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Financial Innovation

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Can we have a general theory of financial innovation processes? A conceptual review

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Abstract

Introduction: Since the financial crisis of 2008, the theory of financial innovation has been a focus at a time of re-evaluation and re-conceptualization. However, little has been done to evaluate the current state of research considering the increasing complexity of financial innovation. This paper examines the hypothesis of a general theory that encompasses increasing complexities in the financial innovation process.

Methods: The paper begins with an overview of the definitions, the features, and the classification schemes of financial innovation. Additionally, the paper reviews the existing literature on the main objects of study in financial innovation and groups the findings under four main concepts. A conceptual analysis is presented that evaluates current approaches to the study of the financial innovation process and the difficulties inherent in constructing a single general theory. The paper proposes a framework based on a meta-theory of financial innovation as a better approach to understanding the inherent complexities and diversities affecting financial innovations.

Discussion: (1) Financial innovations present diversities and complexities that make it infeasible to build a unifying general theory to explain their development. (2) The current state of research on financial innovation theories is limited and requires additional input. (3) A meta-theory that identifies, classifies, and connects theories of development for financial innovations is better suited to explaining the complexity of financial innovation processes.

Keywords: Financial innovation process, Complexity, Meta-theory, General theory

Introduction

Increasing attention has been paid to the subject of financial innovation since the last financial crisis of 2008. Despite the wide acceptance in the literature of the benefits of financial innovations to the real economy (e.g., Finnerty, 2001; Levine, 1997; Merton, 1992; Shiller, 2012, 2013; Van Horne, 1985, 1986, 1992), the crisis of 2008 made financial innovation a focus at a time of re-evaluation and re-conceptualization (Engelen et al., 2010, Greenwood and Scharfstein, 2013). Some researchers claim that the misuse or abuse of financial innovations were factors leading to the 2008 financial crisis (Boz and Mendoza, 2014; Hausman and Johnston, 2014). Other researchers examine what became known as the "Dark Side" of financial innovations (Allen, 2001; Diaz-Rainey and Ibikunle, 2012; Henderson and Pearson, 2011). Allen (2001) finds empirical evidence suggesting

that financial innovation increases the complexity of transactions that provide opportunities to explore questions of interest of consumers of financial services.

For these reasons and others, a wave of pessimism has arisen concerning the long-term effect of the increasing complexity of financial innovations. Additional regulation (Acharya et al. 2010) calls for responsible financial innovation, and good governance has also been notably on the rise (Armstrong and Muniesa, 2012; Asante et al. 2014). On the other hand, the market competition for financial innovation is undergoing several changes due to the financial innovations of Fintech startups that, in many cases, promise to deliver better and safer services than traditional financial institutions.

These factors and others create new challenges for the management and regulation of financial innovations. Therefore, a more detailed understanding of the complexity of the financial innovation process becomes a crucial element in the new market context. Shiller (2009) argues that bad complexity should be distinguished from good complexity. Nevertheless, as several authors note (Anderloni and Bongini, 2009; Frame and White, 2004), studies on financial innovation are few and do not provide a consistent framework for understanding the financial innovation process.

Mention and Torkkeli (2012) recently suggested the need for a more holistic approach to the study of financial innovation. By addressing the questions of what, why, and how, the authors open what they call the financial innovation black box that highlights the unique characteristics of financial innovation and shed light on how innovation occurs in financial services. This present paper goes a step further by noting that there is a need for a more detailed theory on financial innovation; one that addresses the increasing complexity of the financial innovation process derived from factors such as the development of technology, institutions, the startup revolution, and historical and economic variables. The importance of such a detailed theory of financial innovations is also justified by the recent evolution of innovation management towards a "*contextual approach,*" where innovating companies adapt their innovation practices to their context (Ortt and van der Duin, 2008) rendering innovation a complex adaptive process.

The hypothesis that this paper is conceptually discussing is whether it is possible to construct a unifying theory that explains the process of financial innovation in general and, if not, the alternative to a general theory. By general, we mean a theory that can encompass the observed complexities and diversities in the financial innovation process. To answer this question, we follow the research method proposed by Poole and Van de Ven (1989, 1995). Poole and Van de Ven examine the variety of theories proposed to understand organizational change and innovation. The authors investigate how to make sense of the multiplicity of these theories The authors further suggest that instead of trying to stipulate one general theory as the best choice to explain innovation, it would be more informative and useful to consider a set of theories and models that can be combined and adapted to understand innovation and change. We believe that this research method is suitable for understanding financial innovations for two main reasons: first, financial innovation is a multifaceted process involving different actors and perspectives and incorporating different and dynamic generative mechanisms. Second, several theories have been proposed to explain financial innovation. However, confusion still exists as to when they apply, what their limitations are, and how they relate to each other.

This paper begins with a discussion of the meaning of financial innovation. We provide an overview of the existing classification schemes. We then turn to exploring the differences between financial and other types of innovations, and we describe features that are unique to financial innovations. In the next section, we identify and examine the existing objects of study in the financial innovation literature; we group the identified objects of study under four main concepts and illustrate the degree of development of each. We argue that the existing approach, which relies on isolated objects of study of financial innovation, is likely to lack several of the theoretical connections and complexities that are essential to understanding and managing financial innovations; thus, making it difficult for a single general theory of financial innovations to emerge. In the last section, we introduce the concept of meta-theory of financial innovation, by identifying and explaining four theories of development. We provide several examples of how this approach results in more detailed and complex theories that better explain the phenomenon of financial innovation and close with a conclusion and some recommendations for future research.

Definition, classification, and features of financial innovations

What is financial innovation?

Understanding the process of financial innovation requires defining the concept of financial innovation. In layman's terms, financial innovation can be defined as innovation in the financial services industry. This, in turn, suggests the need to understand innovation in general and how it plays out in finance as crucial elements defining, more technically, the term "financial innovation." As far back as the 1930s, the economist Joseph Schumpeter defined innovation as the introduction of new or qualitative change in existing products, processes, markets, sources of supply of inputs, and organizations (Arthur, 2009). This definition suggests that innovation encompasses a "creation activity" focused to a large extent on the element of "newness" (Damanpour, 1991; Nohria and Gulati, 1996; Boer and During, 2001). Despite this, Baumol (2002) goes a step further and highlights that innovation, which can be incremental or disruptive in nature, transcends creation to include adoption; thus, promoting the argument that innovation is often a complex, multi-actor process. Bessant (2013) describes this as "knowledge spaghetti" where commercialization and diffusion of the innovation in practice is necessary for valorization (Tidd et al., 1997). These general notions of innovation have influenced the classification of financial innovation as most researchers (Llewellyn, 1992; Sibler 1975; White, 1997; Tufano, 2003; Mishra, 2008; Gubler, 2011; Lerner and Tufano, 2011) accept the definition of financial innovation as the creation and the popularization of new financial products, processes, markets, and institutions.

Although this definition suggests that financial innovation includes a broad spectrum of things. The use of the word popularization connotes a focus on specific types of financial innovations, which creates confusion. This is because popularization implies a need for the innovation that has been created to be widely understood and accepted by society. While this may apply to financial innovations such as those in the products category – their value is based on their individual properties and their acceptance by a group of people as a representation of value (Nightingale and Spears, 2010) – process innovation and regulatory innovations in financial services, or innovations in financial

theory, may not need user approval to be considered financial innovations. To this end, we believe that a minimal definition of financial innovation could be the following:

> *Financial innovation is a process, carried out by any institution, that involves the creation, promotion and adoption of new (including both incremental and radical) products, platforms, and processes or an enabler of technologies that introduce new ways or changes to the way a financial activity is carried out.*

Implicit in our definition is the argument that financial innovation does not necessarily come from financial institutions. Innovations such as Amazon's one-click payments, Blockchain, PayPal, and others are all financial innovations that came from non-financial institutions. On the other hand, the proposed definition is not limited to innovations in the securities or financial instruments segment and can be extended to include all classes of financial innovations that we explain in the next section.

How to classify financial innovations?

Classification of innovations is an active research subject in the innovation literature, and we encounter several challenges when we attempt to classify financial innovations. The first challenge is derived from the decision on how to define financial innovation. Many authors start with the premise that financial innovations are products and services innovations. Thus, the classification adopted focuses mainly on the type of financial innovations (Iwamura and Jog, 1991; Batiz-Lazo and Woldesenbet, 2006; Oke, 2007) where innovations are grouped primarily under products or processes. Within the product category, some researchers create further sub-groups using factors such as product types, their functions, or characteristics as criteria for their groupings (Anderloni et al., 2009). Process financial innovations involve the creation of new ways or the introduction of changes in the way a financial activity is carried out and delivered.

The second challenge faced when classifying financial innovations is that several financial innovations can serve multiple goals and fall under more than one class. This can happen when a functional approach to financial innovation classification is adopted (Finnetry, 2001; Llewellyn, 1992; Merton, 1992; Merton, 1995a; Tufano, 2003). The functional approach classifies financial innovations according to their contribution to the functioning of the financial system, that is, their purpose. Some of the frequent criteria used are:

- *Transaction costs reduction*
- *Transferring and sharing of risks*
- *Risk pricing*
- *Liquidity management and enhancement*
- *Enhancing credit generation and availability*
- *Equity generation*
- *Insurance*
- *Asset and liability management*
- *Funding of financial institutions*

Using a different classification scheme (based on motives), Llewellyn (1992) also categorizes financial innovation into four main categories: (i) *defensive* (as a response to regulation and policy); (ii) *aggressive* (the creation of new financial products that financial institutions believe can be successfully promoted and sold.); (iii) *responsive* (when a financial institution develops a new instrument or service order to meet a change in clients' portfolios), and (iv) *protective* (when portfolio constraints of institutions force them to adopt new techniques or instruments).

While the categorization of financial innovation by type and motive can be more general, the grouping of financial innovations by function seems to focus narrowly on securities innovations. Nevertheless, all three approaches assume that financial innovations come from financial institutions only, ignoring the fact that some of the most recent innovations come from non-financial institutions.

Another issue with the classification of financial innovations is the decision to include those innovations that are not per se the end of financial markets in the sense that they are not the final product to be sold and exchanged. We can perceive these innovations as "enablers." The most notable financial enablers are the proliferation of sophisticated mathematical models (e.g., Louis Bachelier's theory of speculation, Markowitz's mean variance of portfolio selection model, the capital asset pricing model (CAPM), the Black-Scholes model for options pricing, and the Gaussian copula model for probability distribution, which have become central to modern finance (particularly investments and capital markets) in the last two decades (Merton, 1995b). These models have played a significant role in the advancement of innovations within the derivatives industry, risk management, asset management, diversification processes, investment banking, corporate banking, and others. Additionally, regulatory innovations such as limited liability, fractional reserve banking, and capital adequacy rules can also be classified as enabling financial innovations because they enable the system to accommodate sustainable financial innovations. Other examples of financial innovations within the enabler class are financial software and information technology (e.g., coding the personal identification number (PIN) verification system that expedited ATM development (Harper and Batiz-Lazo, 2013), near field communications, advancements in the computational power of computers, data collection, and telecommunications, which led to the development of algorithmic trading (Kirilenko and Lo, 2013). Financial indices could also be perceived as enablers. For example, much of the growth in markets, such as credit derivatives, would not be possible without the development of pricing benchmarks such as the LIBOR swap curve.

What features are unique to financial innovations?

A theory of financial innovation must capture the features that are unique to financial innovations. Since financial innovation is a creative activity, it is reasonable to assume that it shares many of the main elements of non-financial innovations. However, as Mention and Torkelli (2014) suggest, financial innovations possess unique features that should be considered if we are to design, manage, and implement innovation processes and strategies sustainably. In the paragraphs that follow, we outline and briefly discuss key features that can be identified from the literature.

Financial innovations are legally non-patentable

Intellectual property rights can play a significant role in stimulating innovation in a society (Al-Sharieh and Mention, 2013). Nevertheless, Lerner (2006) argues that until recently, most financial innovations were typically considered ineligible for patent protection. Although there have been some patenting instances of financial innovations (Hunt, 2010), Lerner (2010) shows that obtaining such a patent is not an easy task because patents on financial innovations are highly litigated. According to Crotty (2008), one of the consequences of non-patentability is the introduction of complex products that are difficult for rivals to copy; and this has the potential to increase the opacity of financial innovations.

Financial innovations have a short lead time

A review of the literature (Reidenbach and Moak, 1986; Drew, 1995; Beard and Dougan, 2006) suggests that most financial innovations have a significantly shorter lead time (on average, 12 months) compared to technological innovations with lead times of years to decades: Odgers and Nimmervoll (1988) suggest that significant technological innovations normally have an average lead time of twenty years. Associated with short lead times for most financial innovations is rapid diffusion in society. Therefore, Llewellyn (1992) argues that financial products have a shelf life measurable only in days due to the fast-paced nature of the financial sector and the ease with which most financial innovations can be copied (Llewellyn, 1992; Lerner, 2006). In many cases, the feature of short lead time is a consequence of non-patentability. We note that the feature of rapid imitation seems to apply only to certain types of financial innovations. Innovations relating to organizational structures and operating systems (Rossignoli and Arnaboldi, 2009), or those in the process category, (Mention and Torkelli, 2014) are much harder to copy than innovations in the product category.

The feature of rapid diffusivity for some financial innovations is a crucial one, particularly when we consider Collingridge's (1982) concept of the dilemma of control, that is, a situation where, at the early stages of the development of a technological innovation, innovators find it difficult to predict all the social consequences of their actions due to insufficient knowledge or foresight. However, when undesirable consequences become visible, the innovation may become locked in with limited ability for control. Short lead times may leave little room for understanding risks and responding before widespread diffusion and lock-in occurs. Nevertheless, it is important to note that there are some financial innovations that took time to diffuse; mainly because they emerged after a long trajectory. An example of this is the diffusion of modern financial risk management (focused mainly on *value at risk* models), which began in the 1970s (Guill, 2016) and took until the 1990s to diffuse among financial institutions as the benchmark for risk management.

Decomposability and adaptability

Another feature of financial innovations, which seems to apply mainly to financial instruments, is their combinatorial nature. By combinatorial, we mean that the underlying structure of financial innovations can consist of a combination of claims. One consequence of this feature is the unbundling of instrument characteristics in ways that allow users of financial innovations (such as investors and borrowers) to pick and

choose features of the instrument they desire (Llewellyn, 1992). Another consequence is the high speed of change in financial innovations by simply making new combinations (Lerner and Tufano, 2011). According to Herrera and Schroth (2004), a financial innovation deal (particularly with credit derivatives) must undergo further incremental changes to meet client specifications and improve product quality. This suggests that financial innovations tend to be adaptive and highly customizable to market needs (Rajan, 2006). It is not clear, however, whether this adaptive nature applies to financial innovation in general or to specific sectors or categories. Zachary (2011) finds that financial innovations that are traded in the market are standardized while those created by banks for their clients could be customized. Although the discussion on incremental innovation, combination, and complexity as a feature of financial innovation appears to relate more to innovations in the products category, Mention and Torkelli (2014) suggest that process innovations could also be incremental in nature.

Financial innovation involves multiple stakeholders but with limited customer involvement

Financial innovation involves multiple stakeholders, including individuals, financial and non-financial firms, governments, markets and exchanges, and technology-related companies. All may be involved to varying degrees as innovators, intermediaries, and/or end users. Therefore, Mention et al. (2014) purport that financial innovation can emerge within financial institutions and outside of financial institutions as they work with partners. Lerner (2006) argues in favor of collaboration as a unique feature of financial innovation citing the syndication of a financial innovation and the development and promotion of securities as examples. A notable example is the collective development of modern financial risk management for which the interaction between and among banks and regulators has been intensive (Bernanke 2006). Nevertheless, evidence from a study conducted by Schueffel and Vadana (2015) shows limited use of the concept of open innovation in the financial sector and, in the few instances where it has been used, customer involvement in co-creation appears limited (Akamavi, 2005).

Financial innovations create complex interdependencies

Financial innovations, particularly those in the products category, create and operate through complex and often multi-layer networks that, in turn, give rise to a high degree of correlation and interdependence (Allen and Babus, 2008). There are different possible sources of interconnection between financial innovations. For instance, banks are directly connected through interbank loans and other balance sheet holdings with financial institutions. Similarly, holding similar assets or sharing the same portfolio or the same depositors can create indirect linkages between financial institutions. Tumminello et al. (2010) show that financial markets present networks of correlation and hierarchies that express dependence among similar assets. This implies that the event of the failure of one or more troubled financial institutions could trigger a contagious collapse of otherwise healthy firms and the entire financial system. This feature of financial innovation renders the assessment of the social consequences of financial innovation a challenging task (Lerner and Tufano, 2011).

Analyzing the process of financial innovation

When investigating financial innovations, different subjects attract the interest of different stakeholders (Flood, 1992). These interests range from management's desire to optimize security design, regulators' desires to understand the consequences of financial innovation on economic stability and scholarly interest in clarifying the process of financial innovation. After reviewing the objects of study in the financial innovation literature, we find four groups of inquiry that have been the focus of researchers: *measurement, emergence, diffusion,* and *evolution*. We refer to this as an object-based research approach since it relies mainly on the identification of different and isolated objects of study in financial innovation and the development of detailed models of investigation. In this section, we analyze each object of inquiry by illustrating the level of development of each object. We outline the shortcomings of the object method and explain why it is unlikely that a general theory of financial innovation processes will emerge from this research strategy. We then explain an alternative to general theory that results in a more detailed and dynamic approach.

Measurement

The first object of study that researchers have focused on concerns the measurement of financial innovation. Although the task of measuring innovation entails several challenges and complexities, subjects have suggested several theories that clarify what financial innovation is and its entity and effects. Notable are the ideas of Joseph Schumpeter, who argues that innovation consists of novelty, that is, the creation of completely new products and services (Schumpeter 1961). However, his definition excludes the fact that innovation does not necessarily consist of totally novel things; innovative activities that cause relatively small changes in product performance may also have important economic and technological consequences (Rosenberg, 1976) as they may accumulate over time and result in significant changes (Tidd et al., 1997). Thus, Llewellyn (1992) acknowledges that not all financial innovations are entirely new; rather, the newness of some financial innovations comes from the unbundling and reassembling (reengineering or re-purposing) of the characteristics and risks of existing instruments to form different combinations. In other cases, newness in financial innovation is not derived only from creating something that does not already exist but also from using existing instruments, practices, and technologies in new ways (Bhole and Mahakud, 2009) that may change over time (Gubler, 2011; Lerner and Tufano, 2011). This suggests that while, in general, the concept of newness in defining innovation applies to financial innovation, what "new" means is not commonly accepted. Findings from a study of 684 firms by Johannessen et al. (2001) show that newness in innovation is a one-dimensional construct that differs only by the degree of radicalness, and this degree of newness or novelty derived from radicalness is inherently subjective (Tufano, 2003).

Another challenge concerning Schumpeter's definition is the complexity involved with observing financial innovations. In the literature on non-financial innovations in manufacturing, researchers observe mostly R&D figures, patents, R&D expenditures, or the share of research staff as measures of innovative activity (e.g., Cohen and Klepper, 1996 and Helpman, 1992). Crucially, R&D activities in the financial sector are not

extensively documented by the institutions who spend on financial innovation (Frame and White, 2004; Lerner, 2006). In a recent study, Beck et al. (2016) collect data on country level R&D expenditure by the financial intermediation sector and created two measures of financial innovation. The authors call the first of these financial measures R&D intensity (value added), which is represented as the ratio of the amount spent on R&D over the value added in the financial intermediation sector. The second measure is referred to as financial R&D intensity (cost), which is the ratio of financial R&D over banks' total operating costs. In contrast, Lerner (2006) takes another approach to the measurement of financial innovation by analyzing new stories in the Wall Street Journal.

Another common way for measuring technological innovation is the functional approach, where the examiner observes not the innovation itself but the desired effect of innovation. For example, Farmer and Lafond (2016) measure innovation in the energy sector indirectly by analyzing the reduction in costs of production of different forms of energy and attributing a decrease in costs to innovation. A similar approach can be applied to test the effect of financial innovations on, for example, economic growth (Levin, 1997), increasing liquidity (Hendershottet al., 2011), volatility reduction (Dynan, 2006), reduction in transaction, search and monitoring costs (Freixas and Rochet, 2008), wider access to credit (Ilyina and Samaniego, 2011), and risk sharing (Allen and Gale 1994) among others. The problem with this approach when applied to financial innovation is complexity. Financial innovations can be so complex that understanding them and their effects is non-trivial. In analyzing complexity in financial innovation, Awrey (2012) used an approach based on information to identify six drivers of complexity in financial innovation: technology, opacity, interconnectedness, fragmentation, regulation, and reflexivity. The author successively examined in detail these six drivers by aggregating them in three categories: "those influencing our capacity to process information, those impacting the availability or intelligibility of the information itself and, finally, those accelerating the velocity of informational change." The information factor is crucial in measuring financial innovations, and Arora et al. (2010) showed that when computational complexity is involved, financial innovation can favor information asymmetries even with complete transparency.

A further challenge with the Schumpeterian approach is that new does not necessarily translate to "*Better*" (Keith, 2006; Silber, 1983). In finance, we can perceive an innovation as any new financial product, process, or paradigm introduced by a financial or non-financial institution. However, the challenge is to distinguish between better or worse financial innovations. Importantly, financial innovations such as products are not subject to approval tests as are products from the pharmaceutical industry (Haliassos, 2013). Financial institutions might have a lot to lose in terms of reputation and trust should they decide to experiment with new financial products on their customer and, unlike doctors, financial advisors often lack the necessary information to assess the true needs of their clients. Even if experts understand the true needs of their clients, they may not have an incentive to recommend the right financial products. Moreover, financial innovations can be hard to test before they are taken to market as they entail an essential component, which is the inter-temporal transfer of value through time (Goetzmann and Rouwenhorst, 2005). Thus, the effect of financial innovation is to be seen in the future. Finally, unlike other forms of innovation (e.g., technological and

scientific innovation) where the impacts on health and environment can serve as one possible basis for testing, broader and undesirable (and systemic) impacts associated with financial innovation can be more difficult to conceptualize and anticipate (Lerner and Tufano, 2011).

Emergence

The second object of study that has received attention in the financial innovation literature is the question of how financial innovations emerge and why they are initially developed (Frame, 2010). Financial innovations emerge as the result of complex interaction between and among the needs of households to save and borrow, to meet the financing needs of firms, to meet the need to identify and manage risks, to respond to advances in financial theory and information technology, to serve the profit motives of the financial sector, and finally as a response to macroeconomic and regulatory factors (Haliassos, 2013). Additionally, different financial innovations can have different emergence patterns according to whether they are products, platforms, or processes. This aspect has been ignored in the literature.

Several interpretations have been proposed to account for the emergence of financial innovation. In economics, the standard account of the drivers of financial innovation is the rationalist view that we could place in Proposition I of the Modigliani and Miller (M&M) irrelevance theory (Awrey, 2013). Proposition I states that the value of a firm is based on its profit generation ability plus the risk of its underlying assets. The M&M theory holds only in the presence of strong assumptions on market imperfections. These imperfections include asymmetries of information, adverse selection and agency problems (Myers and Majluf, 1984), incomplete markets (Duffie and Rahi, Duffie and Rahi 1995; Tufano, 2003; Van Horne, 1985), regulation and taxes (Miller 1986), and other frictions that constrain the ability of market participants to maximize their utility and would require financial innovations to reduce them (Tufano, 2003; Allen and Gale, 1994; Harris and Raviv, 1989; Ben-Horim and Silber, 1977). In parallel with the M&M theorem, the works of Markowitz on modeling risk, Eugene Fama on efficient financial markets, William Sharpe on quantifying the worth of an asset, and Black, Scholes, and Merton on the value of risk paved the way for innovations to emerge in finance (Mandelbrot and Hudson 2007). The M&M theory has two shortcomings. First, the prevailing view in M&M theory is demand driven, and this ignores the fact that financial innovations can represent technology push, meaning that they can emerge independently of market demand factors. The push-pull debate dominated the technological thinking for some time (Dosi, 1982). A conclusion has been reached among industrial technologists according to which both factors (push and pull) are important (Dosi, 1982; Mowery and Rosenberg, 1979). Following this conclusion, the shift has been toward understanding the mix of economic, political, institutional, and technological factors that underlies innovations (Van den Ende and Dolfsma, 2005). In the financial innovation literature, the matter is still open. In a recent study by Andrei Shleifer and others, dominance of the demand-driven view suggests that clarification has not yet been achieved in finance (Gennaioli et al., 2012). The demand-side view of financial innovation has received criticism since it

ignores the incentives of the financial institutions for financial innovation (Awrey, 2013). In Engelen et al., the authors discuss the need to rethink the concept of financial innovation that relies mainly on the neoclassical rationalist view of market demand. The authors proposed the following definition of financial innovation:

> *the outcome (or the emergent property) of the accidental coming together of structural preconditions, conjunctural situations and a repository of techniques, heuristic devices, and skills that together form the resources of the cadre of (successful and unsuccessful) bricoleurs whose innovation is constructing chains (2010, p.57).*

Diffusion

Diffusion of innovations is a theory that seeks to explain why and how innovations are adopted by participants in a social system and the characteristics of those users (Rogers, 2010). The concept of diffusion of financial innovation as a third object of study appears to have received more attention in the financial literature. Among the most notable studies of financial innovation diffusion is Tufano (1989). He found that an innovation diffuses through imitators who try to copy profitable innovations introduced by banks. The diffusion of financial innovation can happen rapidly, particularly with innovation in the securities class (Cavanna, 1992). As a feature of financial innovations, non-patentability is the main reason behind this fast diffusion.

The diffusion of financial innovations can have different patterns and different speeds when different types of innovations are examined. For example, ATMs took several decades to diffuse. Other financial innovations such as microfinance and inflation-indexed bonds also took longer to diffuse.

The diffusion of financial innovation is important both in promoting the process of "collective acceptance" (i.e., where financial products are valuable not because of their individual properties but because a collective group of people accepts their status as a representation of value (Nightingale and Spears, 2010)) and in ensuring corporate and societal return on investment from the innovation (Frame and White, 2004). Further, financial innovations benefit from diffusion since liquidity depends on the number of institutions using an innovation (Merton, 1995a). The standardization of risk language is another example of how financial innovations benefit from diffusion.

In the existing literature on the diffusion of financial innovation, a review by Akhavein et al. (2005) reveals only seven quantitative studies that examine the diffusion of financial innovations (Hannan and McDowell, 1984, 1987; Sinha and Chandrashekaran, 1992; Saloner and Shepherd, 1995; Molyneux and Shamroukh, 1996; Ingham and Thompson, 1993; Gourlay and Pentecost, 2002). The first four of these studies used the same data on ATMs where the lines of inquiry focused on factors such as speed and the mechanisms behind the diffusion, characteristics of adopters and users, and notions that certain technologies may win over others due to technological lock-in and positive feedback (Cecere et al., 2014). Compared to the larger, older, and more varied literature on non-financial innovations, studies on the diffusion of financial innovation are non-exhaustive and require more investigation.

Evolution

In most studies that use the concept of diffusion, there is an implicit assumption that the innovation being adopted has reached its final development or commercial stage. However, innovations can change their content, their shape, become more detailed, and evolve into different forms through time. In this case, we use the concept of "*evolution*" of innovations. The issue here is not simply why and how certain technologies are adopted but to understand the mechanism behind the temporal evolution of innovations as though they are living organisms undergoing mutations and recombination (Arthur, 2009). The study of the evolution of financial innovations has received little attention and remains one of the most challenging research areas. In technology studies, one of the most accepted definitions of evolution is Joseph Schumpeter's combinatorial evolution (Schumpeter 1961). In financial literature, some researchers suggest that financial innovation is an incremental and recombinant process (Allen and Gale, 1994; Llewellyn, 1992; Anderloni et al., 2009; Lerner and Tufano, 2011). Most notable is a study by Merton (1992) that describes the process of financial innovation as a "spiral process" in a situation where the creation of one financial product leads to the creation of a new financial product. Persons and Warther (1997) model this spiral process analytically. In a recent field study, Asante et al. (2014) confirm the recombinant nature of financial innovations, but no empirical studies have explained the financial innovation process from an evolutionary perspective. According to Kauffman (1990), there could be two possible reasons behind the lack of evolutionary studies of innovations. First, researchers find it convenient to assume that technologies evolve because of "network externality," meaning factors outside the economy itself. Second, the evolution of innovations, which happens mainly through combination, requires the decomposition of products or services into complements and substitutes, and this is a difficult task. This difficulty is particularly pronounced for many financial innovations since they entail high levels of complexity (Zachary, 2011; Awrey, 2012). Using network analysis, Arora et al. (2010) prove that structured financial products entail a high amount of opacity and complexity that makes it extremely difficult to decompose them into their constituent parts. Finally, the high confidentiality of data on financial innovations makes it difficult for researchers to trace their temporal evolution.

Nevertheless, there is evidence that the financial sector is still growing and evolving. For example, Kirilenko and Lo (2013) find that finance exhibits a Moore law behavior of its own. Between 1929 and 2009, the market capitalization of the US stock market doubled every 10 years. The trading volume of stocks in the Dow Jones Industrial Average doubled every 7.5 years during this period. Philippas and Siriopoulos (2011) showed that financial innovations have not yet reached the point of diminishing returns. Therefore, we believe that more research and data collection are needed to explore the evolutionary patterns of financial innovations.

Meta-theory in the study of financial innovation processes

The need for a meta-theory

The object-based approach presented in the previous section has several shortcomings. First, it does a poor job distinguishing which development patterns, from emergence to adoption to evolution, apply to which financial innovations. The drivers that may lead

to the development of financial innovations can vary according to the type of financial innovation, geographical space, and time and regulatory framework. For example, in eighteenth century America, geographical distance was a major driver of financial innovations in banks while, today, distance has a marginal effect on financial activities (Davis, 1975). In another study, Su and Si (2015) observe different innovation patterns across countries with different levels of economic freedom. The second shortcoming concerns the role of institutions, which, like human behavior, has received little attention in the financial innovation literature until very recently. In 1975, William Silber proposed a general theory of financial innovation that is based mainly on the hypothesis that new financial instruments or practices are developed to lessen the financial constraints imposed on banks (Silber, 1975). However, Silber's approach is neoclassical in nature, does not account for the role of institutions in the financial innovation process, and is likely to apply only to certain classes of financial innovations. Finally, by focusing on isolated objects of study, we are likely to miss important connections and transitions that are characterizing most innovation processes (Poole et al., 2000). For example, the diffusion of certain financial innovations (e.g., those that are significantly disruptive, new to market, and technological in nature, such as ATMs (Arthur, 2017)) can take significant time because they must undergo several evolutionary phases before they become attractive for potential adopters. Thus, the interaction between diffusion and evolution results is important.

Relying on a single theory to explain and effectively manage financial innovations is not sufficient given the complexities and high diversity of financial innovations. For this reason, we believe that no general theory of the entire financial innovation process from beginning to end is likely to emerge from this strategy. To overcome these shortcomings without pretending to have a general theory of financial innovation, we adopt a second strategy that is based on the development of a meta-theory. By meta-theory, we mean a theory about financial innovation theories. In this perspective, the first question we pose is the following: "*What is the function of a good meta-theory of financial innovation*?" To answer this question, we build on the research method proposed by (Poole and Van de Ven, 1995) to understand and analyze innovation processes with their associated complexities. In their paper, Poole and Van de Ven propose a method that relies on the development of four basic theories that can serve as building blocks to explain the process of organizational change and innovation: *life cycle, teleology, dialectics,* and *evolution.* These theories represent different sequences of changes that are driven by different development motors at different levels in organizations. The analyzed method also identifies the circumstances under which different theories apply and shows how the combination of elements from these theories can lead to more complex theories of innovation and change processes. Since financial innovations entail high levels of complexity and the existing objects of study are not sophisticated enough to explain the multifaceted nature of financial innovation, we believe that the research method of (Poole and Van de Ven 1995) is suitable for explaining financial innovations.

Another question that may arise here is what should characterize a good meta-theory of financial innovation? As Poole and Van de Ven (1989) eloquently explained, a good theory should define its statement of scope where the scope conditions specify why a theory is suitable to explain certain phenomena, the circumstances under which the theory works, and the limitations of the theory. It is reasonable to assume that no

useful theory will apply to all cases, always, and under all circumstances. Following this logic, this paper claims that a good meta-theory of financial innovation must specify the structure of a suitable theory of financial innovation and indicate what the theory should accomplish. Building again on the reasoning of Poole and Van de Ven (1989), we posit that to describe the process of financial innovation is to describe its development, and an explanation of how things develop requires a theory of development. Therefore, a good theory of financial innovation must (1) specify the type of theory that drives the development of financial innovations and (2) illustrate the inter-level connections between these theories. The second element in the development of a meta-theory of financial innovation is the identification of the conditions under which certain models are adequate to explain a financial innovation and how and when to switch between models to explain a financial innovation process at a given point in time.

The next section represents the first step toward this approach. We believe that this approach, when modeled and performed properly, reflects the criteria for a good meta-theory. It also provides a flexible way to better address the complexity of the financial innovation process and avoid generalizations.

Topology of financial innovation development models

After examining the diversity and complex nature of financial innovations, and by building on the four objects of study analyzed in section 3.1, we have identified four development theories that may constitute the building blocks for a meta-theory of financial innovations: *life cycle theory, the evolutionary theory, economic theory,* and *institutional theory*. For each of these theories, we examine different models as illustrated in Table 1.

The first theory is the life-cycle theory. According to Poole and Van de Ven (2000), the main assumption in the life-cycle theory is that innovation is a sequence of events occurring within a system that has a goal or end state toward which it moves over time. This is usually referred to as immanence. Initially, this approach relied on natural laws, which assert that each step is an evolution from the last. In the financial literature, the process of financial innovation has been frequently described as a continuous process driving the financial system toward a predefined goal. Merton, for example, sustains that financial innovations could be perceived as a continuous spiral process that is driving the market toward "*an idealized target of full efficiency*" and "*toward the theoretically limiting case of zero marginal transactions costs and dynamically complete*

Table 1 Financial innovation development theories

Evolutionary	Life Cycle Theory
• Optimization	• Natural Laws
• Combinatorial Evolution	• Immanence
• Natural Selection	• Logical Necessity
• Self-Organization	Institutional Theory
Economic Theory	• Regulation
• Demand side	• Financial Architecture
• Supply side	• Innovating Institutions
	• Behavioral approach

markets" (Merton, 1995a). The life-cycle theory emphasizes the need to place the financial innovation process in a historical perspective, which some studies have attempted. For example, in (Goetzmann and Rouwenhorst, 2005), the authors analyzed financial innovations in the last 4000 years using a historical approach that they called "financial archeology." The authors relied on survived documents to draw their conclusions on financial innovations. Consequently, one of the main conclusions of the authors was that the historical development of financial innovation has focused mainly on achieving three goals: the inter-temporal transfer of value through time, the ability to contract on future outcomes, and the negotiability of claims. This is an example of how financial innovations are sequences of events geared toward a known end.

Another source of immanency in conceptualizing the life-cycle theory is logical necessity (Poole and Van de Ven, 1995). Logical necessity means that one historical step constitutes a logical requirement for the next. For example, singing requires the ability to speak a language. Many of the financial innovations could be classified as a sequence of events where each step necessitates the previous step. For example, the development of risk management first required the identification of a problem, then the advancement in financial theory, then the availability of data, the consensus of regulators and, finally, the implementation of computers.

The life-cycle holds as a theory of development when the history of financial innovations shows some continuity and non-opportunistic behavior. If financial innovations appear suddenly as a market reaction to some changes in the form of opportunist products, the life-cycle of the innovation is too short to have a history and does not follow a well-defined developmental course (Philippas and Siriopoulos, 2011). Instead, innovations such as financial risk management, stock exchanges, investment banking, and financial theory are better understood in the context of their long history. The life-cycle theory is more general in nature since it typically relies on describing the process of innovation as a move from one stage to another. When there is high complexity surrounding the process of innovation, the life-cycle model exhibits less explanatory power. As Poutanen et al. note:

> *The innovation process has been historically understood as a linear sequence of events, but in reality, it is clearly much more intricate and complex, including unpredictable interactions between different phases (market situation changes due to the intervention), multiple stakeholders with varying needs, and collaboration that blurs the boundaries between different entities and participants' roles* (Poutanen et al. 2016, p.207).

We consider the ATM a suitable example to explain the life-cycle theory. This is because its development, as explained in an earlier paper on ATMs by Arthur (2017) and by Harper and Batiz-Lazo (2013), involved a continuous sequence of events over a long period of 18 years. We could argue that the development of the ATM began with an innovation outside of the financial sector, the development of automation and its use in retail services. This was an event in history that created a logical necessity for the use of automation in financial services following pressures on financial institutions in Europe and the United States to limit Saturday banking and branch expansion activities, respectively. Thus in the early twentieth century, bankers, engineers, and end-

users began efforts to create a secure and reliable automated system that would allow users to perform basic but primary financial transactions at any time. Events in the transition from ideation to commercialization involved device design, the development of associated verification systems such as PINs (personal identification numbers) and PANs (personal access numbers), and enhancement of device capabilities. Each step in the development process was an evolution of previous designs, security systems, and functional capabilities. Therefore, while the first version of the ATM, for example, could only dispense cash, newer versions could do much more including accept deposits and print balances. Additionally, advancements in information and communication technology have led to additional add-ons to the ATM. The latest units are web-enabled, modular, and have memory storage features that allow the customization and coordination of payments across financial institutions.

Another essential branch of thought in explaining financial innovation is *economic theory*. Economic theory states that the demand and supply of financial innovations are the results of market players trying to overcome limitations such as transaction costs, information asymmetries, and other forms of market frictions in addition to the profit motives of the shareholders. Economic theory entails four main models. The first two models are the demand model and the supply model. The idea here is to decide whether a financial innovation occurs due to market demand for new financial innovations that require institutions to innovate to satisfy this demand, or, financial innovation is something that emerges independent of market factors. Some researchers note that financial innovation is a combination of supply and demand and market player's limitations (Ross, 1989; Harris and Raviv, 1989; Duffie and Rahi, 1995). However, as we mentioned in section 3.2, the view of supply versus demand in financial innovation emerged following the crisis of 2008 (Awrey, 2013). The demand for financial innovations can originate from the client side in the form of household need to borrow and invest money or firm demand for innovative ways to hedge risks and reduce taxes. Demand may also originate from the innovator side, for example, financial firms facing external or internal constraints. Examples of external constraints include regulation, exchange rates, and inflation while internal constraints could be risk limits or balance sheet growth. All of these are factors that can lead to financial innovation (Silber, 1983). The economic model should determine who is demanding the financial innovation and under what conditions. This is important in meta-theory since we are interested in a set of models where different theories can be applied in different contexts and at different times according to the situation.

Advocates of the supply-side theory of financial innovation maintain that regulators and conventional economic theory do not consider the incentives of the financial system to supply financial innovations, mainly financial instruments (Awrey, 2013). Awrey states that the main incentive of financial intermediaries to innovate is to recreate the monopolistic condition that is usually lost due to the non-patentability of financial innovations. The author further discusses two strategies for restoring this monopolistic condition. The first strategy is to accelerate the rate of financial innovation (Hu, 1991). This is among the strategies that banks pursue to achieve product differentiation (Tufano, 2003). However, the differentiation is not with respect to competitors but to the previous innovations of the same financial institution. This strategy does not depend on market demand but capitalizes on factors such as investor short-termism,

behavioral factors, and the innate desire for the "next new thing" (Van Horne, 1985). The second strategy is complexity. Increasing the complexity of the products and services of financial institutions could be another way of seeking monopolistic rent from an environment of non-patentability and a high rate of imitation. Economic theory holds as a model for explaining financial innovation when there is agreement on the goal or the need for financial innovation. Economic theory also holds when the financial sector assumes high relevance such that financial innovation becomes a valuable source of profit and shows non-diminishing returns.

As an example, we consider options for financial innovation that is mainly explained by the economic theory model. In history, there were several instances where options or similar instruments were used (Kiernan 2015). A notable example is the Greek philosopher Thales of Miletus. Thales made predictions as to the size of the season's olive harvest and, based on his predictions, he paid press owners a certain amount of money to obtain the right to use their olive presses. When spring season arrived, and the olive harvest happened to be larger than expected, Thales exercised his options by renting the olive presses to farmers and making more money than he had paid for buying such options. Another notable episode in history where options were used is the tulip bulb mania of the seventeenth century. At that time, in Holland, tulips were very popular as a symbolic object among the Dutch aristocracy. Both tulip growers and wholesalers used to buy put and call options to hedge against price fluctuation of tulips. From an economic standpoint, options provided their owners with both protection against unpredicted events and substantial leverage power making them popular among many agents in the economy. For a long time, option trading was controlled by put and call dealers who traded over the counter. In 1968, the Chicago Board of Option Trade began trading options and other derivatives. In the modern options market, options continue to be traded in huge volumes, and the exchanges are always increasing showing that these contracts still hold significant economic importance for financial markets.

The third theory of development in our meta-theoretic approach is the evolutionary theory. Evolution is another well-known theory that explains innovation as a process of variation, optimization, selection, and self-organization (Poutanen et al., 2016). In evolutionary theory, no assumption is made regarding a preconfigured direction of development or a well-defined goal or need that development must satisfy (Poole and Van de Ven, 1995). Four models of evolutionary processes can be distinguished in the innovation literature that we think are relevant to financial innovation. The first is optimization. The optimization model assumes that firms face problems for which they search for a solution in a space of possibilities (Kauffman et al., 2000). The development of new financial innovations could be viewed as the result of constrained optimization by financial firms who are trying to maximize their utility function (Ben-Horim and Silber, 1977). In searching for the optimal solution, evolutionary theory assumes a space of possibilities. Space of possibilities is frequently used to indicate the set of solutions that are feasible at a certain moment in time. Firms who search in the space of possibilities are faced with search cost and different fitness values that can change. An expansion of the search space translates into new feasible solutions that could be better than existing solutions (Loreto et al., 2016). Optimization is essential in the implementation

phase of financial innovations, which, for financial instruments, is usually called "financial engineering." Finally, the process of optimization is not necessarily efficient and may entail substantial trial and error. In Mason et al. (1994), the authors analyze a list of financial innovations most of which were not successful but produced new information that helped the development of new financial products.

Combinatorial evolution is another important model to be considered in the evolutionary theory of development. As explained in section 3.4, financial innovations, and particularly financial products and financial theory are developed by combining existing elements in novel ways. The third evolutionary model that we consider is self-organization. Self- organization is a term borrowed from biology to refer to the emergence of some form of order without the intervention of a controlling entity (Holland, 2014). Self-regulation is an important feature of the financial sector. In the United States, for example, the Securities and Exchange Commission delegates substantial authority to self-regulating organizations (SROs), which act as representatives of their industry who can design and implement rules that govern the practices of their members (Stefanadis, 2003). Examples of SROs in the United States are the New York Stock Exchange, the Government Securities Clearing Corporation, and the National Association of Securities Dealers. Before the financial crisis of 2008, the subject of self-regulation in financial markets was dominated by the view of the former chairman of the Federal Reserve, Alan Greenspan, who claimed that financial innovations, particularly financial derivatives, followed a Schumpeterian "creative destruction" pattern that helped the emergence of the "new economy" (Leathers and Raines, 2004). Following the crisis, a debate emerged where actors questioned whether finance was self-regulating (Haldane, 2013). The development, diffusion, and implementation of financial innovations can be analyzed from the self-regulating perspective.

Finally, evolutionary theory considers issues of *natural selection,* which are critical to financial innovation. Here, the question of whether natural selection applies to financial innovation can be explored. Several factors can influence the process of natural selection in the development of financial innovation. Bettzüge and Hens (2001), for instance, present a model in which the survival of new financial products depends on sufficiently high trading volumes, marketing, and new hedging opportunities. Johnston and McConnell (1989) find that the success and diffusion of financial securities may depend on which financial innovation has the best security design.

The evolutionary model shows how innovations evolve and what makes it possible for them to emerge, but it does not explain why financial innovations are initially developed. With the evolutionary model, we have more details on the process of financial innovation than the life-cycle or economic theories provide since different financial innovations have different and complex evolutionary patterns. The evolutionary model also applies when there is no emphasis on the institutional context or the final goal and end of financial innovations.

An interesting example of financial innovation that could be explained using evolutionary theory is modern risk management (Barlow, 1993). From World War II to the mid-1960s, risk management was mainly shaped by the practices and heuristics of business people, investors, and employees. Beginning in the late 1960s, new risks emerged, and old ones were aggravated. Interest and exchange risks emerged after the termination of Bretton Woods. Other risks became more relevant such as energy prices,

inflation, and rising funding costs. In response, the risk management function started to evolve and gain more relevance. In the late 1970s, the US Bankers Trust developed the concept of risk-adjusted return on capital for the purpose of obtaining a measure of profitability adjusted for risk. At the same time, regulatory authorities began considering more standardized rules for risk management in banks (Field, 2003). For risk estimation, banks initially used repricing gap analysis, which estimated the effect of interest rates on interest income. Gap analysis evolved further to consider market values with the introduction of duration analysis. Duration is a measure of the sensitivity of a fixed income asset to interest rates. Another important evolutionary step was the introduction of value at risk measures by JP Morgan. Value at risk is a quantitative measure used to estimate the potential loss that a portfolio can have over a specific time frame. With the increasing use of derivatives and the need for a standard risk language, banks and regulators needed a measure for risk that was both easy to understand and allowed for comparison across banks. Therefore, a paradigm was established called modern risk management for which the value at risk measure was the main risk instrument. Risk management is still evolving and changing, particularly in response to the increasing number and complexity of risks faced by financial institutions.

The final motor of development, institutional theory, is required to show how the development of financial innovation is influenced by institutions and institutional changes. In this theory, substantial influence is given to the nature of the innovating institutions and the role of the financial architecture, which helps shed light on which institutions innovate in finance and the best structure of financial markets for the promotion of innovation. This is crucial considering that financial innovation could come from both financial and non-financial institutions. Despite this, financial innovation literature has paid little attention to the nature of institutions that innovate (Allen, 2001; Lerner, 2006). Ross (1989) makes a similar argument regarding the scarcity of literature on the nature of financial innovators. Ross examines the role of investment banks who maximize their profits by developing financial innovations that reduce the costs of search and marketing. Boot and Thakor (1997) suggest a model that illustrates how different institutional structures can result in different patterns of innovation. The authors find that there would be less financial innovation in a universal banking system than in an environment where the financial system is functionally separated into commercial and investment banks.

Interestingly, the existing literature on financial innovation has focused mostly on the macro-level antecedents of financial innovation (Frame and White, 2004) with little attention on the micro-level factors such as firm size and age (Lerner, 2006). The debate that relates to competition and innovation is known in the literature as the Schumpeter/Arrow debate. Schumpeter (1934, 1942) maintained that innovative activities require high profit levels and large internal R&D resources; thus, concentrated markets are more conducive to innovation. For Schumpeter, monopolies would be in a better position to innovate because they face less market uncertainty and have more stable funds. On the other hand, Arrow (1962) claimed instead that competition is more beneficial for innovation and that monopolies may have incentives not to innovate. Bhattacharyya and Nanda (2000) examined a model based on incentives for understanding innovation in the investment banking sector. They find that larger banks, which have greater market share, will tend to innovate as will investment banks whose

clients are sticky. Lerner (2006) found that there is a disproportionate relationship between size and financial innovation because bigger firms are not proportionally more innovative than smaller firms. These results are in line with predictions by Silber (1975, 1983) who suggests that marginal firms will contribute most of the financial innovations. This debate is interesting if we consider the recent revolution in financial technology where financial technology startups have proven to be as innovative as the large banks. In the annual letter to shareholders, Jamie Dimon, CEO of JP Morgan Chase, wrote:

> *Silicon Valley is coming. There are hundreds of startups with a lot of brains and money working on various alternatives to traditional banking. The ones you read about most are in the lending business, whereby the firms can lend to individuals and small businesses very quickly and – these entities believe – effectively by using Big Data to enhance credit underwriting. They are very good at reducing the "pain points" in that they can make loans in minutes, which might take banks weeks. We are going to work hard to make our services as seamless and competitive as theirs. And we also are completely comfortable with partnering where it makes sense* (Dimon 2015).

Startups play an important role in changing the process and landscape of innovation activities (Spender et al., 2017). In his influential article, (Granovetter, 1973) maintained that the presence of "weak ties" could lie behind the process of diffusion of certain innovations, particularly when innovations are unconventional. Innovators outside the conventional system, such as startups, may have more freedom in experimenting with new ideas and methods and, should they succeed in achieving an important discovery, players from the conventional system who have weak ties to the innovators outside the system may achieve better results (Rogers, 2010). Mohan (2016) shows that there are emerging signs of collaboration between banks and Fintech startups.

Behavioral theory is the third motor of development in institutional theory. The emphasis on the importance of behavioral theory in the study of financial innovation has been increasing since the financial crisis of 2008 (Shiller, 2012). The behavioral model explains the interaction between financial innovation and the behaviors of participants in financial markets. Integrating elements from behavioral theory into financial innovations can have positive consequences for the management and design of new financial innovations (Shefrin and Statman, 1993) and financial regulation (Shiller, 2012). On the one hand, behavioral aspects could be perceived as a precondition for the emergence and diffusion of financial innovations. For example, Bhatt (1987) suggests that trust is among the essential factors that contribute to the development of financial innovations since no financial innovation is possible without a general climate of confidence. This is important because end-users of financial products and services can sometimes lack the knowledge and capabilities necessary to evaluate financial innovations and related information accurately. Therefore, there is a need for some form of assurance. Additionally, Salampasis et al. (2014) suggest that the need for trust worthiness among stakeholders in the financial innovation process is even more crucial to foster open innovation and improve performance of the operational, collaboration, branding, and marketing aspects of the financial innovation process. On the other hand, financial

innovations can induce certain behaviors in their adopters with positive or negative consequences. For example, a field study showed that farmers who faced uncertain weather conditions changed their behavior after the adoption of new risk management products. The adoption of the new financial innovation induced farmers to invest more in higher sensitivity cash crops (Cole et al., 2016). Santomero and Trester (1998) show that financial innovation can induce banks to increase their risk profile. Another study showed that banks' behavior changes in favor of clients when banks make active use of credit derivatives (Norden et al., 2014). Shiller (2006a) discussed the development of private accounts for social security driven by behavioral roots. According to Stiglitz (2010), institutional changes that took place in the period before the 2008 crisis induced markets to develop financial innovations and strategies that were short-sighted. With the shift to short-termism, the natural selection laws ceased to be the driving force of market innovation.

The last theory in the institutional model is regulation. Regulation can interact with the process of financial innovation in two ways. First, regulation can be a driver of financial innovation. For example, a new regulation can forbid banks or other institutions to engage in a certain financial activity. To circumvent these regulations, banks can innovate to maintain their profits. Other forms of regulation-driven financial innovations are focused on avoiding capital requirements such as securitization. On the other hand, financial regulation can be reinforced to actively encourage market participants to develop beneficial and responsible financial innovations. Following the 2008 crisis, increasing attention has been paid to the role of regulation in designing mechanisms for responsible and social financial innovations. Thus, regulation remains a crucial driver of the development and direction of financial innovations.

Institutional theory holds when institutional changes and the structure of market interaction is the driving force of financial innovation development. No assumption concerning the historical development course or economic factors is assumed in institutional theory. Institutional theory results are useful when cross-regional differences in financial innovation are observed.

An outstanding example of how institutional factors can lead to the emergence of financial innovations is money market funds (Wall, 2014). In 1933 and 1935, banking acts were passed in the United States that gave the Federal Reserve the freedom to ceil interest rates paid by commercial banks on savings and time deposits. This regulation is famously known as Regulation Q. This regulation created an institutional barrier for investors (mostly small investors) who sought interest payment on their deposits. To overcome this regulatory constraint, Bruce R. Bent and Henry B. R. Brown created an alternative in 1971 called a money market fund. The fund was named the Reserve Fund, and it offered services to investors who wanted to secure a modest rate of return on their cash and earnings. Money market funds invested in low-risk securities that paid interest rates in line with market rates, such as certificates of deposit. As Regulation Q ceilings continued to fall behind market rates in the late 1970s, investments in money market funds grew rapidly, and many more funds were created (Fink, 2011).

Relations between models

The previous section discussed the theories of development of financial innovations and the contingencies under which each development theory applies. However,

observed financial innovation processes may be more complex than any of these theories suggest because the development of an innovation can be triggered by an interplay among the theories (Poole et al., 2000). Therefore, we posit that a good meta-theory of financial innovation must allow for inter-level combinations of the four theories to better account for the complexity of financial innovation processes. This section provides some examples of how the different models can be combined to explain the development of financial innovations under different conditions. The following examples should encourage researchers to develop more detailed and complex models to better understand the process of financial innovation.

In some cases, the life-cycle model can be extended to include institutional requirements instead of logical laws. For example, some financial innovations occur only after many law-making and regulation stages, in which case the regulation theory under the institutional theory can be adopted to better explain the financial innovation at hand. An example of this could be the period between the introduction of the Glass Steagall and Gramm Leach Bliley Acts and the engagement of US commercial banks in securities markets and the introduction of financial innovations (Walter, 1985). Additionally, although the life-cycle theory argues in favor of financial innovation being a continuous sequence of events, discontinuities could exist, and economic theory could help explain this inconsistency by assuming demand and supply factors (Philippas and Siriopoulos, 2011). Finally, related to the life-cycle theory, evolutionary theory can be adopted to explain the logic where several enabling technologies in the space of possibilities can be assumed necessary for the next stage in the life-cycle of financial innovations (Loreto et al., 2016).

In many cases, the development of financial innovations may be technologically feasible. Consideration of institutional aspects or institutional changes might be necessary before they can emerge. For example, in analyzing the idea of radical financial innovations in macro risk management, Shiller, (2006b) argues that such financial innovations would be possible only if combining existing information technology with institutional aspects like behavioral finance is considered.

The self-organization idea is associated with the life-cycle theory to explain the development of important financial innovations like stock exchanges, clearing houses, and fractional reserve banking, each of which has a long history and has emerged without direct government control (see, for example, Campbell-Kelly, 2010).

Conclusion and further research

This paper proposes a new theoretical approach to the study of the financial innovation process using a meta-theoretic method. The need for such a theory is justified by the increasing complexity and diversity of financial innovations, which makes it impossible to construct a single general theory for financial innovation. By relying on the research method proposed by Poole and Van de Ven (1995), four ideal-type theories of financial innovation development are identified: life-cycle theory, evolutionary theory, economic theory, and institutional theory. Each of these theories has rich scientific traditions, and they offer different interpretations of the financial innovation process.

The main advantage of the proposed meta-theory is that it makes it possible to construct contextualized explanatory models of different financial innovations without assuming any restrictive assumptions. The development of financial innovations can be

more complex than any of the proposed four theories suggest, and the reason is the inter-level connections between the different development theories.

The proposed meta-theoretic approach allows for combining different parts of each theory to construct more realistic and dynamic theories for financial innovation. However, more research is needed to validate and extend the proposed framework. An extension could be to explore the inter-level relationships between the proposed theories, the criteria to be used when switching between models, and the weight to be assigned to each model in explaining a financial innovation. To some extent, this might seem reductionist and not a reflection of the likelihood of feedback loops or interdependencies among the proposed models. Nevertheless, when integrated with researchers' experience on the financial innovation being analyzed, the resulting explanatory theory would be more reliable. Another extension that might be useful is to consider the role of complexity theory in the development of financial innovations. Concepts including non-linear dynamics, emergent phenomena, and networks deserve more investigation as potential explanatory models of financial innovation.

The proposed meta-theoretic framework is an innovative tool for academics and researchers that can be used to better understand and communicate financial innovation theory. Additionally, it can help managers and decision makers improve their decisions where financial innovation is concerned. The dynamic nature of financial markets, the increasing competition from Fintech startups, regulation, and the increasing complexity of consumer demand are factors that increase the need to communicate to managers how financial innovation occurs in a firm and the factors affecting its successful development.

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