Academic production and technological emergence in finance

Bibliometric study on FinTechs

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Abstract

Purpose – This paper aims to study the FinTech enterprises and the management theories related to this subject in a scientific way.

Design/methodology/approach – This study is a bibliometric study on FinTech enterprises. Its origin is a survey of 1,749 papers in 6 traditional peer-reviewed academic databases (e.g. Science Direct and Scopus) and in the "gray" literature, published by other agents and not subject to double-blind peer review. In this analysis we use three approaches: academic paper or not; journal main interest, and main purpose of the paper.

Findings – The first approach shows 45% of papers without blind review. The second approach shows no concentration on any journal. It represents no concentration on any kind of specific journal. And the third approach shows four kinds of contents in all researched papers: FinTech categorizations; FinTech related to theory of disruptive innovation; FinTech and theories of administration or economy; and finally, FinTech and regulatory and legislative aspects.

Originality/value – The findings identified the emergence of new research strands, precedence of studies of "gray" literature to explain the phenomenon, distribution of studies in different fields of knowledge (e.g. information technology, business and law) and lack of consensus in theories to explain the matter.

Keywords FinTechs, Financial technologies, Innovation, Bibliometry, Grey literature

Paper type Literature review

1. Introduction

FinTechs are an example of technological innovations competing with the traditional system of service provision, in this case, the provision of financial services. The different software and applications developed require study, not only for the use of new technologies to offer traditional services, but also for the competition and complementarity of these with the agents of the traditional financial system.

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Three factors contributed to the emergence and growth of FinTechs. The first was the emergence of new technologies such as big data, distributed ledger technology, cloud computing, artificial intelligence and machine learning (Basel Committee on Banking Supervision, 2018; Gomber, Koch, & Siering, 2017; International Monetary Fund, 2019; Jagtiani & John, 2018). These innovations have enabled the processing of higher volumes of information, increased storage capacity and automation of decisions in the financial sector (He et al., 2017), traditionally characterized as the vanguard in the application of "information technology" (IT) innovations (Arner, Barberis, & Buckley, 2015; Barras, 1990). This technological progress has generated changes in financial products, services, production processes and organizational structures (Frame, Wall, & White, 2018).

The second factor was the decrease in consumer, business and government confidence in the large banking institutions after the 2008 financial crisis (Arner et al., 2015; Larsson, Teigland, Shahryar, Moreno, & Bogusz, 2018) and the need to reduce the concentration of transactions in large banks thereafter. The third factor is associated with the adoption of new technologies by consumers, especially the new generation of digital natives (Basel Committee on Banking Supervision, 2018).

This article aims at scientifically studying the subject FinTech and the theories of administration currently associated with it from a broad bibliometric survey in academic databases. Thus, it is intended to contribute to filling a gap currently existing: the search and identification of theories of administration currently used to study this theme.

Producing science requires a systematic and organized body of knowledge in some area of understanding using scientific methods (Bhattacherjee, 2012). Studies on current topics show additional difficulties to the researcher, as they involve new technologies, academic literature is still incipient, without wide dissemination in publications with the peer-review process, and competes with the non-academic literature, "grey."

FinTechs, financial technology companies, fall into this spectrum. According to the bibliometric work of Wu (2017), the development of works related to the theme began in 2014 and the academic research on this theme is in the exploratory stage.

This article develops a bibliometric study on the subject FinTechs. The concept is emerging, therefore, not only traditional databases are researched, but also "grey" literature works. Examples of this are surveys of consultancies, publications of government agencies and works of dissemination from other agents, not subject to peer review, typical of academic publications.

The justification for this article is the need to deepen the study of FinTechs, to identify how the theories of administration are currently trying to explain the FinTechs phenomenon. A total of 1,749 publications in 6 databases (Emerald, ProQuest, Science Direct, Scopus, Web of Science and Google Scholar) were identified. Two review studies on FinTechs (Cai, 2018; Martínez-Climent, Zorio-Grima, & Ribeiro-Soriano, 2018) and a bibliometric study (Wu, 2017) stand out, which did not show which theories of administration were used more to understand these types of enterprises. This gap allows considering the subject as lacking in surveys and understanding of the theories established.

This article begins by presenting a literature review on innovation, the disruptive innovation theory and FinTechs. Next, the method and details of the steps used in the bibliometric research are described. In Section 4, the discussion is carried out and, finally, in Section 5, the final considerations and suggestions for future works are described.

2. Literature review

The FinTechs-related publications demand the conceptualization of innovation, disruptive innovation theory and FinTechs. These innovations can be characterized as incremental and/or disruptive innovation and the activities can be complementary to traditional financial agents or they can be characterized as threats to business.

2.1 Innovation

As it is a broad field of research (Damanpour, 1991), innovation should be studied from different perspectives and in an interdisciplinary manner (Fagerberg et al., 2004).

One of the most used propositions was defined by Schumpeter (1983), such as the introduction of new products, new production methods, opening of new markets, development of new sources of raw materials/inputs and the creation of new market structures in an industry.

Technological innovation was defined by Dosi (1988) as the solution of problems with information taken from previous experiences and formal knowledge. The concept involves specific and non-coded training on the part of inventors, in addition to the tacit knowledge generated in innovative activities.

A more uniform and institutional definition of innovation has been described by the Organization for Economic Co-operation and Development (OECD) (2005): the implementation of a new or significantly improved product (good or service), or a process, or a new marketing method or a new organizational method in business practices, workplace organization or external relations.

The literature differentiates innovations as radical, defined as unique and significant, or incremental, when they consist of a series of small changes that can constitute a significant change (Organization for Economic Co-operation and Development [OECD], 2005; Damanpour, 1996; Fagerberg et al., 2004; Rowley, Baregheh, & Sambrook, 2011).

2.2 Theory of disruptive innovations

One of the main associations existing in the literature for the categorization of FinTechs' innovative stage is disruptive innovations (Chiu, 2016; Gomber, Kauffman, Parker, & Weber, 2018; Larsson et al., 2018; Schuelke-Leech, 2018).

In addition to the concepts and typologies of innovation exposed, disruptive technologies are studied in the field of innovation (Organization for Economic Co-operation and Development [OECD], 2005) and their initial ideas were launched by Christensen (2013).

The author indicates that traditional technologies offer more than customers want. In addition, leading companies and more profitable customers in traditional markets ignore emerging or insignificant markets or do not want and cannot use these new technologies. Then, the disruptive technologies arise, that initially offer fewer products/services than customers actually want (or think they want).

Other examples in the literature have applications in the fields of pharmaceutical products (Sabatier, Craig-Kennard, & Mangematin, 2012), telecommunications (Boccardi et al., 2014), education (Conole et al., 2008; Sharples, 2002) and photographic equipment (Lucas & Goh, 2009). Further improvements and discussions of the concept were developed by Adner (2002), Danneels (2004), Govindarajan and Kopalle (2006), Markides (2006), Paap and Katz (2004), Schmidt and Druehl (2008) and Yu and Hang (2010).

2.3 FinTechs

FinTechs are derived from the term financial technologies and are used to describe the variety of innovative business models and emerging technologies with the potential to

transform the financial services industry (International Organization of Securities Commissions [IOSCO], 2017).

2.3.1 FinTechs and financial innovation. The Financial Stability Board defines FinTechs as financial innovations derived from technology that can result in new business models, applications, processes or products, with material effects on financial markets and established institutions (Financial Stability Board [FSB], 2017).

Puschmann (2017) defines it as an "umbrella" term, which encompasses innovative financial solutions made possible by IT. The concept also applies to startups that provide these solutions and also includes traditional financial service providers such as banks and insurance companies. The conceptualization of the term is also linked to the use of applied technology or as an aid to finance (Eickhoff, Muntermann, & Weinrich, 2018).

Schueffel (2016) seeks a common understanding of the theme by researchers and users of the concept. After researching 203 articles (peer review), he identified the conceptualization in 13 of them and, using semantic analysis, defined FinTech as a new financial industry that applies technology to improve financial activities.

The Central Bank of Brazil presents the concept as a correction of imbalances. For the institution, FinTech means identifying obsolescence and omissions in the financial market, and developing innovative solutions in response (offer) (Banco Central do Brasil [BACEN], 2018).

As for the chronology of innovation events in the financial industry that contributed to the emergence and evolution of FinTechs, Arner et al. (2015) cite three main stages.

The first (Fintech 1.0) occurred between 1866 and 1987, a period in which analog technologies were used and began with the installation of the first international transatlantic cable (1866). The second (1987 to 2008) is based on the financial connections among countries and their relations with technology, ending with the global financial crisis of 2008. The third and current stage in the evolution of FinTechs (Fintech 3.0) began in 2008 with the global financial crisis and it was motivated by the creation of FinTechs by professionals who lost their jobs in the financial area during the crisis.

A comparison between FinTechs and traditional banks was prepared by Alt, Beck, and Smits (2018). Table I shows the three levels of transformation to demonstrate the main differences between these two categories of companies in terms of "external organization," "organization of work networks" and "internal organization".

2.3.2 Categorization of FinTechs. In addition to the need to conceptualize the theme, the categorization of the subject and its subdivision into different fields of research are described by different authors. This categorization is performed by types of services offered, types of innovation, target audience and specific taxonomies.

To better represent the different dimensions of the FinTechs concept and demonstrate the diversity of services offered by these companies, Eickhoff et al. (2018) created a taxonomy for the division of business models based on six dimensions (dominant technology, value proposition, delivery channel, consumers, revenue flow and product/service offering).

Another taxonomy, proposed by Drasch et al. (2018), used 136 cases of cooperation between banks and FinTechs and interviews with 12 bank professionals to study FinTechs, regulators and consultants. The results were divided into six different dimensions: type of cooperation, type of innovation, innovation maturity, location of the value chain, business ecosystem and holder of innovation.

Another taxonomy was developed by Gimpel, Rau, and Röglinger (2017), with 15 dimensions related to the perspectives of interactions, data and monetization, generated

Level of transformation	IT-using banks (until around 2008)	FinTech (after 2008)
External organization		
Regulation	Low need for equity capital and low supervision	Stricter rules and less protection
Business model innovation	Business in offline agencies and services	Online and mobile services
Infrastructure governance	Centralized institution as a focal firm	Distribution of tasks
Payment style	Most customers use cash money	Reduction of cash payments
Organization of working networks		
Networking	Small number of partner networks	Many specialist partners
Costs: margins and structure	High margins in the core business	Reduced margins and increased competitiveness
Competitors	Other traditional financial service providers	Startups and side entrants
Culture	Hierarchical	Cooperative and agile
Customer retention	High consumer loyalty	Low switching costs
Internal organization		
Business focus	Process-oriented	Centralized in the consumer
Interaction with consumers	Initially offline	Initially online and multiple channels
Key competences	Distribution, products and transactions	Online distribution and platforms
Vertical integration	High integration	Low integration
Service portfolio	Banks as general service providers	Small diversified suppliers
Automation	Processes require manual steps	Fully automated processes
IT architecture	Monolithic systems and internal development	Modular systems and application programming interface

Source: Alt *et al.* (2018)

Table I. Comparison of FinTechs in three levels of transformation

from the analysis of 227 FinTechs from different countries oriented to end consumers (business to consumer).

2.3.3 State-of-the-art of FinTechs research. Based on searches in the following databases, Emerald, ProQuest, Science Direct, Scopus, Web of Science and Google Scholar, two previous literature review articles (Cai, 2018; Kim et al., 2016) and a bibliometric survey (Wu, 2017) on the current state of research on the topic were identified.

The bibliometric article by Wu (2017) conducted searches in the institute for scientific information - Web of Science database and identified 80 keywords used in publications on the concept. He mentions that the articles published with the term started in 2014 and the main areas covered were "payments" (25.65 per cent); "deposits and loans" (25.54 per cent); "insurance" (17.29 per cent); "capital increase" (14.35 per cent); and "investments" (13.67 per cent).

The article by Cai (2018) contains a bibliographic review of the terms "crowdfunding" and "blockchain," while that of Kim et al. (2016) conducted the application of topic modeling in the study of the theme. The latter has greater adherence to studies in the area of computer science.

As it is a subject related to development, implementation and execution of information systems, part of the published literature has a closer relationship with the areas of IT and others related to it. An example of this are the articles by Eickhoff et al. (2018) and Gai, Qiu, and Sun (2018).

3. Method

This article follows an exploratory quali-quantitative approach because of the initial ignorance of the important variables to be examined (Creswell, 2010). This lack of knowledge does not derive from the reduced scope of research, but from the fact that it is a new theme, without association with established theories and still little explored by the academic literature.

The bibliometric approach, is a science field that aims to group and interpretate of statistics related to books and publications (Pritchard, 1969). In the area of new technologies, this technique is not only used to quantify the academic production on specific topics, but can also be applied in the forecast of new technologies (Morris, DeYong, Wu, Salman, & Yemenu, 2002; Li, Zhou, Xue, & Huang, 2015).

The strictly quantitative treatment via bibliometric metrics and the exclusive use of peer-reviewed articles could disregard recent and relevant articles in the area, a justification also used by Schueffel (2016). Thus, the selection did not consider only the evaluation (rating) of the analyzed publications, quantity of citations of the studies used as references or only articles approved by the peer-review system. To privilege the exploration of the theme and the ideas associated with the concept also through the insertion of articles from gray literature was sought.

The gray literature is classified as those materials publicly disclosed and not subject to the traditional peer-review process, and it can be used as a way to expand the scope of searches, insert updated materials on the concept studied and enable new discussions on the research theme (Adams et al., 2017). This literature includes business reports, works for discussion, guides to procedures and business reports, and it is considered as a timely and comprehensive source of information (Lawrence et al., 2014).

3.1 Research steps

The research steps began with the formulation of the research problem, followed by the construction of hypotheses about the problem found, as described by Creswell (2010).

The issue of the article approaches how to research the FinTechs phenomenon in an administration academic way and what the main theoretical approaches are in the field of theories on administration that the published articles/books use to analyze the subject.

The first approach is about the existence of an initial literature not strictly academic to disseminate and analyze the phenomenon. The second concerns the initial production of articles with preponderance in the IT area, because FinTechs show the technological base as one of its principles. The third and last approach contemplates the existence of initial exploratory and preliminary studies on these types of companies, such as theoretical articles and with FinTechs categorizations.

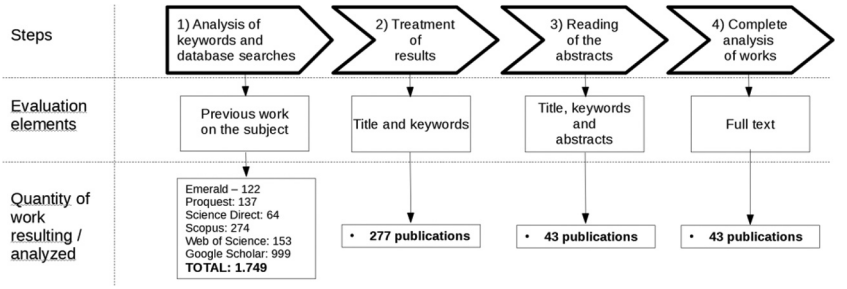

Figure 1.
Flowchart with the research steps

Source: Prepared by the authors (2019)

The bibliographic survey was composed of four steps for the final selection of works, which resulted in the complete analysis of 43 articles/books. The treatment and analysis of references were performed in the software Publish or Perish version 6.35 and the steps are described in Figure 1.

The first step consisted in the analysis and selection of the keywords to be used for the search, which resulted in the terms "FinTech," "FinTechs" or "Fintec*." The term "Financial Technologies" (or equivalent) was not adopted because of the scope of the concept, which does not necessarily cover only the articles associated with FinTechs.

By using these keywords, surveys were conducted in the scientific publications databases, Emerald (122), ProQuest (137), Science Direct (64), Scopus (274), Web of Science (153) and Google Scholar (999 articles), which returned 1,749 results between 25/09/2018 and 23/10/2018. The choice of six different databases was made in an attempt to contemplate as many studies as possible (Harzing & Alakangas, 2016), despite the existence of an overlap between the sources (Vieira & Gomes, 2009). Google Scholar was used for its growing relevance in literature review articles, as highlighted by Haddaway et al. (2015).

In the second step, treatment of the results, the reading of the title and keywords for framing according to the research theme was performed. To consolidate the database, duplication exclusions, articles in the fields of knowledge not included in the research (e.g. medicine, psychology and biology), inconsistent records (e.g. blank names) and those related to IT development tools were performed. This treatment resulted in a new file composed of 277 articles published between 2014 and 2018.

In the third step, reading the abstracts, the 277 abstracts of the works obtained in the second step were read to select the articles best related to the topic of interest. This phase also considered (but was not restricted) the existence of the publication score in the Scientific Journal Ranking, number of citations in the databases of scientific publications used, the origin of the article (government institutions, central banks and international organizations) and adherence to the research theme. The database resulted in 43 articles.

In the fourth step, the 43 articles located in the third step were read and analyzed. The results of this analysis were divided into three analysis approaches, detailed in Section 4 – Discussion.

4. Discussion

This chapter shows three analysis approaches (divided into topics), resulting from the reading of the 43 articles originating from the final selection, performed from the bibliometric data located and identified in Figure 1. These approaches are related to the types of articles, concentration of articles and interest lines of publications and treatment of the subject by selected articles.

The first approach consists of dividing the origin of articles into two categories, characterized by peer-reviewed scientific journal articles or by articles classified as gray literature.

The second approach investigates the thematic division of publications and demonstrates the areas of interest of those that have the largest numbers of articles published and selected for composition.

In the third approach, articles were identified and commented according to the focus and treatments given to FinTechs, such as categorization, theories used and regulation/legislation.

4.1 Type of publications

The analysis of references resulted in Table II, with the 20 most evidenced works among the 1,749 records resulting from the search for keywords.

Authors	Title	Publisher	Thematic orientation	Type	Number of citations
Demiürguç-Kunt, A., Klapper, L., Singer, D., Ansar, S., Hess, J. (2018)	The Global Findex Database 2017: Measuring Financial Inclusion and the FinTech Revolution	*World Bank*	Finance/ Banking	Book	1167
Arner, D. W., Barberis, J. N., Buckley, R. P. (2015)	The evolution of FinTech: A new post-crisis paradigm	*University of Hong Kong Faculty of Law Research Paper*	Management	Article	148
Philippon, T. (2016)	The fintech opportunity	*NBER Working Paper Series*	Finance/ Banking	Working Paper	84
Buchak, G., Matvos, G., Puskorski, T., Seru, A. (2018)	FinTech, regulatory arbitrage, and the rise of shadow banks	*Journal of Financial Economics*		Article	80
Dapp, T. (2014)	FinTech–The digital (r) evolution in the financial sector	*Deutsche Bank Research*	Finance/ Banking	Working Paper	58
Nienaber, R. (2016)	The FinTech book: the financial technology handbook for investors, entrepreneurs and visionaries	*John Wiley & Sons*	Finance/ Banking	Book	55
Shim, Y., Shin, D. (2016)	Analyzing China's fintech industry from the perspective of actor–network theory	*Telecommunications Policy*		Article	54
Gabor, D., Brooks, S. (2017)	The digital revolution in financial inclusion: international development in the fintech era	*New Political Economy*		Article	54
Channon, D. F. (1977)	British banking strategy and the international challenge	*Macmillan*	Finance/ Banking	Book	51
Gai, K., Qiu, M., Sun, X. (2018)	A survey on FinTech	*Journal of Network and Computer Applications*	Information Technology	Article	50
Banque de France (2018)	Financial stability review	*Banque de France*	Finance/ Banking	Working Paper	48
Mackenzie, A. (2015)	The fintech revolution	*London Business School Review*	Finance/ Banking	Working Paper	48
Peters, G., Panayi, E., Chapelle, A. (2015)	Trends in cryptocurrencies and blockchain technologies: a monetary theory and regulation perspective	*Journal of Financial Perspectives*	Finance/ Banking	Book	48
Dapp, T., Slomka, L. (2015)	FinTech reloaded–Traditional banks as digital ecosystems	*Deutsche Bank Research*	Finance/ Banking	Working Paper	44

Table II.
Twenty works most evident in the databases analyzed

(*continued*)

Authors	Title	Publisher	Thematic orientation	Type	Number of citations
Zeng, Y., Chiang, R, H. L., Yen, D. C. (2003)	Enterprise integration with advanced IT: ERP and data warehousing	*Information Management & Computer Security*	Information Technology	Article	43
Guo, Y., Liang, C. (2016)	Blockchain application and outlook in the banking industry	*Financial Innovation*	Finance/ Banking	Article	42
Skan, J., Dickerson, J., Masood, S. (2015)	The Future of FinTech and Banking: Digitally disrupted or reimagined	*Accenture*	Finance/ Banking	Working Paper	37
Gomber, P., Koch, J. A., Siering, M. (2017)	Digital Finance and FinTech: current research and future research directions	*Journal of Business Economics*	Finance/ Banking	Article	36
Arner, D. W., Barberis, J., Buckey, R. P. (2016)	FinTech, RegTech and the reconceptualization of financial regulation	*Northwester Journal of International Law and Business*	Law	Article	35
He, M. D., Leckow, M. R. B., Haksar, M. V., Griffoli, M. T. M. (2017)	FinTech and financial services: initial considerations	*IMF Staff Discussion Note*	Finance/ Banking	Working Paper	32

Source: Prepared by the authors from 1,749 initial references

Table II.

It was found that 55 per cent of the papers (11) were not published in peer-reviewed academic journals, and only nine articles were published in this means of academic dissemination. From 11 papers in the gray literature, 7 are "working papers" from public and private institutions and 4 are books published by electronic and digital means. Instead of raising concerns about the non-academic origin of the works related to the subject, the survey reflects the specific dynamics of the industry in which FinTechs are inserted, characterized by agility in the use and dissemination of information.

Given the possibilities of emerging technologies associated with the theme, it can be considered, as demonstrated in the articles by Dietz, Moon, and Radnai (2016), Dombret (2016), Gomber et al. (2017) and Drasch, Schweizer, and Urbach (2018), that the study of FinTechs shows the opportunities and concerns of the agents involved in the future of the banking industry.

4.2 Concentration of articles and interest lines for publications

The second approach divided the 43 articles selected in the fourth step (Figure 1) according to the title and subject of the publications. From 39 different publications/books found, the maximum concentration identified was three articles per publication. The scientific journals with the most published articles were *Journal of Economics and Business*, with three articles, and *Electronic Markets* and *Financial Innovation*, with two each. Table III lists the seven articles concentrated in the three main publications.

The *Journal of Economics and Business* (three articles – in press) focuses on finance and economics studies. Its interest is in related topics (industrial and financial structure of companies, insurance, monetary policy and financial markets).

As for *Electronic Markets*, it covers several aspects of the digital economy and is interested in business networks enabled by IT (digitalization). Finally, *Financial Innovation* also seeks innovative studies on research in finance. Its main topics covered are derivatives, asset pricing/hedging and disruptive models.

The reading of the objectives, vision and focus of the remaining 27 publications revealed a division into 3 main research interest lines: business (13), IT (10) and legislation (2). It is important to clarify the allocation of the two articles in the area of legislation, which demonstrates the concern of the work with the regulation and preparation of standards to enable the stable development of the sector. By region, the sites with the highest number of publications were the USA (17), UK (8), Germany (5) and Holland (4).

The distribution of articles in different publications can be explained by the fact that it is an emerging concept and still little explored academically (Wu, 2017; Puschmann, 2017; Schueffel, 2016) or the lack of a broader definition of the subject (Anagnostopoulos, 2018; Dorfleitner et al., 2017; Eickhoff et al., 2018; Gimpel et al., 2017; Larsson et al., 2018; Zavolokina, Dolata, & Schwabe, 2016).

4.3 Treatment of the subject by the selected works

In this third approach, after reading and analyzing the content of the articles/books, different treatments given to the subject were identified. Among these different ways/views of analysis of FinTechs, four stands out, which are described in Table IV.

Authors	Title	Year	Source
Jagtiani, J., Lemieux, C.	Do fintech lenders penetrate areas that are underserved by traditional banks?	2018	*Journal of Economics*
Anagnostopoulos, I.	FinTech and regtech: Impact on regulators and banks	2018	*and Business*
Drasch, B. J., Schweizer, A., Urbach, N.	Integrating the Troublemakers: A taxonomy for cooperation between banks and fintechs	2018	
Alt, R., Beck, R., Smits, M. T.	FinTech and the transformation of the financial industry	2018	*Electronic Markets*
Gimpel, H., Rau, D., Röglinger, M.	Understanding FinTech start-ups - a taxonomy of consumer-oriented service offerings	2017	
Zavolokina, L., Dolata, M., Schwabe, G.	The FinTech phenomenon: antecedents of financial innovation perceived by the popular press	2016	*Financial Innovation*
Li, Y., Spigt, R., Swinkels, L.	The impact of FinTech start-ups on incumbent retail bank's share prices	2017	

Source: Prepared by the authors (2019)

Table III. Concentration of articles published by journal

Article focus	Year 2015	2016	2017	2018	Total
Categorization of FinTechs	1	3	5	5	14
Theory of disruptive innovation		3	4	5	12
Relationship with the theories of administration/economics	1	2	5	2	10
Regulation/legislation	1	2	1	2	6
Total	3	10	15	14	42

Source: Prepared by the authors (2019)

Table IV. Treatment of the FinTechs theme by the analyzed articles

In the next four topics, the works that sought to categorize FinTechs, relate them to the "theory of disruptive innovation," using the theories of administration to understand the theme and analyze the subject according to regulatory aspects and legislation, are commented.

4.3.1 Categorization of FinTechs. The 14 articles classified as "Categorization of FinTechs" sought to divide the activities performed, tools used and the environment in which these companies are inserted in specific categories. For this purpose, the 14 articles compare the services and products offered by FinTechs with those made available by the established banks.

In these categorizations, the four most commonly cited types of products/services are loans/financing, investments, value transfers and insurance. Examples of articles that used this division are Wu (2017), Arner et al., 2015 and Mittal and Lloyd (2016).

Divisions and classifications were also described, which are distinct from those described above. These descriptions involve, for example, tools and the environment in which companies are inserted, such as those presented in the articles by Eickhoff et al. (2018) and Gomber et al. (2017).

4.3.2 Theory of disruptive innovation. The mention that relates FinTechs to the "theory of disruptive innovation" (and its variations) appeared in 12 of the 43 selected works. Examples of articles with this analysis are Chiu (2016), Dorfleitner et al. (2017), Gomber et al. (2018), Larsson et al. (2018) and Zalan and Toufaily (2017).

Puschmann (2017) treated this relationship with the development of a conceptual framework with three dimensions. In this model, the author differentiates FinTechs as to the type of innovation (disruptive or incremental), scope of innovation (intra or inter-organizational) and object of innovation (business models, product/service, organization, process or system).

A concern about the use of the "theory of disruptive innovation" in these types of companies, cited by Anagnostopoulos (2018), says that additional data are needed to understand the phenomenon in a deeper way and also offer regulatory solutions for this category of business.

4.3.3 Relationship with management/economics theories. Out of the ten articles that exposed the relationship between FinTechs and theoretical approaches to administration and related sciences, four of them stand out: FinTechs and the theories of the diffusion of innovations Wonglimpiyarat (2017), FinTechs and institutionalism Larsson et al. (2018), FinTechs and two-sided markets (Jun & Yeo, 2016) and FinTechs and banking microeconomics (Financial Stability Board [FSB], 2017).

Among the 43 articles selected, only 10 (23 per cent) explain their theoretical approaches. This can be explained by the incipiency of the theme, still in the development of ideas and categorization phase, without consensus of the most appropriate theories and methodologies to study the phenomenon.

4.3.4 Regulation and legislation. The articles by Arner et al. (2015), Chiu (2016), Dombret (2016), Anagnostopoulos (2018), Lagarde (2018) and Financial Stability Board (FSB) (2017), deal with the regulation of FinTechs and show concern with the dynamics inherent in these companies. This becomes more evident when three of these studies published by regulatory agencies or government financial institutions are verified.

The emerging concept and the insertion of the topic in the financial market environment raise concerns about the legislation to be adopted. This can be verified by the existence of articles that address the regulatory aspects of FinTechs also in publications in the area of "law and regulation," as they operate in a segment subject to systemic crises and show fewer barriers for entry than conventional banks, as described by Financial Stability Board (FSB)

(2017), these types of companies show several types of risks to the financial system, mainly related to IT, which demands agility from regulators.

5. Concluding remarks

The academic production on FinTechs, as shown in Table II, started in 2014 and, as well as its object of study, can be considered recent. The research in the works not belonging to peer-reviewed publications (gray literature), 55 per cent of the 20 most cited articles in the databases analyzed, was justified because of the emergence of the theme and the concern in not disregarding recent and relevant works in the area, as justified by (Schueffel, 2016).

It is natural that initial research of a non-academic nature should be carried out prior to academic studies. The articles published in scientific journals go through peer review and result from complex research, supported by theories and methodological basis. Thus, the time required to meet these procedures may cause the response time of academic studies to emerging phenomena to be longer than that provided by the analyses that do not pass through this screen, such as the disclosures via gray literature.

In the analysis of the 39 publications where 43 articles were published, there was a multidisciplinary coverage, such as the existence of 10 publications in the area of IT/computer science and 2 in the area of law/regulation.

Thus, as shown in Table IV and in Section 4.3, there is no consensus within the theories of administration for the treatment of the subject: these are categorizations, conceptual/empirical tests and analyses of possible regulatory solutions for understanding the phenomenon. The use of gray literature was also useful to seek new areas of research capable of assisting in this understanding.

The selected books, despite not being peer-reviewed works, show a wide range in the treatment of concepts associated with the theme and expand the range of analysis beyond the restricted views of academic publications. Thus, they are presented as important manuals for the dissemination, understanding and categorization of concepts associated with FinTechs. The "working papers," which make up the "grey literature," are composed of works by regulators and multilateral institutions to analyze the phenomena of FinTechs, the current banking legislation and suggest possible changes in this legislation to protect the market against possible negative impacts from these new companies.

The categorization of FinTechs, subject of 14 out of 43 articles analyzed, seeks to situate the phenomenon, compare the activities of these companies with those of existing banks and classify the main differences among them, which can serve as a basis for new research. The growth in the number of articles published with this purpose, from one in 2015 to five in 2018 (Table IV), demonstrates a growing effort of the authors to provide subsidies for the study of the theme.

Regarding the use of theories to explain the phenomenon, some applications and concepts were found to direct the research. The theory of disruptive innovations, cited in 12 of the 43 articles analyzed (Table IV), was the most used in treating the phenomenon, which allows comparison with the emergence of other industries that did not exist before or were not theoretically conceived.

Other theoretical approaches in the areas of administration and related sciences, such as "institutional theory," were used in 10 of the 43 articles analyzed (Table IV). This fact characterizes the search for more theoretical definitions of the phenomenon as an important gap and an opportunity for researchers.

From the first publications, when it was sought to conceptualize the subject, to the most recent ones, there is the emergence of new research areas, such as small and medium enterprises, regulatory aspects, acceptance of technologies and the deepening in specific

sectors (e.g. payments and value transfers) of this new industry. This change in perspectives can be explained by the evolution of research on the subject. Even at an early stage, it goes beyond conceptual aspects to experiment with more elaborate forms of investigation.

Considering this evolution in research, it has highlighted the fact that two of the three journals with the largest number of publications (*Electronic Markets* and *Financial Innovation*) analyze the digital economy and publish innovative studies on research in finance. This indicator can demonstrate an initial interest in the aspects of FinTechs, which can be followed by more in-depth analysis of the impacts of these new companies using the "management theories".

In short, FinTechs can be characterized as incremental innovations because they improve and diversify financial services, but they can also be characterized as radical innovations because they eliminate some traditional financial services. The technology used by FinTechs tends to be disruptive because it threatens the traditional structure of financial agents. The most obvious categorization is about FinTechs as service providers similar to traditional financial agents (e.g. credit, collection and investments), but using new technologies and differentiated means of interaction with the target audience.

Although the analysis of impacts and perspectives are not the objective of this work, FinTechs can also be considered as a fragmentation of the products/services offered by multiple banks, which can generate changes in the competitiveness of the financial market. Thus, the prospects for the competitive impact of FinTechs depend largely on the structure of diversification of products/services by the incumbent banks and the legislation of the countries in which these new companies operate.

In Brazil, for example, the largest banks are multiple institutions in an industry with a high concentration and wide range of products/services. As for regulation, the current legislation on payment systems, peer-to-peer lending, open banking and cryptoactive will be the master line that will allow the analysis of the impacts of FinTechs on the financial industry.

Therefore, as a suggestion for future research studies, revisions of works on the categorization and identification of companies such as FinTechs, association of the term with the "theory of disruptive innovations" and the identification of eventual associations of the subject with theories in the field of administration to reinforce the legitimacy of the concept can be considered.

To stimulate discussions in the field of the emerging new technologies, it is possible to approach the dissemination of publications of gray literature as antecedents of these new technologies. In addition, how the transition of knowledge of these types of publications to peer-reviewed academic publications occurs and how this can reveal signs of maturation of the new technologies studied can also be analyzed.

Another research line can deepen the impacts of FinTechs on the traditional financial system or, in another way, one can research how traditional financial agents are incorporating FinTechs into their business models.

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