Bank of Israel   Research Department

Do words create reality? The development of fintech-banking as seen in financial reports

Lilah Shema Zlatokrilov Adv. CPA[1]

Discussion Paper 2021.20

October 2021

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מילים יוצרות מציאות?
התפתחות הבנקאות הפינטקית הנקראת מהדוחות הכספיים

לילך שמע זלטוקרילוב עו״ד- רו״ח

תקציר

בעבודה זו נציע דרך לבחון את התפתחות בנקאות הפינטק בעשור האחרון (2010-2020) באמצעות מדד חדש האומד את הנטייה של בנק לחדשנות. המדד מבוסס על ניתוח טקסט בדוחות הכספיים, והוא חושב למדגם של 127 בנקים מ-18 מדינות לשנים 2012–2019. התוצאות שהתקבלו הושוו למגמות המצופות בשוק בהתאם למודל החדשנות המאתגרת (״disruptive innovation״), בהינתן שה״פינטק״ מייצג את התופעה המוכרת כ- ״הפרעה חדשנית טכנולוגית״. ההשוואה מלמדת שהמדד המוצע יכול להסביר את השונות בין בנקים ובין מדינות מבחינת התפתחותה של החדשנות בבנקים. נמצא שהמדד מתואם חיובית עם מתן רישיון רגולטורי לבנק דיגיטלי ללא סניפים, כך שלבנק דיגיטלי עשויה להיות השפעה של הפרעה חדשנית לבנקאות המסורתית במדינה שבה הוקם. המדד אמנם משקף מצב עבר, אולם הוא מראה שבנקים אשר זיהו את כניסת ההפרעה החדשנית הקדימו את האחרים בשימוש במונחים ״חדשניים״ בדוחותיהם הכספיים. לכן מעקב אחר התפתחות המינוח בדוחות כספיים הוא בעל ערך תחזיתי מהותי. בהתבסס על הספרות בנושא ניתן לומר שאם הנטייה של בנקים לחדשנות עולה ככל שהפינטק מתבסס במדינה, רגולציה התומכת באימוץ חדשנות בבנקים תורמת מהותית לשימור התחרות בשירותים הבנקאיים לקראת כניסתן של חברות הטכנולוגיה הגדולות, שכן הנטייה של שוק מפוקח היא להמתין להוראות הרגולטור.

Do words create reality? The development of fintech-banking as seen in financial reports

Lilah Shema Zlatokrilov Adv. CPA

Summary

In this work, we propose a way to examine the development of fintech banking in the previous decade (2010–2020) through a new index that measures innovation tendency.

The index is based on textual analysis of financial statement relying on a sample of 127 banks from 18 countries for the years 2012–2019.

The results were compared to the expected trends in the market as may be predicted by the "disruptive innovation" model, given that "fintech" represents the phenomenon known as technologically innovative disorder.

The comparison indicates that the proposed index can explain the variance between banks and countries in terms of the development of innovation in banks.

The index was found to be significant positively correlated with the granting of a regulatory license to a digital bank without branches. Thus a digital bank may have the effect of innovative disruption to traditional banking in the country in which it was established.

While the index reflects a past situation, it shows that banks that have identified the introduction of the innovative disruption have preceded others by using "innovative" terms in their financial statements, so tracking the development of financial statements is of material forecasting value.

Based on the literature on the subject, it can be said that if banks' propensity for innovation increases as fintech becomes more established in the country, an innovation - supporting banking regulation is an important factor in maintaining the competition in banking services a head of the entry of the large technology companies, since the tendency of a regulated market is to wait for the regulator's instructions.

<u>Highlights</u>

The decade between 2010-2020 was characterized by an accelerated combination of finance and technology ("FinTech"). "FinTech" is defined as "a technology that enables financial innovation that can yield new business models, applications, processes or products that have a material adverse effect on financial markets and financial institutions, and that may alter financial services" (FSB, 2017a). These developments have raised the question of whether banks will continue to exist in the traditional format (IMF, 2019a) (Navaretti, 2017). The classic answer was based on the financial intermediation model (Merton, 1995)[1], according to which the development of FinTech included the way banks perform their functions, but the banks will not disappear because they were prepared for change in advance, and the business model did not change.

Another common approach in the professional literature describes the development of FinTech as compatible with the challenging innovation model - (Christesen, 1995). According to this approach, FinTech is a technologically "Disruptive Innovation". It starts at the margins of the market, then establishes and competes with traditional products, and finally takes over the market and replaces the old product. Thus, the viability of traditional banks depends on the level of innovative strategy they have adopted (Vives, 2020).

An expression of the various stages of the challenging innovation model can be found in the development of research on FinTech in the previous decade. At the beginning of the decade, it was not at all clear whether this was a competitive threat to the banking system (Buchack, 2018). There was also no evidence of the impact of technological development on the cost of financial intermediation and income from it (Phillipon, 2015). But in the second half of the decade, it became clear that fintech is a developing technological "disruption", which may affect banks (Phillipon, 2018). At the same time, various scenarios have begun to emerge regarding the strategy that banks need to take to overcome the long-term disruption (IMF, 2017; BCBCS, 2018).

In this study, we sought to develop an international index of strategy that a traditional bank adopts in relation to FinTech (an index of propensity for innovation). Such an index could help with further research, which would examine the effect of a bank's tendency to innovate on its profitability and stability. The question of the impact of technological development on traditional banking has been examined in the past, for example, in the context of the

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[1]   Please see Michel Crouhy, Dan Galai and Zvi Wiener (2021).

establishment of SWIFT, but most empirical studies dealing with FinTech in recent years have examined developments from the perspective of non-banking companies rather than traditional banks. Only a few empirical studies have examined the impact of FinTech development on the traditional banking system (Phillipon, 2018; Allen, 2020).

Estimating the level of innovation of a traditional bank based on financial data involves an objective difficulty, since the innovative banking activity is conducted in parallel with the traditional, with different emphases for each country, and there is no accounting report on it as a separate business line. In this study, we chose to treat the technological disruption as a dynamic disruption, spanning a whole range of business activities, and therefore it is reflected in the business strategy.

Against this background, the index is based on a textual analysis of annual financial statements. This approach is based on previous literature, which found a correlation between the wording of the report and the firm's financial results as detailed in Loughran, 2016). The index is calculated as the ratio between the frequency of use of a limited number of related concepts for innovation products (e.g., "digital") and the total number of words in a controlled report of a bank. At the international level, it is necessary to take into account the differences between the countries in the products used in them, in regulation, in financial reporting, in the level of development and technological-financial literacy of individuals and institutions, in the structure of the banking system and more. Thus, the study data are based on a sample of annual financial statements (text and data) of 127 traditional banks from 18 countries for the years 2012–2019. This is a period of stability between two crises - the financial crisis in 2008 and COVID-19 - which enabled banks to become more efficient and implement innovative technologies. The sample is representative as a random sample of banks that have published annual financial statements to the public in the English language on a website, although it does not include the entire banking system in the countries represented in it. The banks selected for the sample are characterized by traditional activity and operate in centralized banking systems in their countries[2].

To the data of the banks and the measurements of the index - which is calculated as continuous and varies between banks, years and countries - data were added on the

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[2] 127 Traditional banks based on retail deposits from 18 countries for the years 2012–2019 - in a random sample of banks from countries where the centralization of the banking system, based on the market power of the five largest banks in the countries where they are registered, is between 65% and 100% (see Table 2).

financial-technological development of the country (for example, the Internet and its mobile devices), macroeconomic data and data on the country's banking system.

Because the banking service and payment services operate in a regulated market, the regulator has an influence on the extent to which the innovative disruption is established in the market (Claessens, 2018; Frost, 2019). As an expression of the advanced stage of the market's disruption, we chose to refer to licenses granted to digital banks with no branches (Neo banks), as this is a new banking model, based on new technologies such as cloud technology and advanced infrastructure, and relies on technological literacy of customers. This figure was added to the sample as a fee variable at the country and year level.

The calculated index is found to be positively correlated with the existence of a regulatory license for a digital bank with no branches, and with the country's investments in research and development. We found that the index reflects the strategy expected of banks wishing to adapt to the disruption subject to their being supervised[3].

The period examined in this study relates to the decade 2010-2020 which was characterized by challenging innovation in the financial sector, at a stage where the digital revolution has not yet been completed. Nevertheless, a positive correlation was found between an increase in the index and an increase in the profitability of a bank as an explained variable (the ratio of fees and commission income to operating income). Possible explanations for this finding are that with the increase in digitization, the number of actions that customers perform, and with it - the income from fees and commissions, and it may be an expression of streamlining.

The results, for the time being, do not reflect a clear identification in laboratory conditions, but they make it possible to present the developments that have taken place in banks around the world and in Israel in the years 2010-2020 using a new approach. With regard to Israel, it was found that, with the exception of Bank Leumi, which is one of the banks with the highest index expectancy in the sample, the banks did not stand out in the level of their index compared with banks from other countries in the sample. In the years sampled, Bank

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[3] Some of the claims heard among experts are that financial institutions were afraid to circumvent the regulators, and therefore were slower in implementing changes than technological institutions that are not subject to stable regulation. BIS Innovation Summit (2021).

Hapoalim had a lower expectancy than Bank Leumi, because its index fell slightly in 2016 and 2017, but rose in 2018, when it introduced the payments app.

The following sections of this paper will include a review of the literature, the index, descriptive statistics, validation of the index, and other preliminary, empirical findings that are consistent with the challenging innovation model.

A review of the literature in the light of the theoretical model

"FinTech" is defined as "a technology that enables financial innovation that can yield new business models, applications, processes or products that have a material adverse effect on financial markets and financial institutions, and that may alter financial services" (FSB, 2017a). This is apparently not a new phenomenon, but the financial crisis in 2008 was a new milestone in the relationship between finance and technology. Following the crisis, public confidence in the banking system was damaged, financial experts looked for other industries to work in, and at the same time a new generation of customers with technological literacy emerged. New technologies began to evolve that changed old patterns, such as artificial intelligence (AI), machine learning (ML), cryptography, and digital currencies. At the same time, the development of a new generation of mobile phones[4] has enabled the use of applications for all financial functions[5]. The development also spread outside the banks, and a trend began to separate the financial services into their components (unbundling).

As a result of these developments, the question arose as to whether banks would continue to exist in the traditional format IMF, 2019a; Navaretti, 2017)). The classic answer was based on the financial mediation model (Merton, 1995)[6], according to which the development of FinTech included the way in which banks perform the aforesaid functions, however, the banks as institutions will not disappear because they have been prepared for

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[4] The sophisticated operating systems of the IPHONE and Android and new technology systems such as HTML5, CSS3 and JavaScript.

[5] This model has evolved with the integration of mobile internet, and today operations can be performed using a mobile device, such as a tablet or a smartphone. Unlike Internet banking, this is a software which is called an application (app), which the financial institution provides for this purpose, and the service is available around the clock. The usual services are in a variety of areas - payment service, receiving information, investments and the like. The history of the said service began with the SMS service, when the smartphone with WAP support was introduced in 1999, however, until 2010 it was only SMS services (SMS). Preceded by the current model is a cellular banking model in a configuration of collaborations between banks and cellular companies, in which the cellular company served as a pipeline for the transfer of payment, and the collection was done through the telephone bill.
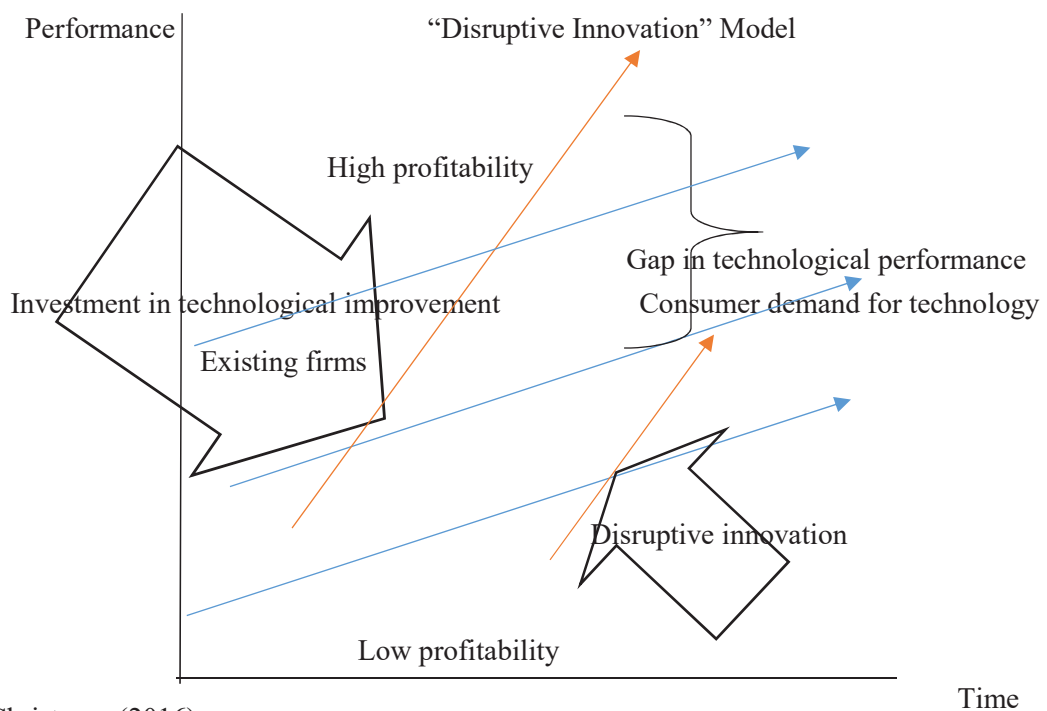
[6] Please see (2021) Michlel Crouhy, Dan Galai and Zvi Wiener.

change in advance, and their business model has not changed. Reference to this approach can be found in past processes: the development of the telegraph has reduced the number of retail banks in England but has not changed their business essence; Mobile banking development has prompted Korean banks to implement this technology to retain customers, and so they did (Bunghin, 2004). The SWIFT system[7] has had a positive effect on sales in the long run, leading to a reduction in costs and a reduction in the employees' ratio to capital. However, even small banks have enjoyed the possibility of connecting to that system[8], without having to bear the costs of setting it up (Scott, 2017).

The "Disruptive Innovation" Model

In recent years, it has become customary to examine the effects of technological development using the "disruptive innovation" model - hereinafter "the model"; Figure 1) (1995, Christesen. (According to this approach, FinTech is a technologically innovative disruption, and therefore the resilience of traditional banks depends on the strategy they will eventually adopt (Vives, 2020).

Figure 1

Performance — "Disruptive Innovation" Model

High profitability

Gap in technological performance

Investment in technological improvement — Consumer demand for technology

Existing firms

Disruptive innovation

Low profitability

Time

Source: Christesen (2016).

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[7] Mentioned in new studies: Claessnes (2018) and (2019) Frost, which were based on a sample of 6,848 banks from 29 European and American countries for the years 1977–2005.

[8] Operating expenses increased in the first two years of SWIFT's leadership, but decreased from the third year to about 2% in the ten years following its adoption. After the adoption, there was a streamlining process affecting the number of employees in relation to assets.

According to the model, the conditions for considering the technological disruption a challenging innovation are: 1. An entirely new technology, which initially exists at the margins of the market; 2. Difficulty in combining new technology with traditional one; 3. Difficulty in anticipating whether the technology will replace traditional business; 4. Technology does not adapt itself, and the market has to adapt itself to it.

The disruption begins on a small scale, and over time it takes over the market and changes the business model in it, according to the following phases: a. The initiation phase, in which new players with a new business model, turn to the less profitable part of the market and offer a new product or service; At this point the firms in the market ignore the disruption or prepare for it. b. The establishment phase, in which the disruption begins to take root in the market, and there is demand for the new product also from the average customer; At this point the new business model of the innovative players is starting to be accepted in the market, and they are gradually biting into the profits of the existing firms. c. The takeover phase - where the new players deliver the product even to the most established segment of the consumers in the market, and the business model of the new product replaces completely the old business model. The classic cases to demonstrate the model are the establishment of Netflix (1997) and (2007) iPhone[9] (Table 1).

Table 1
Disruptive Innovation Events

Sector affected by disruption	Disruptive innovation
Mainframe	PC
Integrated steel mills	Mini mills
Landline	Mobile Phone
Four-year colleges	Community colleges
Department stores with full service	Discounted retail
Traditional doctors' offices	Retail medical clinics

Source: https://claytonchristensen.com/key-concepts

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[9] Netflix (1997) enjoyed a good Internet deployment and a significant library of movies in the first phase, but the transfer to the consumer took several days by email. Therefore, in the first phase its services did not seem tempting to most Blockbuster users, and they continued to rent movies. The company's customers were consumers of Internet products who were less interested in watching new movies. In the first phase Blockbuster ignored the new threat because the consumers it served were completely different. But as technology evolved and allowed Netflix to stream video over the Internet, its products began to interest the average Blockbuster user as well.

The iPhone model (2007) is a sophisticated product in the mobile market, but is not a new product, so the initial disruption it created was a sustainable disruption. The product began to conform to the definition of a challenging disruption in the laptop market with the launch of Internet usage via a mobile phone. The connection between the Internet and the cellular created a new business model, connected app creators with the cellular users, and gradually replaced uses of the laptop.

The duration of the change in the market is not fixed. In the steel industry the change lasted over 40 years, whereas the transition from minicomputers to PCs lasted only 12 years. Thus, existing firms can be creative and adapt their business strategy. Their survival depends on responding to a disruption in time, and on maintaining, in the first phase, the core of traditional business alongside the development of the new product[10].

The Disruptive Innovation Model and Traditional Banking

We will demonstrate the application of the said model on FinTech as a challenging innovative disruption to traditional banks. FinTech is currently spread over a range of banking products and services, but the challenging innovative disruption has found visible initial expression in the retail sector[11]. The entry of FinTech services focused initially on services where the banks' return-to-capital ratio was high, such as payments, consulting and distribution of financial services. In addition, developments in the cellular field have changed the interface with the customer, and technological tools of artificial intelligence (AI) and machine learning (ML) have enabled data processing for remote recognition. All of these obviated the need for the physical presence of the banking service provider, and FinTech lenders and traditional banks began to compete for bank borrowers (Fuster, 2019)[12]. However, in the early years, until about 2015, it was still unclear what benefit would accrue to banks from the rapid adoption of technological change. This is because the cost and income from financial intermediation has not changed for 100 years or more (Phillipon, 2015). Technological changes have not necessarily contributed to the efficiency of financial entities, and the financial service remains expensive (Cecchetti, 2014 Shin, 2012); Moreover, the prediction was that there is no real competitive threat arising from the intrusion of FinTech companies into the areas of credit extension (Buchack, 2018).

From the middle of the decade or so (2015 onwards) there is evidence in the professional literature of the establishment of the Disruptive Innovation challenge; Since then, payment services and the provision of non-bank Internet credit extension have strengthened[13].

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[10] They will have to continue to strengthen the relationship with existing customers while investing in sustainable innovation, and at the same time establish new departments, which will focus on future businesses that the disruption breeds.

[11] Please see Vives (2020. The focus of this article is not on a particular FinTech activity but on the basket of services that a retail customer receives digitally.

[12] The study examined P2P mortgages in the United States and found that the market share of the FinTech lenders increased from 2% to 8% during 2010–2016, and that technological improvements increased the speed of response in apps by 20%. The competition occurs mostly around banking customers.

[13] Innovative payment services such as M-Peza, Apple pay, Android pay, Alipay, Samsung pay, and new credit providers based on online brokerage such as Lending Club and British Zopa.

During these years, the volume of non-bank loans known as "marketplace" loans increased significantly[14]. Preliminary signs of an improvement in the cost-per-unit of the banking system were seen, and the conclusion was that this happened under the influence of FinTech (Phillipon, 2018). FinTech companies have entered the business in the areas of money transfers, payments, investment banking, asset management and insurance. These together are the source for 60 percent of the profits in global banking, and their average return on capital is 22 percent[15]. At the same time, banks began to prepare for a repositioning in light of the expected entry of the technology giants into the field. Instead of separating services, we see more horizontal mergers between banks and FinTech companies for the sake of collaborations that are beneficial to both parties[16]. The market supports collaborations and responds positively to "digital strategy" in banks, especially when it comes to digital banks announcing partnerships with FinTechs (Jornuf, 2018). At the international level, various scenarios have begun to be discussed regarding the banking system and the strategy that it should adopt (BCBCS, 2018; IMF, 2017).

The expectation in the literature in the second half of the decade was that banks would find it difficult to continue with the existing business model given the pace of the technological advancement and customer expectations for digitization. Therefore, at least starting in 2015 "vigilant" banks were supposed to endeavor to adapt their strategy to the Disruptive Innovation, along with the increasing competition[17].

The Disruptive Innovation model assumption is that banks that have pre-adapted their strategy to the Disruptive Innovation, despite the high costs involved in running two business models together, will benefit from the move as the FinTech disruption takes over the market. It has recently been found in the context of U.S. banks that high FinTech scores

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[14] At this stage, however, these loans have not yet exceeded the rate of 1.3% of global credit volume, and therefore have not yet posed a competitive or stability threat to the banking system in the countries where it is established and concentrated. As of 2017, 69% of these loans were concentrated in retail credit, mainly in the US, China and the UK.

[15] See Michel Crouhy, Dan Galai and Zvi Wiener. For comparison - the traditional activities of banking, such as extending loans and maintaining deposits, yield a return of only 6% (Mckinsey, (2016).

[16] This is for several reasons, including: 1. FinTech companies supplement their basic banking operations; 2. Banks have significant advantages over FinTech companies, in terms of efficiency, market power, political influence, implied guarantee from the government, leverage benefits, and more, and therefore the connection between the strong and the weak is required (Phillipon, 2016); 3. The threat to banks will stem from the entry of large technology companies into the banking service, hence the sensible strategy for banks would be horizontal mergers with small FinTech companies (IMF (2017); Navaretti, 2017); 4. The more the public develops confidence in machines, and the more machines can replace personal familiarity with behavioral algorithms, the less the bank will need its traditional model. However, public confidence in banks stems from the government support those traditional banks have enjoyed in previous years.

[17]   Please see Vives (2020).

(attributed to banks that focus on brokerage activity) are correlated with operational efficiency and high rates of non-interest income (Allen, 2020). Another study in the context of the US market, based on an index developed that relies on a textual analysis of patents and classified job opening ads, found that the FinTech impact is consistent with a challenging innovation in the financial sector labor market, particularly affecting workers aged with mid-sized salaries[18].

The next step according to the Disruptive Innovation model is the taking over of the Disruptive Innovative. This phase may characterize the decade that began in 2020, with the completion of the entry of large technology companies (BigTechs) into the field of the banking services. These BigTech companies enjoy all the benefits of FinTech companies, plus a customer base, access to informal (soft) information on customer leisure time, entertainment and consumption habits, reputation, goodwill, branding and a deep pocket. Even if they will not be rushing in to hold deposits due to the regulatory obligations that will be imposed on them, they will be able to offer consumers the option to operate through Internet platforms[19]. Thus, in the short term, the entry of large technology companies may increase competition, however, they will dominate in the long run the interface with the customer, and if their market share reaches a critical rate, they may become a monopoly with regard to customer access (Vives, 2020)[20].

The Disruptive Innovation model and the regulation in the banking context

Fintech involves risks, such as invasion of privacy, cyber-attack, dependence on third parties and risks of concentration. New methods of machine learning and artificial intelligence raise issues of ethics and fairness. Therefore, the establishment of the Disruptive Innovation in the market also depends on the banking regulator, who can block or enable it. There is extensive literature in the context of regulatory costs, which may block the entry of new companies Stigler, 1971; Pelzman, 1976)). Regulators are working to minimize regulatory arbitrage. Therefore, the more adamant the Supervisor of Banks is,

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[18] Wei Jiang, Yuehua Tang, Rachel (Jiqiu) Xiao & Vincent Yao, Surviving the FinTech Disruption, NBRE discussion paper https://www.nber.org/papers/w28668.

[19] The source of the market power of the platforms is a chain of peoples' feedbacks that yields a lot of information about customers; The processing of information in innovative techniques produces more activity, followed by more information, which improves the ability to predict customer behavior. This is a process that produces an ecosystem with high costs for customers, while harming the competitiveness of traditional banks.

[20] This was also the case with antitrust lawsuits against Google, Microsoft and Apple. Already today in the field of payments in China, two companies control 94% of the market.

the more difficult it is for FinTech companies to operate (Claessnes, 2018). In developed countries with a centralized banking sector, the easier the banking regulation, the more prosperous is the FinTech activity in the credit extension field (Raw, 2019). However, burdensome regulation also impairs the ability of the existing companies (traditional banks) to implement the new technology in time (Phillipon, 2012). Therefore, the point in time of removal of regulatory barriers is a good indicator of the timing in which the market disruption establishes itself. The problem is that it is a multi-dimensional indicator. Although most countries apply banking legislation to digital banking services[21], they differ in the timing and manner in which they allow FinTechs to establish themselves in the market [22]. Another complexity stems from the fact that the technologies are being implemented with regard to a variety of FinTech products, and only some of them require regulatory approval. There have been previous attempts in the literature to formulate an identification for the removal of barriers to the entry into the technological disruption in a country. In 2019, the FSI surveyed the regulatory response to the development of FinTech in 31 countries. The classification of a country as a FinTech enabler depends on whether the country has a digital system for customer identification (digital ID), open banking, open data protection, cyber security and innovation facilitators. However, the existence of the systems is not a clear indication of FinTech's establishment in the country; The government's stated policy does not necessarily have to be in line with the state of innovation in the banking sector, or with the technological literacy of consumers; Moreover, sometimes a government that seeks to promote itself in the world as an innovator, sets a strategy and establishes systems, but at the same time delays in issuing approvals or establishing the necessary infrastructure to promote innovation in the financial system. Evidently, in the period under review, Germany had fewer systems than

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[21] Of the 31 countries examined by the FSI, in two countries there alone was a designated FinTech licensing procedure, and in one country there was a development process. In Hong Kong, the Hong Kong Monetary Authority (HKMA) in May 2018 issued guidelines regarding virtual banks. The guidelines require compliance with the proper banking practice in the country at a basic level. In the EU, the ECB issued in 2018 guidelines regarding licensing requirements for FinTech operations, including guidelines for banks with a FinTech business model. In the absence of specific regulation, some countries have launched new programs for the establishment of new banks. In Australia the Australian Prudential Regulation Authority (APRA) [established in May 2018 a new licensing policy, which allowed activity on the basis of a limited business model for two years, according to which the bank enjoys regulatory relief. In the UK, the Prudential Regulation Authority (PRA) and the Financial Compliance Authority (FCA) have set up a unit of innovative banks to deal with potential inquiries. The unit was established by the PRA in 2016 and merged in 2018.

[22] It is more difficult to launch FinTech and BigTech activities (services provided by large technology companies in the financial field) in the field of credit extension in countries where the stable financial regulation is adamant and a bank license is required. However, when regulation is not stringent, and the banking system is centralized, BigTech will be more active in providing credit than FinTechs (Frost, 2019).

Australia, although it was ahead of Australia in licensing a digital bank. Therefore, another approach is to see the establishment of Neo Banks[23] as evidence of the regulator's openness with respect to a range of FinTech activities in the new banking model (Vives, 2020)[24]. A Neo bank is a bank without physical presence, based on cloud technology, which allows the customer to open a remote account within a few minutes (on boarding) and offers unique products for distribution on various platforms[25].

<u>Textual analysis of financial statements using text analysis methods:</u>

Depending on the phases described earlier, banks wishing to survive were supposed to adjust their business strategy ahead of time. The strategy is reflected in publications and proposed products. Annual financial statements of banks are audited and supervised, and management bears legal responsibility for their accuracy, therefore they are reliable enough for their text to serve as an indirect measure of performance. Previous studies have found a link between the wording of the financial statements and the financial results. The more complex and wordier the financial statement, the slower the investors' response, due to the difficulty of analyzing the state of the company (Zhang, 2009). On the other hand, the more "readable" the financial statements are, the higher is the investment in the company's capital. Firms responded to the Enron affair by increasing the number of pages in their financial statements to improve information flow, and found that the higher the number of pages in a report, the lower is the cost of capital (Levzand Schrand, 2009). The prevalence of the word "ethics" on its various inflectional forms in those parts which are related to corporate responsibility, is also related to the labeling of the company in the eyes

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[23]   Challenger banks - Banks that hold a bank license which were established with the aim of challenging the big banks, competing with them and giving customers more FinTech options. The trend started in England and the US, and later reached Europe, the development of regulation and the introduction of regulation regarding open banking and PSD2 helped FinTech leaning banks to develop. These banks focus on modern design, customer service tailoring, and low customer temptation fees. Neo banks - also digital banks, but unlike Challenger banks - which have a certain physical presence (lower than traditional banks but nevertheless having a brick and mortar presence), a Neo bank has no physical presence at all. It is a completely digital bank, which is based on cloud technology, and provides customers with services on Internet platforms and banking applications.

[24] Thus, an environment has developed in England that supports the entry of FinTechs and digital banks with no branches based only on a mobile device such as Monzo, Revolut and Starling, and all of them have one regulator for (FCA), an open banking base and a sandbox. In Europe, a significant development in the field was legislation that allowed open banking - 2015 Payment Services Directive I - II (PSD2), and adjustments were made in the aspects of anti-money laundering and terror financing, for the possibility of opening an account and providing customer service remotely by digital means. These in fact formed the basis for the development of digital banking with no branches.

[25] In some cases, developments in digital banking have expressed an advanced response to the need of small and medium-sized businesses and high-tech companies. Such was the case of Solarisbank (2016) in Germany.

of investors as "sin stock" (Loughran, 2009).The findings of Loughran (2016) show that the use of the term "non GAAP" is related to business weakness, and expresses the company's desire to convey a better financial picture than that which emerges according to accepted rules. Hence, the use of "FinTech" terms in a financial report is not just a "buzz word", but symbolizes an innovative bank that will emphasize its being such, and will use appropriate terminology to influence investors and customers. Moreover, because of the legal responsibility, the signatories to the report are supposed to make sure that the wording rests on the business activity.

This approach is supported by recent studies. A parallel study, which has not yet been published, relies on the textual approach to validating a quantitative index developed based on the distinction between brokerage and dealership activity in American banks (Allen, 2020). Another index calculates the exposure to FinTech disruption in the labor market. It is based on a textual comparison between job search ads and patents, and is examined at the industry level. The study found that companies that develop patents (inventor firms) are characterized by relatively high exposure to FinTech in terms of recruitment (hire more technologically skilled workers), invest more in research and development, and enjoy increased sales and return on capital. It was also found that the impact of the Disruptive Innovation on the financial industry is higher than on the other industries[26].

The present study deals with the impact of a technologically Disruptive Innovation that pervades all financial business activity on banks as an extension to previous studies examining the impact of technological development or specific products in the banking or non-banking context. In line with the Disruptive Innovation model, the development of FinTech was supposed to influence the banks' business strategy. To examine this, we have developed a benchmark for a bank's propensity to innovate, based on a textual analysis of annual financial statements of banks from different countries and continents. The index will be used in this paper to examine the changes in the strategy of traditional banks around the world with regard to the development of FinTech as a Disruptive Innovation; And in particular - to examine a possible correlation between banks' propensity to innovate and the maturation of regulatory conditions for licensing digital banks with no branches in the country.

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[26] Wei Jiang, Yuehua Tang, Rachel (Jiqiu) Xiao & Vincent Yao, Surviving the Fintech Disruption, NBRE discussion paper; https://www.nber.org/papers/w28668.

Data methodology and descriptive statistics:

The sample is based on annual financial statements of 127 traditional banks based on retail deposits from 18 countries for the years 2012–2019 - in a random sample of banks from countries where the estimation of centralization of the banking system, based on the market power of the five largest banks, is between 65 percent to 100 percent (Table 2).

Table 2
Sample characteristics
Data for 2019 (non-systemic depiction)

	Country	Percent Concentration Index (2017)	Number of banks sampled	The ratio of capital to assets Expectancy (in percent)	Capital to asset ratio Standard deviation
1	Canada	83	7	6.4	1.3
2	Korea	84	6	6.6	0.7
3	Denmark	95	3	10.3	2.2
4	Spain	85	6	6.6	0.8
5	Finland	97	4	6.5	2.0
6	Hong Kong	66	6	13.4	1.0
7	Australia	93	2	7.4	1.7
8	Israel	85	7	6.9	0.8
9	Austria	79	14	11.7	6.1
10	Germany	84	3	5.9	0.9
11	Iceland	85	2	16.3	1.8
12	France	71	9	4.9	2.5
13	Ireland	83	4	17.2	13.6
14	Italy	78	29	7.7	3.0
15	South Africa	98	4	11.1	5.7
16	Switzerland	85	9	9.1	2.6
17	Netherlands	92	6	9.2	4.4
18	UK	67	5	7.9	4.4

The source of the banks' data - Bank Focus database

For the purpose of further examinations of the characteristics of the index, a data panel of bank and country variables was constructed for the said years. Data collection was based on the conventional in empirical studies that examined the factors influencing the performance of banks (De Young, 2004; Hahn, 2008; Vozkova, 2016) and in studies dealing with the development of the FinTech type credit extension (Frost, 2019; Claeres, 2018). In order to examine the relationship between financial development in the country and the FinTech type credit extension, there are studies that use economic development

indices and are cataloging for debt, for access and for financial causes (Sahay, 2015). This paper uses financial inclusion indices of the bank debt rate, the distribution of ATMs in the country and the market share of the five largest banks as an estimate of the level of concentration, which is often negatively correlated with the financial inclusion (Owen, 2018). As a variable for the country-level technological literacy was the level of Internet connection used, which is usually positively correlated with the level of competition in the market, particularly in retail banking (Gropp, 2017). To this we have added variables to the extent of the use of cell phones - in light of the development of the use of banking applications (apps) - and to the level of investment in research and development in the country. A dummy variable was also built, which receives the value of 1 starting from the year in which a license for a Neo bank type is granted in the country. The data calculated as a measure of a bank's propensity for innovation were added to the panel, as detailed below. The data are quantitative and continuous. Due to gaps in data accessibility between banks and countries, for the purpose of validating the index and the research question, a balanced data panel of about 100 banks was used.

Calculation of the index (propensity for bank innovation)

The index is based on a set of words specializing in financial innovation in the banking sector (dictionary). Studies usually use existing dictionaries even if they were not created for the purpose of the research topic, but FinTech banking is a developing field and dictionaries, such as HARVARD GI, have not yet addressed it. Therefore, in this study, a list of concepts that characterize the new phenomenon was formulated, using a combined method approach of a basket of words and specialized expressions (targeted phrases; Loughran, 2016). The definitions were compiled from official documents of the Bank for International Settlement (BIS) and the International Monetary Fund (IMF), which first explained FinTech terms that developed between 2010-2020. The list of concepts is well-defined, content-focused, and does not require sentiment or tone analysis. The order of the words and their direct context in the sentence (sequence) are not substantive; it is therefore possible to focus on a simple search of the terms within the text. The size of the letters and the configuration in which the words appear in the financial statements were neutralized in the search. The banks' annual financial statements have been downloaded from the Internet in English. This reduced the sensitivity of the tests to language related changes. The terms are most often related to physical products, so their use is precisely appropriate to the nature of a particular activity - for example, mobile banking. A problem that may

arise is that the use of an external dictionary is driven by the subjective influence of the researcher (Loughran, 2016). A partial solution to this challenge relies on the fact that in parallel with this study, independently, a study was conducted on banks in the United States, which used a similar list of words (Allen, 2020). The latest study found that banks whose text indicates high "self-identification" as FinTech wise, matched the score based on a quantitative index which was proposed by the researchers. The advantage of our study over the American study is in examining the behavior of the textual index across country and time variables in different countries outside the United States. Compared to other textual studies, the biases in the frequency of occurrences related to the characteristics of different industries have been minimized, because the sample includes only affiliated commercial banks. However, in studies of this type, it is still possible for high-frequency word occurrences for reasons unrelated to the objectives of the study (for example, a term that also appears in the name of the company). In this study, the term "online" can be linked to a reference to the bank's website and not to the business context in which one is interested. This problem is also minimized by the fact that we deal with banks alone and such bias characterizes the entire sample and therefore its impact on the conclusions is very limited. Beyond that, the conventional advantage in dictionary-based index literature is that the method can be relatively easily replicated in follow-up studies. Similarly, the follow-up work to this study that we are conducting expands the list of terms in accordance with the other studies (for the lists of terms, please see Appendix A). Hence, we will use the concepts "FinTech type term" or "FinTech type product" when referring to such new terms or products.

In the second stage, after reviewing the results, terms that did not meet the needs of the study were removed from the broad dictionary, as follows; Terms that may be used in other textual contexts such as "application", "direct" and "platform"; The word "technology", which increase in its use during the period may reflect general effects on the economy; Terms that have not been used at all, or that have been used very little, that do not indicate a trend, or that have been used extensively even at the beginning of the decade, hence it is possible that the use of the term was also not in the digital context[27]. The identification that we have conducted shows that in the sample years the main use in the FinTech type context

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[27]   Smart contracts, Smart speaker, Multi-channel, Voice activated, Computerized transaction protocol, Two factor authentication, Suptech, Robo- advisor, E-kyc, Eidas, Dlt, Api, AI

of financial statements was in the terms of "online", "mobile"[28], "innovation", "digital", "cyber". From this is derived a limited index, consisting of the terms "online", "cellular", "mobile" and "digital". The second, broader index also includes the terms "cyber" and "innovation". However, in tests conducted, both the broad index and the narrow index indicated similar trends. Therefore, for reasons of focus and simplification, we focused on the limited index.

Figure 2

The development of a term. The total mentions of the term "digital" in financial statements compared to the total mentions of other terms – the entire sample of bank reports
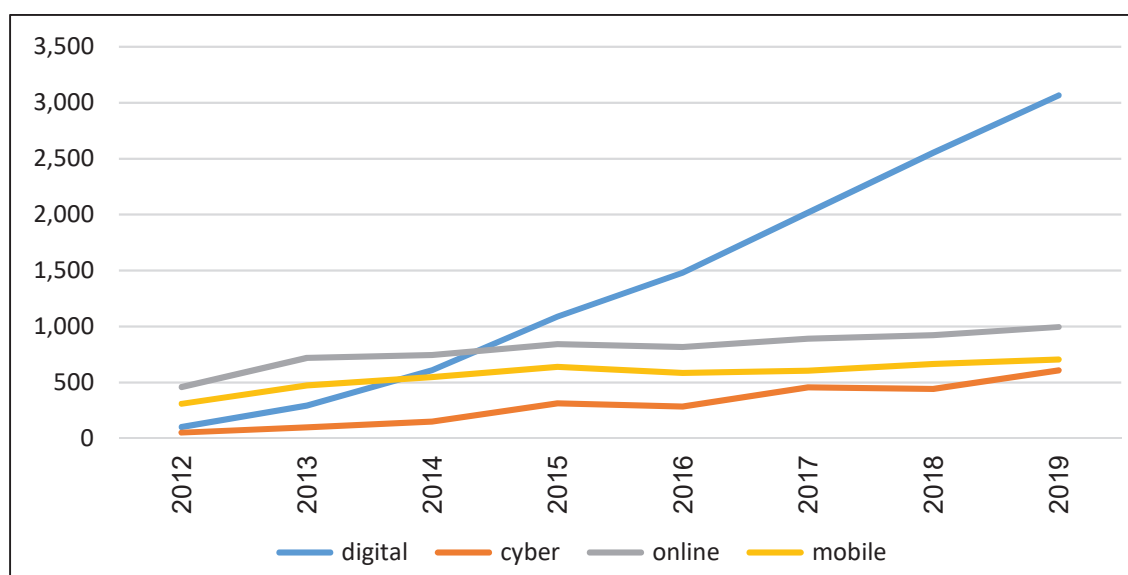
Source: Annual financial statements of the sample of banks in the study (published to the public in English).

The use of the term "digital "is dominant in reports mainly from 2015 onwards, and before that the terms "online" and "mobile" were used (Figure 2). The terminological change reflects developments in FinTech products, and is in line with the phases described in the Disruptive Innovation model, because at this phase, in some countries, digital banks with no branches have been licensed, and the implementation of the new retail business model has intensified (part of the process was changes in legislation and systems development that made it possible to identify and open an account remotely). The impact on language, if it is indeed coordinated with product development, should also be reflected on the

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[28] In the case of Israeli banks, the term "cellular" was used, and the use of "mobile" referred mainly to a "mobile branch" (in the context of business continuity).

consumer side. Examining trends in Google Trend in the aforesaid years shows that in 2011–2015 there was an upward trend of these word searches in the banking context, with some decline and stabilization until March 2020. In March 2020, another jump was recorded following the COVID-19 crisis (Figure 3). At the country level, this trend was reflected on both the banks and the consumer side (Figure 4).

Figure 3
Frequency of use of fintech banking terms worldwide - Google Trend
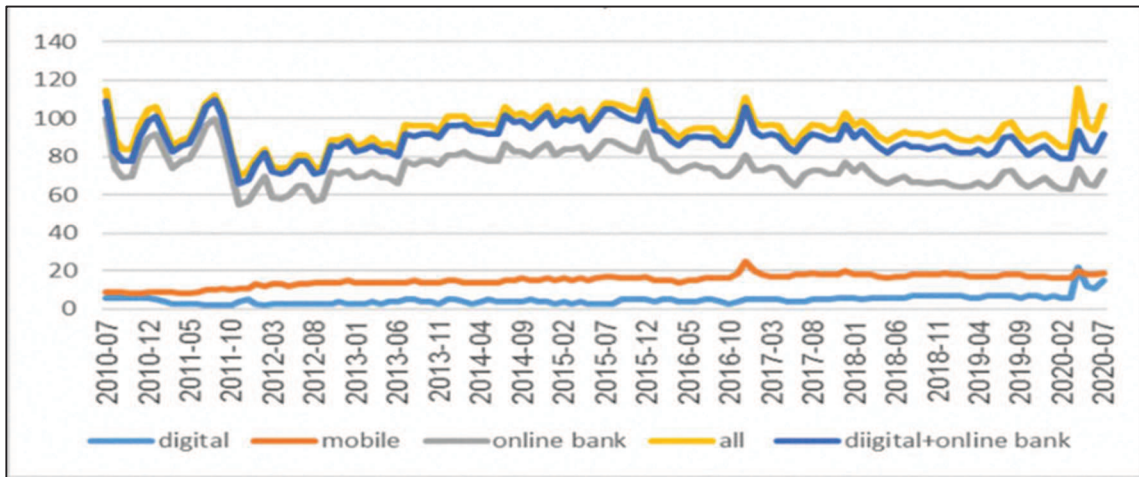
Source: Google Trend.

The frequency of use of the term digital in the report of the Board of Directors and the management to the investing public should reflect the level of innovation that the Bank sought to adopt during the period under review. In particular, in the year in which a strategy is published at the bank level, if it is leaning towards innovation, the number of expressions stated in the report will increase. However, for an index that will allow a comparison between banks, normalization is required, and it is usually customary not to use only a raw count of terms, because there is a connection throughout the document. The simplest method of solving this problem is by proportion[29] (Loughran, 2011). In our study, for the purpose of proportion, a relatively simple method of dividing by the number of words in the report was chosen.

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[29] A more complex method is to calculate the term frequency in relation to the frequency of the document (tf-idf). In this method the calculated ratio gives a better correlation than a simple ratio, however this is a method that has not yet been used widely in the literature, and is less relevant to the platform I have examined in this study which is an annual financial report.
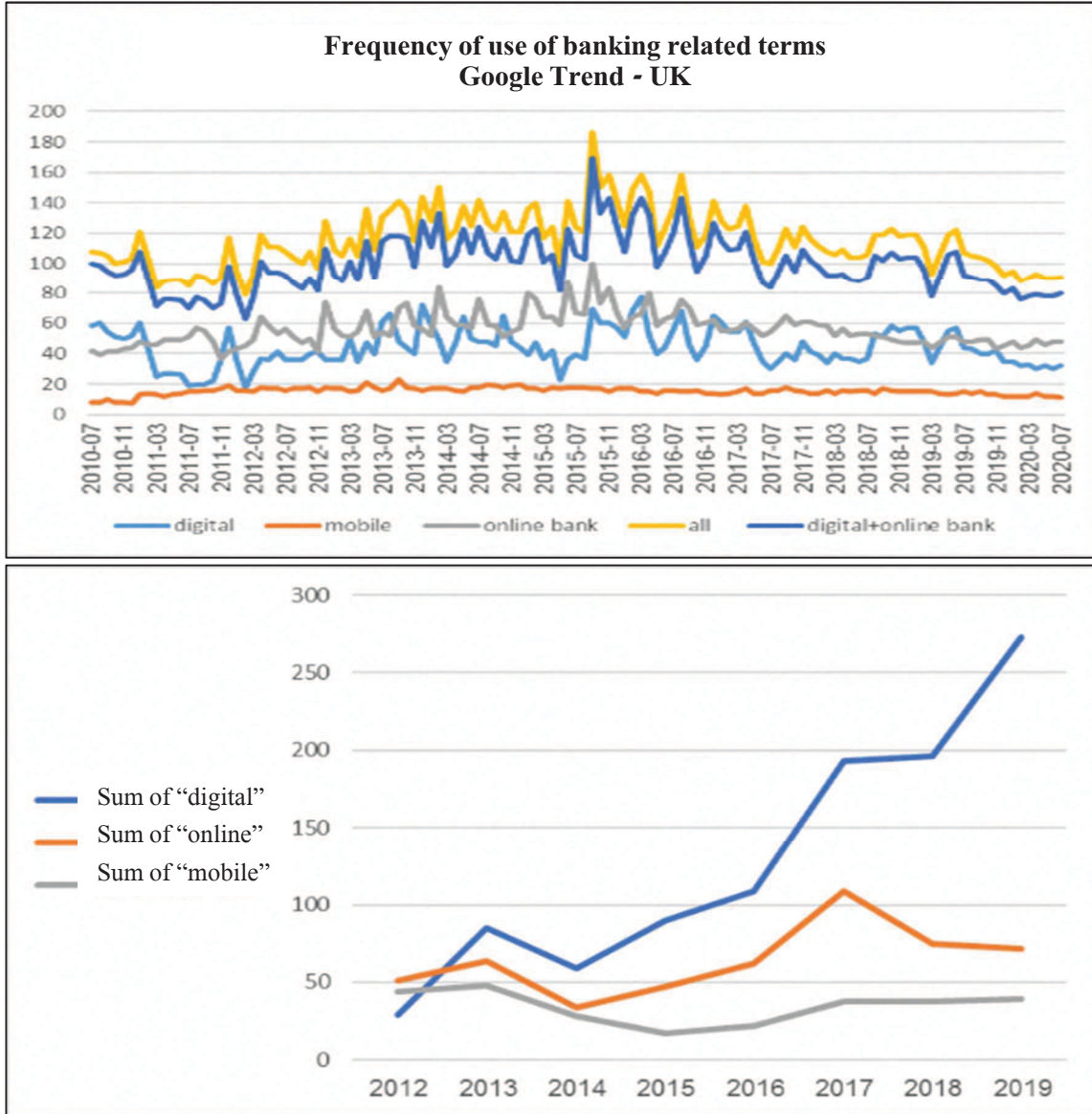
Source: Annual financial statements of the sample of banks in the study (published to the public in English).

Another issue to consider is the place of the terms in the report. Most of the terms appear in the literal part of the report, in the words of the chairman and the report of the board of directors and management. The concepts are scattered between the description of the strategy and the description of the Bank's activity in the retail context and other parts, and in years when a new strategy is published, the terms will increase in the strategy part. Hence the place in this or that part of the report is less essential to the present study, and

the simple measure can be used, which divides the number of occurrences of the term by the total number of words in the report. In many cases of text analysis, the results are not unequivocal, but in this study we found that in the years examined (2012–2019), an overall upward trend of the index can be identified, and at the same time there is considerable variation between banks within a country and between countries. Regarding the Israeli banks, we compared the development of the index with inside information regarding the rate of regulatory approvals given by the Supervisor of Banks to new products of a bank. It appears that Israeli banks that applied for approvals for FinTech products (such as payment applications) earlier than others, are on average characterized by a higher index than others. Thus, the small banks Bank of Jerusalem and Union Bank are characterized by a low index, and the index of Bank Mizrahi-Tefahot is lower than that of banks which have led in the launch of payment applications (Bank Leumi, Discount Bank and Bank Hapoalim). The First International Bank of Israel is noticeable in the increase in the level of use of terms starting only in 2017 (Figure 5).

Figure 5

Development of the index in the reports of the Israeli banks

Comparison with the reports of a Spanish bank - Banco Santander SA, which is

characterized by having a high index expectancy in the banks' sample (above 0.05)

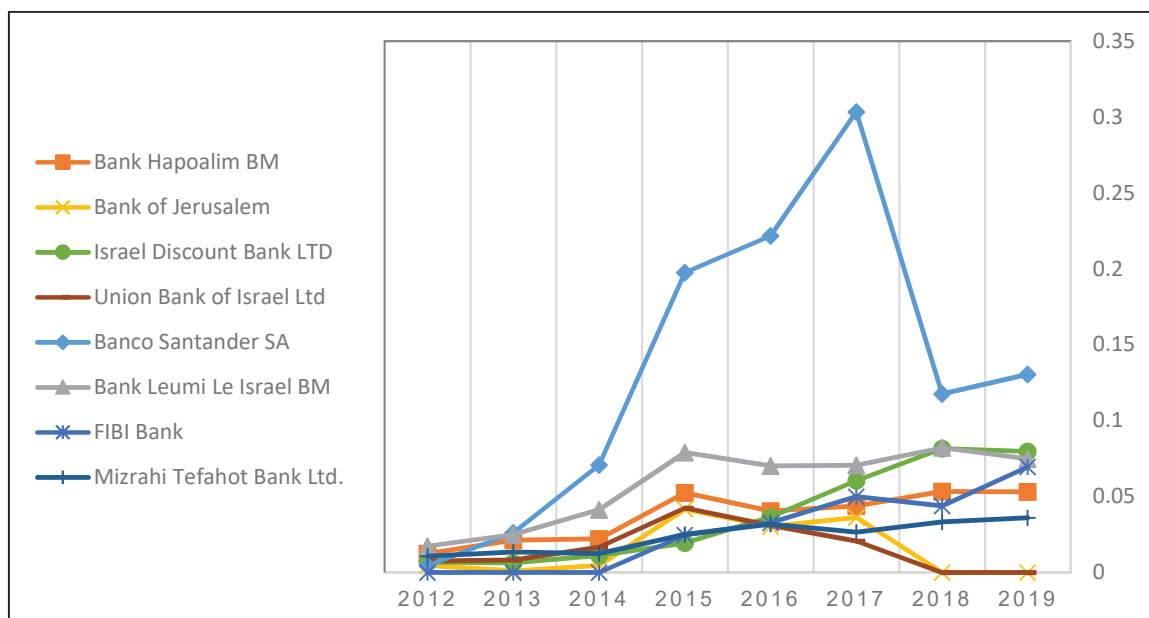Source: Annual financial statements of the sample of banks in the study (published to the public in English).

The distribution of the index expectancy over the sample shows that most of the banks in the sample are characterized by an index expectancy that is up to 0.05, but there are some notable exceptions in the higher index (Figure 6), and we examined their characteristics. (Table 3).

Figure 6

<u>Distribution of the index expectancy (vertical axis) to the Bank (horizontal axis)</u>
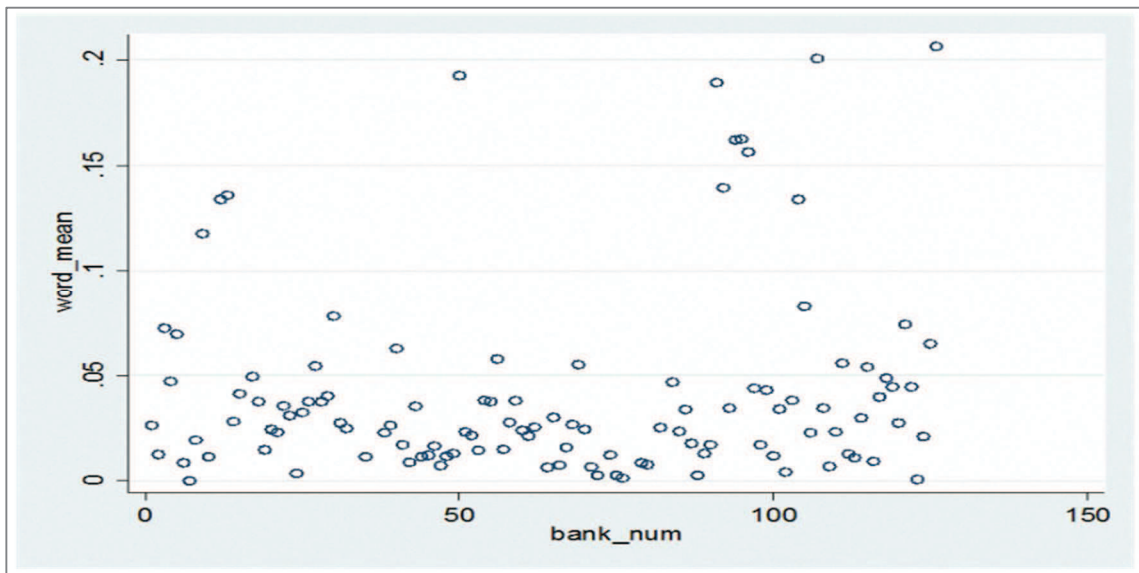
Source: Annual financial statements of the banks' sample, and research adaptations.

The five banks that are characterized by the highest index expectancy in the sample have a higher return on capital expectancy than that of banks that are characterized by a low innovation index. Banks with low index expectancy, on the other hand, are characterized by a low average return on capital, and low average operating efficiency. These findings may indicate that innovation contributes to the bank's profitability. Although at this stage of the study these are only descriptive statistics, which can be explained by the size of the bank and additional or other strategic decisions made at the bank and not necessarily by its propensity for innovation. However, the emerging picture is consistent with findings in the United States regarding the relationship between banks' FinTech brokerage activity and an increase in non-interest income (Allen, 2020).

Table 3

Comparison - The five leading banks in the propensity to innovate index compared to the five most conservative banks

	Name of the sampled bank	Income from commiss-ions fm. total operating income	Size (asset log)	Return on equity	Efficie-ncy ratio	Number of bran-ches	Rate of deposits from the assets	Text-based index of propen-sity for innovation	Country of regist-ration of the sampled bank
	"Innovators" (high index expectancy)								
1	Standard Bank	**30.51**	18.40	**15.61**	**59.36**	368	65.0994	0.2062	South Africa
2	Bankinter SA	**17.21**	18.16	**9.53**	**56.69**	437.5	54.83614	0.2005	Spain
3	Islandsbankihf	**66.35**	15.94	**10.53**	**63.28**	15.71	55.34742	0.1924	Iceland
4	Industrial Bank	**6.91**	19.21	**8.00**	**49.12**	573.6	38.63075	0.1893	South Korea
5	Shinhan Bank	**13.23**	19.38	**8.66**	**57.51**	816.85	73.32119	0.1624	South Korea
	"Conservatives" (very low index expectancy)								
1	Finbond Mutual Bank	**67.18**	11.61	**0.67**	**75.65**	437.2	66.23575	0.0007	South Africa
2	Banco di Sardegn	**34.47**	16.53	**1.68**	**72.47**	361.25	72.80588	0.0012	Italy
3	Banca Nazionale	**38.17**	18.43	**1.90**	**66.68**	845.71	48.41612	0.0026	Italy
4	Banco di Desio	**36.338**	16.46	**3.28**	**63.91**	247.75	64.30457	0.0026	Italy
5	BankNordik P/F	25.23	14.79	**4.66**	**72.15**	21.125	77.37181	0.0035	Denmark

Source: Bank Focus database.

Among the top ten banks are the sampled South Korean banks. South Korea is characterized by technological and cellular literacy. South Korean banks began providing mobile banking in the first decade of the 2000s[30], and the regulator took a neutral approach, not restricting the market. Hence a high index may reflect the impact of the environmental conditions and of the regulator in the country. Moreover, an examination of the financial statements of selected banks in South Korea, which stood out in their FinTech strategy in the annual report to the public, shows that since about 2014, there has been an improvement in the return on capital and efficiency ratio. The trends identified are particularly noticeable

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[30] As mentioned, in the early phases of the process, the banks were required to cooperate with the cellular providers, but starting in 2009 with the introduction of smartphones, which constituted a PDA and eliminated the need for cellular providers, it was enough for banks to register their applications in the Apple or Samsung application center or in an operating system like Google, and interested customers could download them to their mobile device.

at Shinhan Bank, which is one of the most prominent banks in the sample with regard to its index level (Figure 7).

Figure 7

Descriptive statistics - time variables, selected banks

(Illustration of the motion and not of the absolute size.
The image is sample-based and not systemic)

	South Korea	Israel
Text-based index for innovation		
Efficiency ratio **(Cost from income)**		
Profitability ratio **(Fees and comm-issions from oper-ating income)**		
Yield **(R0AE)**		
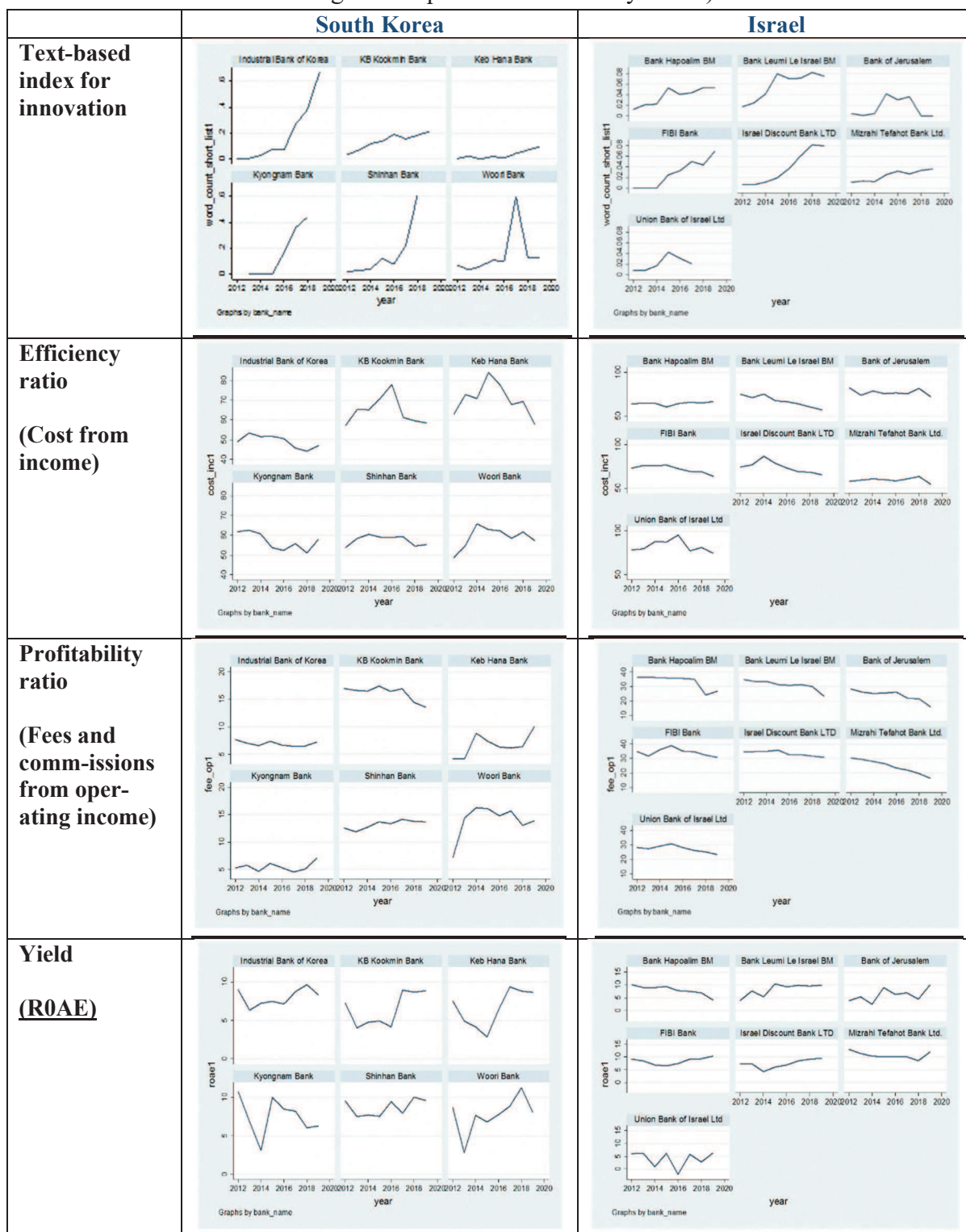
Source: Bank Focus.

Validation of the index based on the Disruptive Innovation model

It would have been called for to base the textual index using numerical financial data, which should reflect the change in business strategy, such as a change in the deployment strength of the branches. But in the early years of the Disruptive Innovation, of which this study deals with, even a firm that adopts the disruption is supposed to develop the new strategy alongside preserving and establishing the old business strategy, something which will make it difficult to identify. The characteristic of the first stage in the case of a firm with a propensity for innovation will actually be a huge cost burden. Therefore, in the early years, banks, as they also reported to the public, did not reduce the number of branches, and in some cases even added branches (including those with a digital option), because they sought to contact customers through a deployment which is as widely as possible. Branch closures and streamlining, sometimes with the encouragement of the regulator, characterized the more advanced phase of the process, as the physical connection with the customer lost its significance. Moreover, it is difficult to locate "FinTech" items in the financial statements because the reporting of investments in innovation and technology also varied from country to country, and it has changed also during that period. In addition, some of the data are reported in a qualitative manner or are mentioned in the notes, and the literal wording is not uniform (for example, there are differences between banks and countries in the level of detail in reporting on investments in computing).

We therefore chose to validate the index by comparing its development subject to the trends which were expected according to the Disruptive Innovation model. If the propensity for innovation is correlated with the establishment of the disruption, we will be expecting to obtain the following empirical results:

(1) A positive correlation between the index and the propensity to innovate per year, increasing as the years go by (as the decade progresses). This is because with the unravelment of the scope of the disruption, the possibility that the large technology companies will enter the field of banking services has become resolute.

(2) A positive correlation between the innovation propensity index and the entry of a digital bank with no branches into the market. Licensing such a bank may indicate that the disruption has escalated, that the new products have moved from the sidelines to the heart of the market, and that competition in the FinTech type banking market is increasing. In order to compete, banks will offer more innovative services, and this will be reflected in the index.

(3) Distinguishing between different business results between banks that are marked as "innovative", whose strategy expectancy is high (above 0.05) and "ordinary" banks. If a fit is found between a high index and an improvement in a bank's profitability, it will validate the index in light of the Disruptive Innovation model.

An examination of 18 sample countries in this paper shows that in about 2015 the disruption of digital banks with no branches (at different time periods) began to take root (please see Appendix B). As mentioned, the studies also reinforce what has been said about the establishment of FinTech in this period. As an indicator of the existence of a digital bank in the country, we chose the type known as Neo bank, which is, as mentioned, a bank with no physical presence, based on cloud technology, which allows the customer to open a remote account within minutes ("on boarding"). We assume that issuing a regulatory license to Neo Banks in a country indicates a high level of technological literacy at all levels - government and infrastructure, regulator and consumers.

The correlations (correlation table) between the index and the propensity of a bank to innovate, to the variables relating to the characteristics of a bank and a country and to the existence of digital banks with no branches in the country are relatively low - probably because the sample is limited in size and scope. However, they show that the index has risen over the years, and with the granting of licenses to digital banks. There is also a positive correlation between the index and the level of development and financial inclusion in the country in terms of ATMs, the deployment of cell phones and the country's investment in research and development (Tables 4 and 5). Since FinTech is, among other things, a product of market collaborations between financial entities and technology start-ups, it was observed that the level of the country's investment in development will also affect the Bank's innovative strategy, and the sample points to this possibility. The correlations point to the possibility that licensing a digital bank with no branches is responsive to market trends concerning consumers (such as the holding rate of mobile devices or Internet connectivity) and less coordinated with national strategic thinking in terms of fostering innovation in the broad sense (national investments in innovation). Also, granting regulatory approval to a digital bank can also result from pressure from the country's banking system on the regulator. It is therefore observed that the regulator will be more innovative the more innovative is the banks' strategy, and vice versa. The correlations support such an option.

Table 4

Matrix of correlations to "environmental" effects

	Propensity for innovation index	Digital bank	Concen-tration	Penetration of mobile devices	Distribution of ATMs	Investment in research	Internet implement-tation
Propensity for innovation index	**1.00**						
Digital Bank	0.28	**1.00**					
Concentration	0.06	(0.09)	**1.00**				
Penetration of mobile devices	0.28	0.35	0.06	**1.00**			
Distribution of ATMs	0.26	(0.08)	(1.58)	0.44	**1.00**		
Investment in research	0.20	(0.02)	0.32	0.27	0.44	**1.00**	
Internet utilization	0.10	0.17	(0.01)	0.06	0.28	0.33	**1.00**
2012	(0.18)	(0.02)	0.004	(0.03)	(0.03)	(0.02)	(0.07)
2013	(0.14)	(0.26)	(0.01)	(0.18)	(0.01)	(0.04)	(0.09)
2014	(0.09)	(0.26)	0.02	(0.02)	(0.02)	(0.01)	(0.05)
2015	0.04	(0.21)	0.03	0.11	0.000	0.01	0.05
2016	0.11	0.46	(0.11)	0.19	0.005	(0.01)	0.02
2017	0.27	0.53	0.063	0.26	0.06	0.08	0.15

Table 5

At the sub-sample level of a random bank from each country

	(obs=89) The largest bank (in the sample) from each country	
	Propensity for innovation index	Digital bank
Digital bank	0.25	**1.00**
Propensity for innovation index	1.00	**0.25**
"Calendar" year *	0.43	**0.67**
Investment in research	-0.002	**0.05**
Distribution of ATMs	0.10	**-0.09**
Penetration of mobile devices	0.15	**0.36**
Internet utilization	-0.13	**0.22**
Concentration	0.19	**-0.10**

* Positive correlation to a later calendar year

We conducted a test of the hypotheses for the above correlations with respect to the variable panel for a bank (i) per year (t). The test was based on the following model:

$Word\_index_{i,t} = a + b * BankSpesificFactors_{i,t} + c* MarketSpecific\ Factors_{i,t}\ or\ g* Reg * year_t + d*YR_i + f * CT_{t-1}+ + \varepsilon_{i,t}$

While Word_index i, is a measure of a bank's tendency to innovate, MarketSpecific Factors i,t are economic variables that include investment in research and Internet utilization and penetration of mobile devices, distribution of ATMs and concentration of the banking system, year * Reg is a fee variable for a digital bank with no branches, which has values of 0 or 1 for the year in which the license was obtained onwards, multiplied by the variable of the year. The last two variables are alternatives, since when adding the investment variable in the study to the equation that promotes the digital bank variable, it is not significant. CTt-1- are country variables, and YR is a constant variable per year (Fixed Effect). A significant positive correlation was found between the index of a bank's propensity to innovate and the granting of a digital bank license in the country, and the country's investment level in research and development. This result is consistent with the assumption that as the technological literacy in the Bank's environment increases, and the disruption enters the market, banks will respond by adapting the strategy to a more innovative one (Tables 6 and 7).

Table 6

Results of a Fixed Effect panel regression for the explained variable - the measure of propensity to innovation

The explanatory variable - a license for a digital bank

The propensity to innovation index	The coefficient	t	The significance
Return on equity	(0.00)	(0.66)	**0.50**
Rate of fees and commissions from operating income	**0.001**	**3.25**	**0.01**
Efficiency ratio	(0.002)	(0.68)	**0.497**
Property Log	0.014	0.74	**0.46**
Ratio of capital to assets	(0.005)	(2.13)	0.034
Loans in difficulty	0.001	1.62	0.107
Interest rate spreads	0.012	1.61	1.09
Inflation in previous year	0.001	1.75	0.081
Gross national product in previous year	-	-	-
Unemployment in previous year	0.003	1.44	**0.15**
Interest rate in previous year	0.007	1.65	0.099
Digital Bank	**0.03**	**2.78**	**0.006**
FE	Year		
Obs	573		
groups	99		
R^{2}- *within*	0.2486		
R^2*total*	0.074		
Prob>F	0.00		

Table 7

Fixed Effect panel regression results for the explained variable – the propensity for innovation index

The explanatory variable - investment in research

The propensity to innovation index	The coefficient	t	The significance
Return on equity	(0.0001)	(0.32)	**0.752**
Rate of fees and commissions from operating income	(0.0005)	(0.7)	0.484
Efficiency ratio	-	-	-
Property Log	0.0004	0.02	**0.981**
Ratio of capital to assets	**(0.005)**	**(1.81)**	0.072
Loans in difficulty	(0.0009)	(0.79)	**0.429**
Interest rate spreads	**0.019**	**1.81**	0.072
Inflation in previous year	**(0.003)**	**(1.87)**	0.063
Gross national product in previous year	-	-	-
Unemployment in previous year	(0.005)	(0.13)	**0.893**
Interest rate in previous year	**(0.005)**	**(1.19)**	0.253
Investment in research and development	**0.163**	**4.58**	**0.00**
Penetration of mobile devices	(0.0004)	(0.74)	**0.458**
Internet utilization	(0.006)	(1.18)	**0.24**
FE	Year		
Obs	380		
groups	93		
R^{2}- within	0.28		
R^{2}total	0.105		
Prob>F	0.00		

The benefit of adopting an innovative strategy

The ratio of fees and commission income to operating income serves as an accepted measure of the bank's profitability[31]. In the 1990s and 2000s, the trend of generating profits from additional activities, unrelated to receiving deposits or provision of loans, changed[32].

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[31]   Net fee and commission income to total net operating income.
Please see https://www.statista.com/statistics/1124912/net-fee-and-commission-income-to-total-net-operating-income-for-banks-in-europe/

[32]   In American banking, there were changes that affected non-interest income. A trend of reducing regulation on the markets in order to increase competition, alongside the development of communication and information technology and financial markets. Many banks have introduced technologies into products in a way that has increased non-interest income. Under the influence of the un bundling process, banks that used to compensate customers for low interest on deposits, for example by waiving fees and commissions for the use of checks and passenger checks, began to charge special fees for deposit-related services. The opening of borders between countries in the enactment of the Riegle Neal Act of 1994 and the development of an online credit extension based on credit ratings and securitization, also contributed to the increase in non-interest income, while interest rates remained low. Banks could rely on customers'

Studies have shown that market conditions and technological changes are most closely related to the increase in non-interest income (De Young) (2004). The depiction emerging from the sample indicates a positive correlation between an innovative strategy and the rate of fees and commission income from operating income (Table 8).

Table 8

Fixed Effect Panel Regression Results for Explained Variable - Rate of Fees and Commissions from Operating Income (Profitability Ratio)

Explanatory variable – Propensity for Innovation Index

Rate of fees and commissions from operating income	The coefficient	t	The significance
Return on equity	(0.27)	(0.99)	**0.322**
Rate of fees and commissions from operating income in previous year	0.45	12.88	0.000
Efficiency ratio	0.01	0.5	0.619
Property Log	1.98	1.48	0.14
Ratio of capital to assets	(0.29)	(1.56)	0.12
Loans in difficulty	(0.04)	(0.57)	0.57
Interest rate spreads	**(5.11)**	**(10.96)**	**0.000**
Inflation in previous year	**0.183**	**2.69**	**0.007**
Gross national product in previous year	-	-	-
Unemployment in previous year	(0.38)	(2.16)	**0.031**
Interest rate in previous year	**(0.21)**	**(0.7)**	**0.486**
Propensity for Innovation Index	**5.22**	**1.7**	**0.09**
FE	year		
Obs	554		
groups	94		
$R^{2\text{-}}$ *within*	0.49		
R^2 *total*	0.26		
Prob>F	0.00		

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willingness to pay a "convenience premium" for carrying out the activity via the Internet or through the ATM device. Thus, banks that have responded to changes in legislation have become more efficient, among other things, by offering fee-based products.

The question that arises is whether traditional banks that stand out in their innovative strategy relative to the rest have maintained better competitiveness. Conservative banks, which used to maintain personal contact with the customer in the branches, provided loans to weak small borrowers at high interest rates, bore higher operating costs, and therefore the fees and commissions charged increased at the same time. Hence it is expected that when the technological disruption increases, and with it the competition, their profitability will be harmed[33]. Innovative banks, on the other hand, will take advantage of their economies of scale of implementing technology and increase their non-interest income as a compensation for declining interest rates, by increasing their supply and multiplying the number of digital retail operations. At the same time, they will become more efficient, and their overall profitability will increase. For example, the rate of non-interest income from total income increased in Europe between 1989 and 1998 from 26 percent to 41 percent also as a result of technological changes (De Young, 2004; Hahn, 2008). We therefore marked the "innovative" banks (whose strategy expectancy is high: 0.05) and the "ordinary" banks. The descriptive statistics indicate a difference between those types of banks in terms of business results (Table 9), as expected in accordance with the Disruptive Innovation model. However, since the technological revolution is in full swing, these are only preliminary indications.

Table 9

<u>Descriptive Statistics – the Expectancy (Standard Deviations)</u>

		Number of banks	Propensity for innovation index expectancy	Return on capital expectancy	Profitability ratio expectancy	Efficiency ratio expectancy
"Innovative" bank	Index expectancy higher than 0.05	24	0.11 (0.05)	7.27 (8.50)	23.89 (13.78)	**65.00 (14.17)**
"Regular" bank	Index expectancy lower than 0.05	90	0.02 (0.01)	4.10 (14.93)	25.54 (13.48)	**61.77 (13.94)**

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[33] In a more recent study (Vozkova, 2016), a group of European banks was examined in the years 2007-2014, and it was found that the rate of fees and commission income of cooperative associations (Credit Unions), which are often characterized as traditional banking, is higher in a less competitive environment.

Summary and Conclusions

In this study, we sought to construct an objective international measure of banks' propensity to innovate. We found that this propensity can be estimated through a textual analysis of the banks' annual financial statements. We have built a sample based on supervised and audited annual financial statements published to the public in the English language, and we validated the index by examining its development against the expected behavior in accordance with the Disruptive Innovation model in a sector prone to technological disruption. Although the study reflects a past situation, it shows that banks differed in the level of use of "innovative" terms in their financial statements over the years, and at the level of the sample as a whole, the index did increase with the increase in the disruption. From this we conclude that monitoring linguistic development in financial statements may assist in analyzing a bank's propensity for innovation. In accordance with the Disruptive Innovation model, it is expected that infrastructure and regulation adapted to the establishment of digital banks with no branches in a country will increase the technological disruption phase in the Disruptive Innovation model, and increase competitiveness in the banking service. The empirical examination based on past data shows that the index is indeed positively correlated with the granting of a license for a digital bank with no branches in a country. The study also shows that banks whose index is high, may maintain their profitability when the disruption is being established in the market, as expected in line with the Disruptive Innovation model.

The results do not reflect an accurate identification under laboratory conditions, because the impact of the Disruptive Innovation on the banking sector has not yet been completed during the sample period. However, we have tried to understand the immediate implications of the financial technological revolution of the previous decade on banks, and what policy should the regulator adopt. The data and relationships between the variables reveal the facts and reflect the appropriate reality for the onset of a long-term change. The study points to a correlation between the policy adopted by the regulator and the level of the propensity for innovation of the banks. Hence, the regulator carries the responsibility for maintaining competition in the market in the future as well, when the large technology companies will eventually enter it.

Compared to the sampled countries in the study period (2012-2019), and in accordance with the criteria defined by the study, Israeli banks did not lead in the level of the propensity for innovation index, based on the wording of their annual financial statements,

relatively to leading banks in the world. The same is true for the large banks in Israel. However, as the establishment and operation of digital banks with no branches in Israel progress, including all of the systems and processes required for their efficient operation – along API and digital identity, this matter might have a positive effect on the index of Israeli banks.

Appendix A

List of FinTech type terms

Allen (2020) list	Shema-Zlatokrilov (2020) list	Shema-Zlatokrilov - advanced list
api	ai	**ai**
application	algorithm	**algorithm**
automate	api	**api**
automation	application	**application**
comparison	artificial intelligence	**artificial intelligence**
aggregator	bank app	**automate**
artificial intelligence	bank applications	**automating**
automating	big data	**bank app**
big data	big tech	**bank applications**
block chain	biometric	**big data**
cloud	bitcoin	**big data**
commerce	cellular	**Big tech**
crowdfunding	Chat bot	**biometric**
crypto asset	cloud	**bitcoin**
crypto currency	computerized transaction protocol	**block chain**
cryptocurrency	copy trading	**cellular**
crypto security	crowdfunding	**chat bot**
cyber security	crypto	**cloud**
data modernization	cyber	**commerce**
deep learning	digital	**computerized transaction protocol**
device	digitized	**copy trading**
digital cash	digitization	**crowdfunding**
digital lending	digitized	**crypto**
digital wallet	direct	**cyber**
distributed ledger	distributed ledger	**data monetization**
distributed ledger	dlt	**deep learning**
dlt	eidas	**device**
e- commerce	e-kyc	**digital**
ecommerce	express branches	**digital wallet**
electronic trading	fintech	**digitized**
engine	ict	**digitization**
fintech	innovation	**digitized**
initial coin offering	interface	**direct**
innovation	intermediate loans online	**distributed ledger**
Insurtech	internet of things	**dlt**
interface	iot	**e- commerce**
internet	kiosks	**ecommerce**
invest	machine learning	**eidas**
lot	mobile	**e-kyc**
machine learning	multi-channel banking	**electronic trading**

micro- insurance	neo banks	**express branches**
mobile	onboarding	**fintech**
mobile banking	online	**ict**
mobile payment	platform	**initial coin offering**
mobile wallet	regtech	**innovation**
online	regulatory sandbox	**insurtech**
open banking	robo-advisors	**interface**
p2p	smart contracts	**intermediate loans online**
peer to peer	smart speaker integration	**internet**
point of sale	smartphone	**internet of things**
programming	suptech	**kiosks**
regtech	technology	**machine learning**
regulation	two-factor authentication	**mobile**
robo- adviser	virtual asset	**multi-channel banking**
robo- advising	voice activated banking	**neo banks**
social	voice technology	**onboarding**
social		**online**
startup		**machine learning**
technology		**open banking**
technology		**p2p**
virtualization		**peer to peer**
		platform
		progrmming
		regtech
		regulation
		regulatory sandbox
		robo- advising
		robo- advisor
		regulation
		smart contracts
		smart speaker integration
		smartphone
		social
		social invest
		startup
		suptech
		technology
		telematics
		two-factor authentication
		virtual asset
		voice activated banking
		virtualization
		virtual asset
		voice activated banking
		virtualization

Appendix B

The effect of the regulator

Table 1: Indicator for the year of digital bank approval *

Country	Neo bank licensing	Digital banking – challengers or subsidiaries of existing banks or joining existing banks - examples	Year
Germany	N 26 (2016) Penta (2016) Solarisbank (2016)	Fyrst (Deutchebank) 2019	2016
Sweden	Northmill 9/2019		2016
Iceland	Indo 3/2020		2020
Canada	-	KOHO 2014 (not a bank) EQ Bank 2017 Simplii 2017	-
France	Qonto (2016)	Hello (BNP) (5/2013) Compete Nickel (2014) Orange Bank (2017) Ditto Bank (Travelex bank) (2018) Ma French Bank (La Banque Postale) (2019)	2016
Australia	Volt 2018 restricted 2019 full Xinja Bank 2019 86 400 2019		2018
Spain	Bnext 2017	CaixaBank 2016 Imagin 2016	2016
Ireland	-	-	2016
UK	Atom and Starling 2017	Monzo and Revoult (2016)	2016
Italy	-	Hype (a digital bank account by the Italian bank Banca Sella) (2015) Buddybank (UniCredit, Italy) (2018)	2016
Hong Kong	A number of banks - 2019		2019
Israel	Digital bank 2019	Paper (2017)	2019
South Africa	Tymebank 2019	BankZero (11/2018) Discovery Bank 2016 (starting 2019)	2019
Korea	KBANK 2017 KAKA0 2017		2017
Switzerland	Neon 2020 Yapeal 2020		2020
Netherlands	Bunq 9/2014		2015
Finland		Holvi (BBVA) (2016)	2016
Denmark	Lunar 8/ 2019	Hufsy (SolarisBank) 2017	2016
Austria			2016

* In the data panel, the indicator (1) is given from the year in which the bank was licensed onwards, and (0) before that time. Among European countries, although all seemingly open to innovation, and a number of European directives are designed to support this, there are differences between leading countries such as Germany, France and Spain, and other countries that are also technologically and financially developed, like Sweden, which has had a system of payments which was common to all banks since the beginning of the decade, but lagged behind in the approval for digital banks, and the last approval given for it was the product of negotiations that lasted about two years (according to the relevant publications). Notwithstanding the foregoing, for the sake of simplicity and since this is the same broad regulatory framework, the approval was attributed to the year in which the European Central Bank - gave the bank named N 26 an operating license in the EU countries - 2016.

Some would argue that in Israel it would also have been possible to take the year of "Pepper" approval as the date of approval of a digital bank, but in fact the remote identification was approved for banks only at a later stage - in 2019. Thus, reference is to the approval of Israel's first independent digital bank in 2019.

Table 2: <u>Public policy that enables the development of digital services</u>

Country	e-ID	National system for e-ID	Public system for protection of privacy	Sectoral protection system for financial cyber	A national strategy in relation to cyber	Mode of open banking access - Instructing banks to share customer data	Innovation authorities
AU Australia	+	+	+	+	+	+	Incubator + sandbox
AT Austria	+	+	+	+	+	+	Incubator
CA Canada	+	-	+	+	+	-	Incubator + regulatory sandbox + Innovation Authority
CH Switzerland	+	-	+	+	+	+	Regulatory sandbox
DE Germany	-	-	+	+	+	+	Regulatory sandbox
ES Spain	+	-	+	+	+	+	Incubator
FR France	+	+	+	+	+	+	Incubator + Innovation Authority
GB UK	+	-	+	+	+	+	Incubator + regulatory sandbox
HK Hong Kong	+	+	+	+	+	+	Incubator + regulatory sandbox + Innovation Authority
IT Italy	-	+	+	+	+	+	Incubator
NL Holland	+	+	+	+	+	+	Incubator + regulatory sandbox
ISR *	+	-	+	+	+	-	Innovation Authority

* Not present in the source.

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