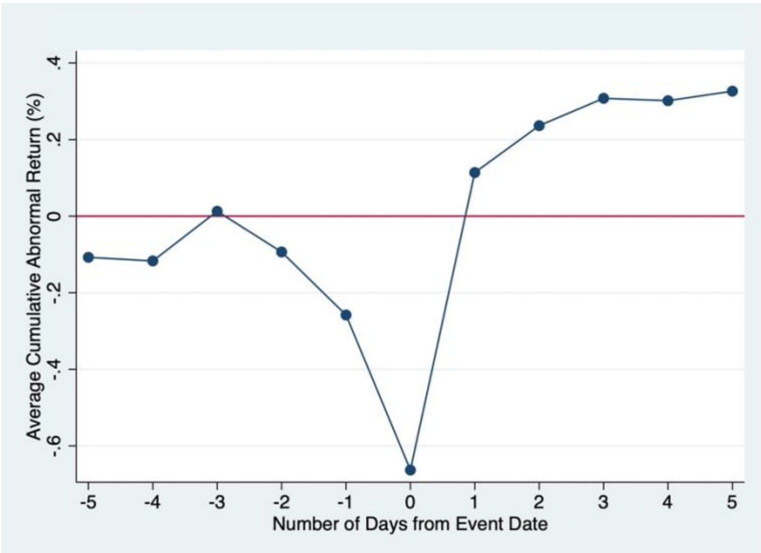

Figure 3 – Daily Average Cumulative Abnormal Returns - "Digital Capital Raising"

Additionally, the generalized sign test also reports a significant CAAR value for the "Digital Lending" category event window [-1,1] for a 90% confidence level, suggesting that when faced with "Digital Lending" funding events, the stock prices of traditional European banks dip, on average, 0,254%, although this result is not robust with the application of the t-student test, which reports the absence of significance. Once again, when analyzing the normality of the CAR values for the event window [-1;1], it was found that the data does not follow a normal distribution (Appendix 1). Therefore, the findings of the non-parametric test are better specified than the ones provided by the t-student test.

According to the generalized sign test, funding events of "Digital Payments" FinTech firms also have a significant effect on the stock prices of traditional European banks for event windows [-1;0] and [0;0]. Although the fact that the event window [-1;0] reports a significant result could indicate that there may have been an information leak about the event, the existence of insider trading or that the event might have been anticipated, when investigating the difference for the significance of the results presented by both tests, it was found that CAR values for event window [-1;0] follow a normal distribution (Appendix 1). Thus, the lack of statistical significance reported by the t-student test prevails over the generalized sign test. On the other hand, normality is verified for the event window [0;0], meaning that there is, in fact, a significant increase in the stock returns of traditional European banks of 0,166% on the event date for a confidence level of 95%.

Even though the results obtained from the application of the generalized sign test are only robust with the use of the t-student test for the "Digital Capital Raising" category, the use of a non-parametric test is also more appropriate and powerful when analyzing smaller samples (N<30), such as the case of every category but "Digital Lending".

Table 8 – CAARs of FinTech category-related subsamples, application of generalized sign test

Event Window	[-5;5]	[-3;3]	[-1;1]	[-1;0]	[0;0]	[0;1]	[0;3]	[0;5]
(1) Digital Lending	-0.49 (0.5217)	-0.532 (0.4348)	-0.254* (0.3696)	-0.199 (0.4348)	-0.0368 (0.0011)	-0.0919 (0.4565)	0.0434 (0.4565)	-0.016 (0.4783)
(2) Digital Capital Raising	0.326 (0.5769)	0.425 (0.5769)	0.208** (0.6923)	-0.57 (0.5385)	-0.405*** (0.7692)	0.372** (0.7308)	0.566* (0.6923)	0.585 (0.6539)
(3) Digital Payments	0.111 (0.579)	-0.21 (0.579)	0.312 (0.579)	0.237* (0.6842)	0.166** (0.7368)	0.242 (0.5263)	0.0889 (0.5263)	0.0282 (0.5263)
(4) WealthTech	-1.089 (0.35)	-0.468 (0.4)	0.102 (0.5)	0.141 (0.45)	-0.0423 (0.4)	-0.0812 (0.45)	-0.386 (0.35)	-0.53 (0.4)
(5) Alternative Credit Analytics	-2.291 (0.5)	-1.396 (0.75)	-2.104 (0.5)	-2.086 (0.25)	0.0102 (0.5)	-0.0079 (0.5)	0.533 (0.75)	0.0639 (0.75)
(6) Digital Banks	2.233 (0.75)	-1.46 (0.5)	-0.88 (0.25)	-0.775 (0.5)	-0.535 (0.25)	-0.641 (0.25)	-1.22 (0.25)	2.629 (0.75)

Note: n_1=46, n_2=26, n_3=19, n_4=20, n_5=4, n_6=4. CAAR values in percentage and fraction of positive CARs in parentheses.

*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed test.

4.3. Discussion of the Results

Overall, the answer to the main research question of this dissertation, that is, whether FinTech firms have an impact on the financial performance of traditional European banks and, studied through the analysis of whether FinTech funding events affect the stock market returns of traditional European banks, is there is no significant evidence of a significant change in these values when analyzing all events collectively. Although this conclusion is not robust to the application of the two different significance tests, the lack of normality exhibited by the data points toward the conclusion given by the non-parametric test. Following that, it cannot also be inferred whether FinTech firms serve as substitutes or complements to traditional banks.

The lack of observation of a significant impact of FinTech firm funding on traditional European banks falls in line with the studies of Abdurrahman (2019) and Li et al. (2017). These last authors argue that the absence of impact could imply that the substitution (negative impact of FinTech funding deals on stock prices of traditional banks) and complementary (positive impact of FinTech funding deals on stock prices of traditional banks) effects cancel each other out. This could be a possible explanation for why, when analyzing the sample as a whole, the presented results show no significance because, when analyzing Tables 7 and 8, it is reported that while some FinTech categories demonstrate complementarity with the traditional banking industry, others show the presence of a substitution effect.

When performing category-related subsample event studies, it was found that "Digital Capital Raising" funding events have an overall significant positive impact on the stock returns of traditional European banks, robust to the application of the two tests. The findings suggest that the highest positive impact registered for this category is generated when an investment is held for three days after the event date. It was also found that, when applying the generalized sign test, traditional banks' stock returns dip 0.405% on the event date, recovering on the following days. In fact, the overall impact of this type of FinTech category on traditional banks seems to be positive since the decrease in stock prices experienced on the event date is almost compensated for on the next day and compensated for over the next three days. Also, when considering the event window [-1;1], which accounts for possible information leakages, positive abnormal returns can be observed in the magnitude of

0,208%. Thus, the overall results suggest that "Digital Capital Raising" FinTech firms complement traditional banks.

Although the CCAF classification of the "Digital Capital Raising" category equates, in part, with the description of the "Crowdfunding" subcategory by Knewtson and Rosenbaum (2020), as detailed in subsection 2.2, which the author neither classifies as complementing nor displacing, it also involves non-investment-based crowdfunding, where the individual who supplies the funds either expects nothing in return or a non-monetary reward (although most of the events included in the sample are related with investment-based crowdfunding, in particular, equity and real estate crowdfunding). Thus, the obtained results are not surprising when considering that crowdfunding platforms often create strategic relationships with traditional banks, with these becoming institutional investors in the platform's project campaigns[15].

Considering the results of the nonparametric test, which is better suited for smaller samples, "Digital Lending" and "Digital Payments" funding events also present significant results. While the findings for the "Digital Lending" category suggest a significant negative impact on the stock returns of traditional banks, the findings for the "Digital Payments" actually suggest complementarity between the FinTech firms that develop activities in this segment and traditional European banks, with significant positive CAARs being registered for two out of the eight event windows.

The "Digital Lendings" category translates to the description of the "LendTech" subcategory in subsection 2.2. The findings related to these types of FinTech firms are in line with both the theoretical and empirical literature, which suggest that out of all segments considered, the P2P/LendTech segment is the most probable or evident substitute to traditional banks, as it fills an important gap in the market aimed at small and medium sized enterprises and underbanked sections of the population. In this context, the findings suggest that, when considering the event window that accounts for the possibility of information leakage [-1;1], the stock prices of traditional European banks decrease 0,254% when faced with funding events of LendTech firms.

---

[15] An example of these strategic partnerships is the case of BNP Paribas, a publicly listed traditional French bank, which joined Ulule, also a French firm which originated the first European crowdfunding platform, in 2013 and created a new business model in 2017 wherein crowdfunders have the possibility of being awarded a bank loan. Another example is Santander partnering with Crowdfunder platform in the United Kingdom.

The last category presenting significant results, "Digital Payments", is equivalent, in part, with the "Monetary Alternatives" categorization of Knewtson and Rosenbaum (2020), particularly, the "Domestic P2P Payments", "International P2P Payments" and "B2B Payments", but it also falls under the "Infrastructure" categorization. Although, on the one hand, authors classify all of the "Monetary Alternatives" subsegments as having a potentially displacing role in the financial industry, on the other hand, the "Infrastructure" category is classified as a complement to the traditional finance sector. The results presented are aligned with this last assertion. In fact, the findings suggest that the stock returns of traditional European banks increase 0,166% on the day of the announcement of the FinTech funding event.

There are two possible explanations for the mentioned result. The first is that oftentimes traditional banks make use of the technology that FinTech firms in this line of activity develop and offer, such as mobile paying apps and online payments solutions, as they can rely on a product that has already been launched and tested, instead of having to create their own[16]. A partnership is then established between the FinTech firm and the bank, meaning that one type of financial firm receiving funds would affect the other in a positive manner. Another possible reason for the obtained results is that almost half of the FinTech firms that constitute the sample of "Digital Payments" funding events develop activities related to the backend and provide auxiliary services to the finance industry, such as the creation of software, hardware and the integration of APIs, which constitute infrastructural activities rather than financial activities.

Lastly, note that the complementary analysis made for country-related subsections, displayed in Appendix 2, yielded overall insignificant results for both the parametric and nonparametric tests except for the Netherlands, which displayed significant negative robust results for event windows [-3;3] and [-1;0] and Sweden, which only reported a significant positive, robust result to the application of both significance tests for event window [-1;0].

[16] An example being the partnership established by the American online payments' solution firm PayPal and two traditional banks: the Brazilian bank Itaú Unibanco and the British bank Barclays.

5. Concluding Remarks

Over the last few years, especially ever since the Global Financial Crisis of 2007-09, the FinTech industry has shown signs of exponential growth and consequential economic relevance. As such, studying the interaction and competitive relationship between incumbent financial firms and these new market players becomes a pressing subject.

In this context, the present dissertation aims at analyzing the FinTech industry's impact on the traditional banking industry through the analysis of the effect of FinTech funding on the stock prices of traditional banks. For this purpose, the event study methodology was implemented to detect abnormal returns in daily stock return data of publicly listed traditional European banks for January 2010 until December 2019, when FinTech funding events occurred. In the first stage, the whole FinTech industry was taken as a sample, looking to assess the more generalized impact of these firms in the traditional banking industry. In the second stage, the sample was subdivided by the type of activity developed by the FinTech firm involved in the funding event. A complementary analysis of the effect of FinTech funding events on the stock returns of traditional banks by country was also implemented. The results were then assessed using two significance tests, a parametric t-student test, and a non-parametric generalized sign test.

The results for the first stage of the analysis, the overall impact of the FinTech industry on the stock returns of traditional banks, showed a lack of statistical significance of abnormal performance for all event windows considered. Although the parametric suggests negative significant abnormal performance for two of the event windows, the lack of normality of the data does not allow for these conclusions, instead relying on the results of the non-parametric test. Thus, in what concerns the main research question, our results point towards a lack of effect of FinTech firms, in general, on the financial performance of traditional banks. The second stage of the analysis allows us to hypothesize about the reasons for this finding.

When evaluating how different categories of FinTech firms individually affect the stock returns of the traditional banking industry, we found significant results, of different signs, for three segments: "Digital Lending", "Digital Capital Raising", and "Digital Payments". The "Digital Lending" category analysis revealed a substitution effect between these firms and traditional banks, as the latter's market performance is negatively affected when faced with a "Digital Lending" funding event. On the other hand, when studying the "Digital Capital Raising" segment, results point towards a generally complementary effect between these firms and traditional banks, except for when the event is first announced, where the stock returns of traditional banks react negatively to the news. However, this initial negative reaction is reversed over the next few days. Also, positive abnormal performance is evidenced when accounting for the possibility of information leakage or insider trading in the event window. Lastly, the funding of "Digital Payments" FinTech firms is also found to instill positive abnormal performance on the stock returns of traditional banks, therefore suggesting a complementary relationship between the two types of entities.

Nonetheless, the findings of this dissertation should be interpreted with caution, as it is subject to several limitations. First, as most traditional banks are private entities, therefore not having stock data available, a major number of these entities were excluded from the data collection process. This means that while the obtained results may be truthful for the collected sample, they may not apply to the whole population. The possibility of this same sample bias problem also applies to FinTech firms. Second, and as mentioned previously, the FinTech industry is still a relatively recent phenomenon, not even having its own industry code, which impacts the difficulty in collecting data relating to these firms, with only one public free extensive repository of information about these firms (i.e., the CCAF) being available. Third, the relative novelty of the rise and development of the FinTech industry also means that there is a current lack of empirical research studies on the study. With the present dissertation being the first work to study the subject in question for the European market through the event study methodology, solid ground of comparison is amiss, as most empirical studies pertain to either the US or developing economies. Fourth, is the possibility of bias due to confounding events. While this was acknowledged during the data treatment process when relating to events of the same type, other external events may have been unaccounted for. This limitation also relates to the restricted database access referenced earlier.

As with all research works, this dissertation opens the doors for further research, which could also address the referred limitations. For example, as the analysis of this dissertation only focused on European markets, and as this is the first work to apply an event study methodology to study the effect of FinTech firms on traditional banks, an additional investigation could be conducted by studying the US financial market. As this market is closely related and similar to the European one, the findings of this investigation would aid in attesting the results of the present dissertation. An event study analysis could also be employed using other types of events, such as earnings announcements and launch announcements. Particularly, the performance of an event study on launch announcements would allow for a better comparison with existing empirical literature that studies the subject by making use of accounting performance measures.

Appendix

Appendix 1 – Checks for Normality of the Data

The data is considered to follow a normal distribution if the skewness coefficient is approximately 1 and the kurtosis coefficient is approximately 3. A lower than 3 coefficient kurtosis means that the data is light-tailed; a higher than 3 kurtosis coefficient means that the data is fat-tailed.

Table 9 – Normal distribution checks of CAR values for non-robust results

Type of Sample	Event Window	Skewness Coefficient	Kurtosis Coefficient
All Events	[-5;5]	-0.5791291	4.255135
	[-3;3]	-0.3260944	4.348708
Digital Lending	[-1;1]	0.3139469	6.168687
Digital Capital Raising	[0;0]	-4.629637	23.02743
Digital Payments	[-1;0]	-0.028113	2.796019
Digital Payments	[0;0]	0.413382	4.949127

Appendix 2 – Complementary Analysis for Country-Related Subsamples

Table 10 – CAARs of country-related subsamples, application of t-student test

Event Window	[-5;5]	[-3;3]	[-1;1]	[-1;0]	[0;0]	[0;1]	[0;3]	[0;5]
Denmark	0.713	0.488	-0.0672	0.107	0.0607	-0.114	0.527	0.391
	(0.00922)	(0.00806)	(0.0031)	(0.00241)	(0.00258)	(0.00351)	(0.01038)	(0.01175)
Finland	0.688	-0.506	-1.016	-0.741	-0.453	-0.728	-0.682	0.245
	(0.01265)	(0.01605)	(0.01062)	(0.00585)	(0.00372)	(0.00964)	(0.00913)	(0.00725)
France	0.0737	-0.0125	-0.0123	-0.0806	-0.0016	0.0667	-0.135	-0.0562
	(0.00456)	(0.00369)	(0.00222)	(0.00202)	(0.00109)	(0.00148)	(0.00224)	(0.00255)
Germany	-0.856	-0.452	-0.394	-0.108	-0.0782	-0.364	-0.189	-0.388
	(0.00634)	(0.00531)	(0.00298)	(0.00228)	(0.00182)	(0.00258)	(0.00441)	(0.0051)
Italy	-1.512	-0.212	0.296	-0.959	-0.837	0.419	0.377	-0.412
	(0.01077)	(0.00829)	(0.00689)	(0.01413)	(0.01146)	(0.00465)	(0.00462)	(0.00595)
Netherlands	-2.286	-2.095*	-0.694	-1.138*	-0.558	-0.114	-1.018	0.0828
	(0.01873)	(0.01001)	(0.00557)	(0.00523)	(0.00352)	(0.00388)	(0.00997)	(0.01248)
Spain	-0.102	-0.315	-0.0953	0.0511	0.123	-0.0237	-0.237	0.0218
	(0.00683)	(0.0055)	(0.00353)	(0.0028)	(0.00166)	(0.00236)	(0.00374)	(0.00512)
Sweden	-0.271	-0.552	0.226	0.358*	0.166	0.0345	-0.477	-0.537
	(0.00936)	(0.00530)	(0.00251)	(0.00183)	(0.0019)	(0.00269)	(0.0051)	(0.00821)
Switzerland	-0.101	0.497	0.251	-0.0314	-0.111	0.172	0.327	0.263
	(0.00898)	(0.00676)	(0.00424)	(0.00319)	(0.00113)	(0.0031)	(0.00434)	(0.00644)
United Kingdom	-0.261	-0.413	-0.371	-0.301	-0.0663	-0.136	0.0624	0.115
	(0.00416)	(0.00338)	(0.00251)	(0.00183)	(0.00095)	(0.00191)	(0.00238)	(0.00296)

Note: CAAR values in percentage and robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed t-student test.

Table 11 – CAARs of country-related subsamples, application of generalized sign test

Event Window	[-5;5]	[-3;3]	[-1;1]	[-1;0]	[0;0]	[0;1]	[0;3]	[0;5]
Denmark	0.713	0.488	-0.0672	0.107	0.0607	-0.114	0.527	0.391
	(0.666)	(0.333)	(0.333)	(0.666)	(0.666)	(0.666)	(0.333)	(0.333)
Finland	0.688	-0.506	-1.016	-0.741	-0.453	-0.728	-0.682	0.245
	(0.333)	(0.5)	(0.333)	(0.333)	(0.5)	(0.666)	(0.5)	(0.666)
France	0.0737	-0.0125	-0.0123	-0.0806	-0.0016	0.0667	-0.135	-0.0562
	(0.684)	(0.632)	(0.526)	(0.526)	(0.526)	(0.526)	(0.526)	(0.474)
Germany	-0.856	-0.452	-0.394	-0.108	-0.0782	-0.364	-0.189	-0.388
	(0.429)	(0.464)	(0.357)	(0.393)	(0.393)	(0.393)	(0.429)	(0.429)
Italy	-1.512	-0.212	0.296	-0.959	-0.837	0.419	0.377	-0.412
	(0.438)	(0.375)	(0.5)	(0.438)	(0.563)	(0.5)	(0.563)	(0.438)
Netherlands	-2.286	-2.095*	-0.694	-1.138*	-0.558*	-0.114	-1.018	0.0828
	(0.286)	(0.143)	(0.286)	(0.143)	(0.143)	(0.286)	(0.571)	(0.571)
Spain	-0.102	-0.315	-0.0953	0.0511	0.123	-0.0237	-0.237	0.0218
	(0.5)	(0.389)	(0.5)	(0.389)	(0.5)	(0.556)	(0.444)	(0.5)
Sweden	-0.271	-0.552	0.226	0.358**	0.166	0.0345	-0.477	-0.537
	(0.539)	(0.462)	(0.692)	(0.846)	(0.615)	(0.615)	(0.539)	(0.615)
Switzerland	-0.101	0.497	0.251	-0.0314	-0.111	0.172	0.327	0.263
	(0.2)	(0.6)	(0.6)	(0.6)	(0.4)	(0.6)	(0.6)	(0.8)
United Kingdom	-0.261	-0.413	-0.371	-0.301	-0.0663	-0.136	0.0624	0.115
	(0.458)	(0.475)	(0.424)	(0.424)	(0.542)	(0.475)	(0.475)	(0.509)

Note: CAAR values in percentage and fraction of positive CAARs in parentheses.

*** p<0.01, ** p<0.05, * p<0.1 for a two-tailed test.

Appendix 3 – Daily Average Cumulative Abnormal Returns

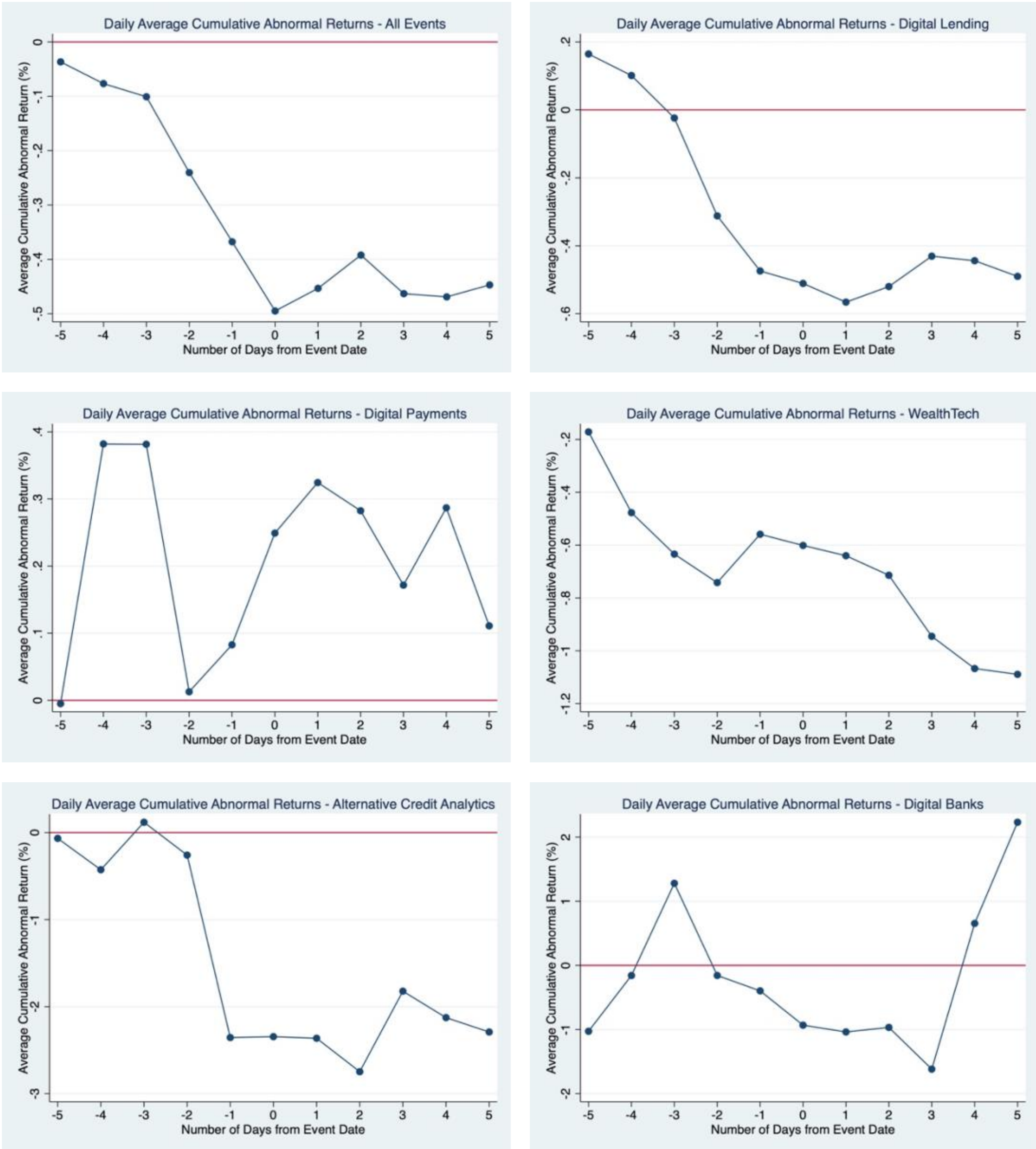

Figure 4 – Daily Average Cumulative Abnormal Returns

6. References

Aaker, D. A., & Keller, K. L. (1990). Consumer evaluations of brand extensions. *Journal of marketing, 54*(1), 27-41.

Abdurrahman. (2019). *The effect of fintech firms on european incumbent banks stock return, the difference between technology adaptive and non-adaptive bank* (Master's thesis, Tilburg University). Retrieved from http://arno.uvt.nl/show.cgi?fid=150214

Accenture. (2014). *The Boom in Global Fintech Investment: A new growth opportunity for London*. Retrieved from https://www.finextra.com/featurearticle/1938/the-boom-in-global-fintech-investment

Ahmed, M. (2015, October 14). Start-ups aim at banks' income streams. *Financial Times*. Retrieved from https://www.ft.com/content/55049480-61cb-11e5-9846-de406ccb37f2

Akkizidis, I., & Stagars, M. (2015). *Marketplace Lending, Financial Analysis, and the Future of Credit: Integration, Profitability, and Risk Management*. Retrieved from https://books.google.pt/books?id=i5wtCwAAQBAJ

Aktas, N., Bodt, E. d., & Roll, R. (2004). Market Response to European Regulation of Business Combinations. *Journal of Financial and Quantitative Analysis, 39*(4), 731-757. doi:10.1017/S0022109000003197

Almulla, D., & Aljughaiman, A. A. (2021). Does financial technology matter? Evidence from an alternative banking system. *Cogent Economics & Finance, 9*(1), 1-21. doi:10.1080/23322039.2021.1934978

Alt, R., Beck, R., & Smits, M. T. (2018). FinTech and the transformation of the financial industry. *Electronic Markets, 28*, 235-243. doi:10.1007/s12525-018-0310-9

Anagnostopoulos, I. (2018). Fintech and regtech: Impact on regulators and banks. *Journal of Economics and Business, 100*, 7-25. doi:10.1016/j.jeconbus.2018.07.003

Armitage, S. (1995). Event Study Methods and Evidence on Their Performance. *Journal of Economic Surveys, 9*(1), 25-52. doi:10.1111/j.1467-6419.1995.tb00109.x

Arner, D., Barberis, J., & Buckley, R. (2016). The Evolution of Fintech: A New Post-Crisis Paradigm? *Georgetown Journal of International Law, 47*(4), 1271-1319. doi:10.2139/ssrn.2676553

Arner, D., Barberis, J., & Buckley, R. (2017). *FinTech and RegTech in a Nutshell, and the Future in a Sandbox*. CFA Institute Research Foundation. doi:10.2139/ssrn.3088303

Ball, R., & Brown, P. (1968). An Empirical Evaluation of Accounting Income Numbers. *Journal of Accounting Research, 6*(2), 159-178. doi:10.2307/2490232

Balyuk, T., Berger, A. N., & Hackney, J. (2020). *What is Fueling FinTech Lending? The Role of Banking Market Structure* (Working Paper). doi:10.2139/ssrn.3633907

Balyuk, T., & Davydenko, S. (2019). *Reintermediation in FinTech: Evidence from Online Lending* (Michael J. Brennan Irish Finance Working Paper No. 18-17). doi:10.2139/ssrn.3189236

Barber, B. M., & Lyon, J. D. (1997). Detecting long-run abnormal stock returns: The empirical power and specification of test statistics. *Journal of Financial Economics, 43*(3), 341-372. doi:10.1016/S0304-405X(96)00890-2

Barten, A. P., & Böhm, V. (1982). Consumer Theory. In K. J. Arrow & M. D. Intriligator (Eds.), *Handbook of Mathematical Economics* (Vol. 2, pp. 381-429): Elsevier.

Basole, R. C., & Patel, S. S. (2018). Transformation Through Unbundling: Visualizing the Global FinTech Ecosystem. *Service Science, 10*(4), 379-396. doi:10.1287/serv.2018.0210

Benston, G. J. (2004). What's Special About Banks? *The Financial Review, 39*(1), 13-33. Retrieved from https://EconPapers.repec.org/RePEc:bla:finrev:v:39:y:2004:i:1:p:13-33

Bergara, M., & Ponce, J. (2017). How Disruptive are Fintechs? *Monetaria, 5*(2), 203-241. Retrieved from https://www.cemla.org/monetary.html

Bettinger, A. (1972). FINTECH: A Series of 40 Time Shared Models Used at Manufacturers Hanover Trust Company. *Interfaces, 2*(4), 62-63. Retrieved from http://www.jstor.org/stable/25058931

Blume, M. E., & Siegel, J. J. (1992). *The Theory of Security Pricing and Market Structure* (Rodney L. White Center for Financial Research Working Paper No. 6-92). Retrieved from https://rodneywhitecenter.wharton.upenn.edu/wp-content/uploads/2014/04/9206.pdf

Bollaert, H., Lopez-de-Silanes, F., & Schwienbacher, A. (2021). Fintech and access to finance. *Journal of Corporate Finance, 68*. doi:10.1016/j.jcorpfin.2021.101941

Bossone, B. (2000). *What Makes Banks Special? A Study of Banking, Finance, and Economic Development* (Policy Research Working Paper No. 2408). World Bank. Washington, DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/19815

Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: Catching the wave. *Harvard Business Review*(73), 43-53. Retrieved from https://hbr.org/1995/01/disruptive-technologies-catching-the-wave

Brandl, B., & Hornuf, L. (2020). Where Did FinTechs Come From, and Where Do They Go? The Transformation of the Financial Industry in Germany After Digitalization. *Frontiers in Artificial Intelligence, 3*(8). doi:10.3389/frai.2020.00008

Buchak, G., Matvos, G., Piskorski, T., & Seru, A. (2018). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics, 130*(3), 453-483. doi:10.1016/j.jfineco.2018.03.011

Bunea, S., Kogan, B., & Stolin, D. (2016). Banks Versus FinTech: At Last, it's Official. *Journal of Financial Transformation*(44), 122-131. Retrieved from https://www.capco.com/capco-institute/journal-44-financial-technology/banks-versus-fintech-at-last-its-official

Burlingame, S. M. (1999). *Competitive Interaction: The Influence of Strategic Group Structure* (Doctoral dissertation, Old Dominion University). Retrieved from https://digitalcommons.odu.edu/businessadministration_etds/10/

Campbell, C. J., Cowan, A. R., & Salotti, V. (2010). Multi-country event-study methods. *Journal of Banking & Finance, 34*(12), 3078-3090. doi:10.1016/j.jbankfin.2010.07.016

Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Retrieved from https://books.google.pt/books?id=qQSfzgEACAAJ

Christensen, C. M., & Raynor, M. E. (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth*. Retrieved from https://books.google.pt/books?id=I0KhAGMknl4C

Christensen, C. M., Raynor, M. E., & McDonald, R. (2015). What is disruptive innovation? Retrieved from https://hbr.org/2015/12/what-is-disruptive-innovation

Christensen, L. R. (1975). Substitution Effects in Consumer Expenditures. *Business Economics, 10*(1), 58-63. Retrieved from http://www.jstor.org/stable/23481254

Claessens, S., Frost, J., Turner, G., & Zhu, F. (2018). Fintech credit markets around the world: size, drivers and policy issues. *BIS Quarterly Review*. Retrieved from https://www.bis.org/publ/qtrpdf/r_qt1809e.htm

Cornaggia, J., Wolfe, B., & Yoo, W. (2018). *Crowding Out Banks: Credit Substitution by Peer-to-Peer Lending* (SSRN Working Paper). doi:10.2139/ssrn.3000593

Coutts, J. A., Mills, T. C., & Roberts, J. (1994). The Market Model and The Event Study Methodology: A Synthesis of the Econometric Criticisms. *International Review of Financial Analysis, 3*(2), 149-171. doi:10.1016/1057-5219(94)90023-X

Cowan, A. R. (1992). Non-Parametric Event Study Tests. *Review of Quantitative Finance and Accounting, 2*(4), 343-358. doi:10.1007/BF00939016

Darden, K., Dixit, N., & Mason, T. (2018). *2018 US Fintech Market Report*. Retrieved from S&P Global Market Intelligence: https://www.spglobal.com/marketintelligence/en/documents/2018-us-fintech-market-report.pdf

Das, S. R. (2019). The future of fintech. *Financial Management, 48*(4), 981-1007. doi:10.1111/fima.12297 de Roure, C., Pelizzon, L., & Tasca, P. (2016). *How does P2P lending fit into the consumer credit market?* (Deutsche Bundesbank Discussion Paper No. 30/2016). doi:10.2139/ssrn.2756191

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2017). *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. Retrieved from World Bank: https://globalfindex.worldbank.org

Dermine, J. (2017). Digital disruption and bank lending. *European Economy: Banks, Regulation, and the Real Sector*(2), 63-76. Retrieved from http://european-economy.eu/wp-content/uploads/2018/01/EE_2.2017-2.pdf#page=65

Dorfleitner, G., Hornuf, L., Schmitt, M., & Weber, M. (2017). *FinTech in Germany*. Retrieved from https://books.google.pt/books?id=wItkDgAAQBAJ

Dyckman, T., Philbrick, D., & Stephan, J. (1984). A Comparison of Event Study Methodologies Using Daily Stock Returns: A Simulation Approach. *Journal of Accounting Research, 22*(Suppl.), 1-30. doi:10.2307/2490855

Eça, A., Ferreira, M. A., Prado, M. P., & Rizzo, A. E. (2022). *The real effects of FinTech lending on SMEs: evidence from loan applications* (European Central Bank Working Paper No. 2639). Retrieved from https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2639~849f8a2608.en.pdf

Eden, L., Miller, S. R., Khan, S., Weiner, R. J., & Li, D. (2022). The event study in international business research: Opportunities, challenges, and pratical solutions. *Journal of International Business Studies*. Advance Online Publication. doi:10.1057/s41267-022-00509-7

Eickhoff, M., Muntermann, J., & Weinrich, T. (2017). *What do FinTechs actually do? A Taxonomy of FinTech Business Models*. Paper presented at the International Conference on Information Systems, South Korea.

Elsaid, H. M. (2021). A review of literature directions regarding the impact of fintech firms on the banking industry. *Qualitative Research in Financial Markets*. Advance Online Publication. doi:10.1108/QRFM-10-2020-0197

England, J. (2020, September 14). The difference between a neobank and a challenger bank? FinTech Magazine. Retrieved from https://fintechmagazine.com/banking/difference-between-neobank-and-challenger-bank

European Banking Authority. (2019). *EBA Report on the impact of FinTech on Payment Institutions' and E-Money Institutions' business models.* Retrieved from https://www.eba.europa.eu/eba-assesses-impact-of-fintech-on-payment-institutions-and-e-money-institutions-business-models

European Central Bank. (2010). Beyond ROE - How to measure bank performance. *Appendix to the report on EU banking structures*. Retrieved from https://www.ecb.europa.eu/pub/html/index.en.html

EY. (2017). *EY FinTech Adoption Index 2017: The rapid emergence of FinTech*. Retrieved from https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/banking-and-capital-markets/ey-fintech-adoption-index-2017.pdf

EY. (2019). *Global FinTech Adoption Index 2019: As FinTech becomes the norm, you need to stand out from the crowd.* Retrieved from https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/banking-and-capital-markets/ey-global-fintech-adoption-index.pdf

Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance, 25*(2), 383-417. doi:10.2307/2325486

Financial Stability Board. (2017a). *Financial Stability Implications from FinTech: Supervisory and Regulatory Issues that Merit Authorities' Attention*. Retrieved from https://www.fsb.org/2017/06/financial-stability-implications-from-fintech/

Financial Stability Board. (2017b). *FinTech credit: Market structure, business models and financial stability*. Retrieved from https://www.fsb.org/wp-content/uploads/CGFS-FSB-Report-on-FinTech-Credit.pdf

Frank, R. H., & Glass, A. J. (2000). *Microeconomics and Behavior*. Retrieved from https://books.google.pt/books?id=bOz8nT2K-sgC

Freixas, X., & Rochet, J. C. (2008). *Microeconomics of Banking* (2nd ed.). Retrieved from https://books.google.pt/books?id=vdrxCwAAQBAJ

Frost, J. (2020). The economic forces driving fintech adoption across countries In M. R. King & R. W. Nesbitt (Eds.), *The Technological Revolution in Financial Services* (pp. 70-89). Toronto: University of Toronto Press.

Frunza, M.-C. (2016). *Solving Modern Crime in Financial Markets: Analytics and Case Studies*. doi:10.1016/B978-0-12-804494-0.00025-5

George, E. (1997). Are banks still special? *Bank of England. Quarterly Bulletin, 37*(1), 113.

Gimpel, H., Rau, D., & Roglinger, M. (2018). Understanding FinTech start-ups - a taxonomy of consumer-oriented service offerings. *Electronic Markets, 28*(3), 245-264. doi:10.1007/s12525-017-0275-0

Gomber, P., Koch, J.-A., & Siering, M. (2017). Digital Finance and FinTech: current research and future research directions. *Journal of Business Economics, 87*(5), 537-580. doi:10.1007/s11573-017-0852-x

Haddad, C., & Hornuf, L. (2019). The emergence of the global fintech market: economic and technological determinants. *Small Business Economics, 53*(1), 81-105. doi:10.1007/s11187-018-9991-x

Haddad, C., & Hornuf, L. (2021). *The Impact of Fintech Startups on Financial Institutions' Performance and Default Risk* (CESifo Working Paper No. 9050). doi:10.2139/ssrn.3837778

Harasim, J. (2021). FinTechs, BigTechs and Banks - When Cooperation and When Competition? *Journal of Risk and Financial Management, 14*(12). doi:10.3390/jrfm14120614

Hau, H., Shan, H., Huang, Y., & Sheng, Z. (2021). *FinTech Credit and Entrepreneurial Growth* (Swiss Finance Institute Working Paper No. 21-47). doi:10.2139/ssrn.3899863

Hendershott, T., Zhang, X. Q., Zhao, J. L., & Zheng, Z. Q. (2021). FinTech as a Game Changer: Overview of Research Frontiers. *Information Systems Research, 32*(1), 1-17. doi:10.1287/isre2021.0997

Henderson, G. V. (1990). Problems and Solutions in Conducting Event Studies. *The Journal of Risk and Insurance, 57*(2), 282-306. doi:10.2307/253304

Huyghebaert, N., & Gucht, L. (2004). Incumbent Strategic Behavior in Financial Markets and the Exit of Entrepreneurial Start-Ups. *Strategic Management Journal, 25*, 669-688. doi:10.1002/smj.415

Iman, N. (2019). Traditional banks against fintech startups: a field investigation of a regional bank in Indonesia. *Banks and Bank Systems, 14*(3), 20-33. doi:10.21511/bbs.14(3).2019.03

Imerman, M. B., & Fabozzi, F. J. (2020). Cashing in on innovation: a taxonomy of FinTech. *Journal of Asset Management, 21*(3), 167-177. doi:10.1057/s41260-020-00163-4

Jagtiani, J., & Lemieux, C. (2018). Do fintech lenders penetrate areas that are underserved by traditional banks? *Journal of Economics and Business, 100*, 43-54. doi:10.1016/j.jeconbus.2018.03.001

Jong, F. d. (2007). *Event Studies Methodology* (Lecture Notes). Retrieved from Empirical Finance and Investment Cases, Tilburg University, https://www.academia.edu/35248600/Event_Studies_Methodology

Knewtson, H. S., & Rosenbaum, Z. A. (2020). Toward understanding FinTech and its industry. *Managerial Finance, 46*(8), 1043-1060. doi:10.1108/MF-01-2020-0024

Knight, E., & Wojcik, D. (2020). FinTech, economy and space: Introduction to the special issue. *Environment and Planning: Economy and Space, 52*(8), 1490-1497. doi:10.1177/0308518x20946334

Kothari, S. P., & Warner, J. B. (1997). Measuring long-horizon security price performance. *Journal of Financial Economics, 43*(3), 301-340. doi:10.1016/S0304-405X(96)00899-9

KPMG. (2016). *A new landscape: Challenger banking annual results*. Retrieved from https://home.kpmg/content/dam/kpmg/pdf/2016/05/challenger-banking-report-2016.PDF

Langley, P., & Leyshon, A. (2021). The Platform Political Economy of FinTech: Reintermediation, Consolidation and Capitalisation. *New Political Economy, 26*(3), 376-388. doi:10.1080/13563467.2020.1766432

Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. *Business Horizons, 61*(1), 35-46. doi:10.1016/j.bushor.2017.09.003

Leong, K., & Sung, A. (2018). FinTech (Financial Technology): what is it and how to use technologies to create business value in fintech way? *International Journal of Innovation, Management and Technology, 9*(2), 74-78. Retrieved from http://www.ijimt.org/vol9/791-M775.pdf

Li, Y., Spigt, R., & Swinkels, L. (2017). The impact of FinTech start-ups on incumbent retail banks' share prices. *Financial Innovation, 3*(26). doi:10.1186/s40854-017-0076-7

Liu, J. J., Li, X. R., & Wang, S. Y. (2020). What have we learnt from 10 years of fintech research? a scientometric analysis. *Technological Forecasting and Social Change, 155*. doi:10.1016/j.techfore.2020.120022

Low, C., & Wong, M. (2021). The Effect of FinTech on the Financial Institution in Six ASEAN Countries: Fama-French Five-Factor Asset Pricing Model Approach. In T. A. Ping, T. Shieunt-Han, & Keni (Eds.), *Proceedings of the Ninth International Conference on Entrepreneurship and Business Management (ICEBM 2020)*. (pp. 224-232): Atlantis Press.

Macchiavello, E. (2017). Financial-return crowdfunding and regulatory approaches in the shadow banking, fintech and collaborative finance era. *European Company and Financial Law Review, 14*(4). doi:10.1515/ecfr-2017-0030

MacKinlay, A. C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature, 35*(1), 13-39. Retrieved from http://www.jstor.org/stable/2729691

Milian, E. Z., Spinola, M. D., & de Carvalho, M. M. (2019). Fintechs: A literature review and research agenda. *Electronic Commerce Research and Applications, 34*. doi:10.1016/j.elerap.2019.100833

Nabilou, H. (2017). Regulatory arbitrage and hedge fund regulation: The need for a transnational response. *Fordham Journal of Corporate & Financial Law, 22*(4), 557-603. Retrieved from https://ir.lawnet.fordham.edu/jcfl/vol22/iss4/2/

Najaf, K., Subramaniam, R. K., & Atayah, O. F. (2021). Understanding the implications of FinTech Peer-to-Peer (P2P) lending during the COVID-19 pandemic. *Journal of Sustainable Finance & Investment*, 1-16. Advance Online Publication. doi:10.1080/20430795.2021.1917225

Navaretti, G. B., Calzolari, G., & Pozzolo, A. F. (2017). FinTech and Banks: Friends or Foes? *European Economy: Banks, Regulation, and the Real Sector*(2), 9-30. doi:10.2139/ssrn.3099337

Nicoletti, B. (2017). *The Future of FinTech: Integrating Finance and Technology in Financial Services*. Retrieved from https://books.google.pt/books?id=IitBDgAAQBAJ

Park, N. K. (2004). A Guide to Using Event Study Methods in Multi-Country Settings. *Strategic Management Journal, 25*(7), 655-668. Retrieved from https://www.jstor.org/stable/20142151

Petralia, K., Philippon, T., Rice, T., & Véron, N. (2019). *Banking Disrupted? Financial Intermediation in an Era of Transformational Technology* (Geneva Reports on the World Economy 22). Retrieved from Centre for Economic Policy Research: https://voxeu.org/content/banking-disrupted-financial-intermediation-era-transformational-technology

Phan, D. H. B., Narayan, P. K., Rahman, R. E., & Hutabarat, A. R. (2020). Do financial technology firms influence bank performance? *Pacific-Basin Finance Journal, 62*. doi:10.1016/j.pacfin.2019.101210

Portugal Fintech. (2020). *Portugal Fintech Report 2020*. Retrieved from https://fintechnavigator.org/portugal-fintech-report-2020/

Rau, P. (2017). Law, Trust, and the Development of Crowdfunding. *SSRN Electronic Journal*. doi:10.2139/ssrn.2989056

Romanova, I., & Kudinska, M. (2016). Banking and fintech: A challenge or opportunity? *Contemporary Studies in Economic and Financial Analysis, 98*, 21-35. doi:10.1108/S1569-375920160000098002

Rotman, S. (2014). *Bitcoin Versus Electronic Money* (CGAP Brief No. 88164). Retrieved from World Bank: http://hdl.handle.net/10986/18418

Ryu, H.-S. (2018). What makes users willing or hesitant to use Fintech?: The moderating effect of user type. *Industrial Management & Data Systems, 118*(3), 541-569. doi:10.1108/IMDS-07-2017-0325

Saiedi, E., Mohammadi, A., Broström, A., & Shafi, K. (2020). Distrust in Banks and Fintech Participation: The Case of Peer-to-Peer Lending. *Entrepreneurship Theory and Practice, 0*(0), 1-28. doi:10.1177/1042258720958020

Sari, D. N. (2020). The Effect of the Growth of Financial Technology Companies Peer To Peer Lending on the Performance of Banking in Indonesia. *Bulletin of Fintech and Digital Economy, 1*(1), 42-60. Retrieved from https://jurnal.uns.ac.id/bfde/article/view/52114

Schich, S. (2019). Do Fintech and Cryptocurrency Initiatives Make Banks Less Special? *Business and Economic Research, 9*(4), 89-116. doi:10.5296/ber.v9i4.15720

Schueffel, P. (2016). Taming the beast: A scientific definition of fintech. *Journal of Innovation Management, 4*(4), 32-54. doi:10.24840/2183-0606_004.004_0004

Singapurwoko, A. (2019). Do Financial Technology Startups Disrupt Business and Performance of Financial Institutions in Indonesia? *International Journal of Business & Management Science, 9*(1).

Stulz, R. M. (2019). FinTech, BigTech, and the Future of Banks. *Journal of Applied Corporate Finance, 31*(4), 86-97. doi:10.2139/ssrn.3455297

Sundaram, A., John, T., & John, K. (1996). An Empirical Analysis of Strategic Competition and Firm Values: The Case of R&D Competition. *Journal of Financial Economics, 40*, 459-486. doi:10.1016/0304-405X(95)00853-7

Tang, H. (2019). Peer-to-Peer Lenders Versus Banks: Substitutes or Complements? *The Review of Financial Studies, 32*(5), 1900-1938. doi:10.1093/rfs/hhy137

Teixeira, T. S., & Piechota, G. (2019). *Unlocking the Customer Value Chain: How Decoupling Drives Consumer Disruption*. Retrieved from https://books.google.pt/books?id=xSdcDwAAQBAJ

Thakor, A. V. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation, 41*. doi:10.1016/j.jfi.2019.100833

Vives, X. (2019). Digital Disruption in Banking. *Annual Review of Financial Economics, 11*(1), 243-272. doi:10.1146/annurev-financial-100719-120854

Zalan, T., & Toufaily, E. (2017). The Promise of Fintech in Emerging Markets: Not as Disruptive. *Contemporary Economics, 11*(4), 415-430. Retrieved from https://EconPapers.repec.org/RePEc:wyz:journl:id:515

Ziegler, T., Shneor, R., Wenzlaff, K., Odorović, A., Johanson, D., Hao, R., & Ryll, L. (2019). *Shifting Paradigms: The 4th European Alternative Finance Benchmarking Report*. Retrieved from Cambridge Centre for Alternative Finance: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/shifting-paradigms/#.YmatAy_5Qcg