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Digital Finance and FinTech: current research and future research directions

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Abstract Since decades, the financial industry has experienced a continuous evolution in service delivery due to digitalization. This evolution is characterized by expanded connectivity and enhanced speed of information processing both at the customer interface and in back-office processes. Recently, there has been a shift in the focus of digitalization from improving the delivery of traditional tasks to introducing fundamentally new business opportunities and models for financial service companies. Digital Finance encompasses a magnitude of new financial products, financial businesses, finance-related software, and novel forms of customer communication and interaction—delivered by FinTech companies and innovative financial service providers. Against this backdrop, the research on finance and information systems has started to analyze these changes and the impact of digital progress on the financial sector. Therefore, this article reviews the current state of research in Digital Finance that deals with these novel and innovative business functions. Moreover, it gives an outlook on potential future research directions. As a conceptual basis for reviewing this field, the Digital Finance Cube, which embraces three key dimensions of Digital Finance and FinTech, i.e., the respective business functions, the technologies and technological concepts applied as well as the institutions concerned, is introduced. This conceptualization supports researchers and practitioners when orientating in the field of Digital Finance, allows for the arrangement of academic research relatively to each other, and enables for the revelation of the gaps in research.

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1 Introduction

New business models and technological concepts provide a basis for innovative solutions in finance. Nowadays, customers in the financial sector demand intelligent, however easy-to-use financial services independent of location and time, and at continually decreasing costs. An increasing Internet-based economy, new usage patterns of digital (especially mobile) devices and media, as well as a decreasing reluctance to use online channels, not only for financial information search but also for financial transactions (even among the elderly, more wealthy Internet users) are key structural changes driving these developments.

Digital Finance challenges existing financial service providers, such as established banks or insurance providers, due to new competition by FinTech companies (FinTechs) and, in parallel, offers new opportunities for the incumbents to reach their younger and more technology-savvy clientele. Against this backdrop, there are ongoing discussions of traditional financial intermediaries on how to cope with FinTechs and whether competitive or co-operative approaches, acquisitions, or the involvement of those companies as service providers best suit their business models. Massively increasing global investments in FinTech ventures from USD 4.05 billion in 2013–12.21 billion in 2014 (Skan et al. 2015) mirror this trend. Incumbents also use the new opportunities enabled by technology and forge new innovative concepts in the field of Digital Finance in order to remain competitive and to offer their customers novel and attractive services.

Academic research on Digital Finance and FinTech has developed in parallel to the emerging business models and technologies. This overview article strives to structure this relatively new field and to systematically analyze existing academic literature. We organize the field based on the three central Digital Finance dimensions: Digital Finance business functions, relevant technologies and technological concepts as well as institutions providing Digital Finance solutions. In this way, the *Digital Finance Cube* is derived, which enables for the arrangement of existing academic research in the field relative to each other and to identify cross-linkages and research gaps. The analysis of research articles applies systematic search based on a pre-defined list of keywords in a pre-selected list of high-ranked international journals and conferences. The central findings of the research analyzed are described systematically. Furthermore, the papers identified are listed in tables which allow the reader to gain a comprehensive summary of the academic research in the field. These overview tables are not included in this paper, but can be accessed online.[1] We organize the articles concerning each business function

[1] Online appendix: http://www.efinance.wiwi.uni-frankfurt.de/forschung/jbe-tables.html.

applying a sub-categorization which regards the main research directions of the articles. Based on this sub-categorization and the identified research gaps, a discussion is provided on future research directions that have been identified by applying the Digital Finance (Research) Cube. This discussion strives to support and guide researchers in the search for new and challenging topics in this field.

The paper is organized as follows. First, information on the background of Digital Finance and its terminology is provided. Next, the Digital Finance (Research) Cube and its dimensions are presented. In this section, also the six Digital Finance business functions that are affected by the disruptive potential of new technologies and services are identified. Moreover, information on technologies and technological concepts as well as on the institutions concerned is provided. Subsequently, the research methodology applied for the systematic literature review is clarified. Then, as the main part, the results of the literature review are presented. After the provision of a meta-analysis, each business function is addressed, the respective articles are structured, and their main findings presented. Following this, the research gaps identified are discussed and opportunities for future research are presented. Finally, the paper is concluded.

2 Background and terminology

In order to lay the conceptual foundation for the subsequent chapters, in the following, the key terms describing the intersection of Finance and IT, namely Digital Finance and FinTech, are described based on their usage in literature to derive their delineation and commonalities.

2.1 Digital Finance

Digital Finance describes the digitalization of the financial industry in general. It entails all electronic products and services of the financial sector, e.g., credit and chip cards, electronic exchange systems, home banking, and home trading services (Banks 2001) as well as automated teller machines (ATMs). Furthermore, it involves all mobile and app services. Particularly in less developed countries having regions that are not covered by bank infrastructure, Digital Finance can provide access to banks and their services, e.g., payment systems and credits, that otherwise could hardly be reached. Especially in these countries, we also find "prepaid" payment services that are not Internet-based (Rizzo 2014). The Digital Finance Institute describes Digital Finance start-ups as "companies that are creating innovation for integrating distributed digital banking, mobile solutions and delivery platforms, micro-finance, payment solutions, peer-to-peer lending and crowd-funding" (Digital Finance Institute 2015). However, new technologies and services are not reserved for start-ups only. Also established service providers intensively strive to engage in this field.

While parts of the digital processes and services stated above are well-established (e.g., ATMs), there exist other services and business models that are novel, not widely adapted, and bear disruptive potential for the financial industry. These innovative services and business models that are based on new technologies are in the center of current discussions, and are often referred to as "FinTech" solutions.

2.2 FinTech

The term "FinTech" (sometimes: Fintech, Fin-tech, or Fintech) is a neologism which originates from the words "financial" and "technology" and describes in general the connection of modern and, mainly, Internet-related technologies (e.g., cloud computing, mobile Internet) with established business activities of the financial services industry (e.g., money lending, transaction banking). Typically, FinTech refers to innovators and disruptors in the financial sector that make use of the availability of ubiquitous communication, specifically via the Internet and automated information processing. Such companies have new business models that promise more flexibility, security, efficiency, and opportunities than established financial services (Lee 2015a). The innovator can be either a start-up (like iZettle), an established technology company (like Google), or an established service provider (like Commerzbank). Based on Christensen's (1997) categorization of innovations, Lee (2015b) differentiates between "sustaining FinTech", i.e., established financial services providers that try to protect their market position by the use of information technologies, and "disruptive FinTech", i.e., new companies and start-ups that challenge established providers by offering new products and services. Zavolokina et al. (2016) provide an interesting article on how differently the term "FinTech" is used and defined by various authors and institutions.

In the past, information technology has often only been viewed as a tool in the financial industries context. Now, FinTech start-ups or established IT companies entering the financial domain (in the following, these are collectively referred to as "FinTech companies") gain ground in the financial sector and seize customers that traditionally have been served by established providers. There are three main reasons for this to happen. Firstly, FinTech companies offer new products and solutions which fulfill customers' needs that have previously not or not sufficiently been addressed by incumbent financial service providers. One example is the introduction of a card-reader unit for smart phones and tablets that makes it possible for street merchants and traveling salesmen to accept cash cards and credit cards. Secondly, FinTech companies have created novel opportunities for selling products and services through the application of novel technologies and concepts. MarketInvoice, for example, offers small- and medium-sized companies the possibility of selling their invoices in order to attain higher working capital by not being dependent anymore on the final payment of invoices (Lee 2015b). Thirdly, companies with an IT background are relatively better suited to provide services in a highly innovative environment. Because changes and developments in the domain of communication and information technologies can be very quick and dynamic, companies in this field need to be agile and innovative. As a consequence, such IT companies often have a culture that is distinctively different from established financial service providers. They are agile and innovative enough to set these established players under pressure. FinTech companies concentrate on affordable and cost-efficient Internet-based business models in order to attack established financial services providers. Some experts in the field even believe that 1 day banks may only be used for deposits while everything else will be done by use of FinTech company services (Hemmadi 2015).

King (2014) argued that founders of FinTech companies are often former bank employees who have been relieved of their jobs in the aftermath of the 2008 crisis. They possess the relevant expertise as well as the knowledge and have managed to connect financial services with the new technologies to launch innovative companies and/or create new business models. Such experts are often specialized in specific tasks within, for example, a bank. Thus, they create point solutions for services which are only small parts of the whole range of services of big financial service providers (King 2014). As a result, they can concentrate on optimizing these offered services. Dapp (2014) emphasized that FinTechs usually do not evolve from the traditional financial sector but have a technology background. The trend towards FinTechs seems to be kept up as the development and improvement of mobile devices, big data analysis as well as cloud processing and data storage continues and new possibilities of simplification, adaptability, and individualization evolve (Dapp 2014).

In summary, FinTech companies, i.e., both start-ups and established IT companies entering the financial domain, evolve at the intersection of information and communication technology and finance. They focus on business model innovations and new solutions for existing challenges in the financial industry.

2.3 Differentiation, delineation, and terminological commonalities

In the 2000s, before the terms "Digital Finance" and "FinTech" were introduced, the term "e-Finance" evolved for the use of information and communication technologies in the financial industry. The definition of the term "e-Finance" differs between authors and reveals different emphases. Petzel (2005) stated that authors start from different definitions of "electronic" and "finance" and, thus, end up with different definitions of e-Finance. Here, "finance" can embrace products, services, and/or institutions of the financial sector. There exist main differences between authors concerning the definition of "electronic". While some use a relative broad definition and include all electronic communication and information processing (Allen et al. 2002), others only focus on the Internet as the electronic technology providing the fundament of e-Finance (Zask 2001). Moreover, there are differences in how terms are set into relation. Concerning the relation of the Internet and financial products, the standardization of financial products is in focus, while regarding the institutions a much stronger emphasis on competition and collaborations between institutions is found. When focusing on information and communication technologies regarding the financial markets and respective institutions, e-Finance is seen as the disintermediation and re-intermediation between these instances (Petzel 2005). This fact bridges to today's understanding of FinTechs because these are seen as enablers for disintermediation and re-intermediation of financial services and products through innovative technologies and solutions.

Frequently and usually, the two terms Digital Finance and e-Finance are used as quasi-synonyms (Gattenio 2002). Basically, all three terms, i.e., Digital Finance, e-Finance, and FinTech, describe the processes of change in the financial sector through the introduction and use of information and communication technology. The term "e-Finance" is frequently used in the context of the early beginning of

companies starting to use information and communication technology in the financial sector; while the term "Digital Finance" is used for the widespread digitalization of the financial sector. The term "FinTech" puts more emphasis on technological innovations and technological development. This becomes apparent in the fact that most FinTech companies have their origins not in the financial sector but are IT companies that create new solutions for challenges and tasks of the financial industry.

The main focus of this paper is on the most disruptive element of Digital Finance: FinTechs. Therefore, in the following literature review, the concentration is on studies in the field of Digital Finance with a specific focus on services offered by FinTech companies.

3 The concept of the Digital Finance Cube

When reviewing a field of research, it is necessary to develop and apply a concept that helps to orientate in and navigate through existing literature and enables to identify untapped territory. Therefore, the concept of the Digital Finance Cube (see Fig. 1), which applies three central dimensions to structure the field, is proposed. These dimensions are: (i) Digital Finance business functions, (ii) relevant technologies and technological concepts, and (iii) institutions providing Digital

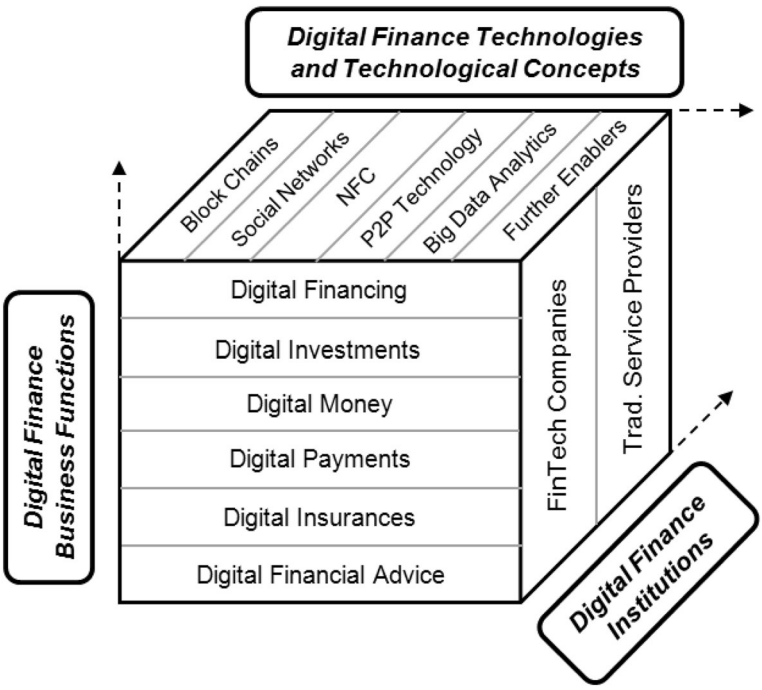

Fig. 1 The Digital Finance Cube and its dimensions

Finance solutions. This enables for the positioning of existing academic research in the Cube. For the literature analysis, the focus is on the most important dimension from a business administration point of view: the Digtial Finance business function. The second and third dimension underly the business function: technologies enable the Digital Finance business function, whereas these business functions are performed by institutions in the area of Digital Finance.

The three dimensions are arranged orthogonal to each other so that each area inside the Cube can be described by certain properties of the three dimensions. All areas inside the Cube represent smaller sub-cubes that refer to a specific combination of one business function, a certain technology, and a specific type of institution. Not all sub-cubes need to be occupied. A number of sub-cubes is neither researched nor touched by practitioners of the financial industry. There are institutions that occupy only one sub-cube and other institutions which occupy a range of many sub-cubes. Likewise, research contributions address either one sub-cube or a number of sub-cubes. Two important features of this Cube are its high level of generalizability and flexibility. As a result, the dimensions can be extended by new elements once innovation yields new business functions or technologies. Although the Cube allows for arranging the whole Digital Financial field, in this paper, it is specifically used for the organization of the research articles identified by the literature review. In the following subsections, the three dimensions of the Cube are presented in more detail.

3.1 Digital Finance business functions

The first dimension of the Digital Finance Cube covers the business functions. Here, we take into account (1) Digital Financing, (2) Digital Investments, (3) Digital Money, (4) Digital Payments, (5) Digital Insurances, and (6) Digital Financial Advice—which will be discussed in more detail in the following subsections. Both literature that focuses on the interaction between financial intermediaries and customers (B2C) is considered as well as literature that addresses business-to-business (B2B) aspects.

3.1.1 Digital Financing

Traditionally, banks are the suppliers of financial resources for individuals or companies. Other sources of capital for companies and start-ups are, for example, venture capital, angel finance, and government financing programs (Klöhn and Hornuf 2012). Digital Financing allows individuals, firms, and start-ups to become independent from these traditional ways by using the Internet to acquire the necessary financing. Digital Financing embraces all digital types of making available financial capital. Today, various platforms offer digitalized services in the area of factoring, invoicing, leasing, and crowdfunding. The term “Digital Financing” should not be confused with the term “Digital Finance”. While the first explicitly focuses on financing aspects, the latter is the superordinate term embracing all business functions—including financing.

Factoring can be described as a "type of supplier financing in which firms sell their creditworthy accounts receivable at a discount (generally equal to interest plus service fees) and receive immediate cash" (Klapper 2006). Typically, a complete portfolio of receivables of diverse customers is sold by the original creditor to a so-called factor. Such a mixed portfolio shall diversify the risk that originates from each debtor of the creditor. In reverse factoring, a "lender purchases accounts receivables only from specific informationally transparent, high-quality buyers" (Klapper 2006). Here, a supplier's customer is the initiator of the factoring process. Reverse factoring helps suppliers to be provided with financial resources to serve the customer with products or services. *Electronic factoring* via online platforms has facilitated the initiation of such factoring relationships tremendously.

Another opportunity for companies to acquire financial resources is the inducing of customers to settle their open accounts. *Electronic invoicing* offers fast, simple, and reliable services in order to transmit invoice data electronically in a structured and standardized format that allows for automated processing (Penttinen and Tuunainen 2011). A better coordination of invoices, better overviews, faster transmission, and account settling help to shorten the time until bills are paid.

Leasing helps individuals or firms that are not endowed with sufficient liquidity to pay for assets, like cars, trucks, or machines. The user is immediately allowed to use the asset while it remains in the possession of the lessor-financier. Various service offers concerning lease-financing can be found online nowadays. As a result, *electronic leasing* has become a simple method for individuals and firms to acquire the necessary assets without paying the full price at once.

A growing segment of Digital Financing with various types is subsumed under the term "*crowdfunding*". Belleflamme et al. (2014) define that "crowdfunding involves an open call, mostly through the Internet, for the provision of financial resources either in the form of donation or in exchange for the future product or some form of reward to support initiatives for specific purposes". On crowdfunding platforms, special project websites are created to present the campaign and to collect money from the Internet community—the "crowd". Hence, not a single intermediary or a small group of experienced investors is addressed like in traditional financing, but a considerable amount of people that support an initiative by relatively small contributions. The basic idea of financing through many little contributions is not new but the Internet has lowered transaction costs as well as transaction time and simplified bringing together people who seek money and people who are willing to provide money (Zhang and Liu 2012). Crowdfunding is rather powerful because amazingly high sums of money can be reached when many contributors support an initiative.

There are four main types of crowdfunding. In *donation-based crowdfunding,* people who provide money do not receive any compensation for their support while in *reward-based crowdfunding* people receive (non-financial) material or immaterial compensations, e.g., objects, products, or services. In *crowdlending* (also called peer-to-peer lending, social lending, or micro lending), the contributors receive a financial compensation for their support in form of interest payments. Especially individuals and companies that have lower chances of receiving bank loans (Auxmoney 2015b) are the main targets. To calculate individual interest rates for

lenders, platforms cooperate with credit rating agencies, analyze incomes and expenses, and collect social media information (Auxmoney 2015a; Berger and Gleisner 2009). *Crowdinvesting* (equity-based crowdfunding) predominantly addresses start-ups. Providers of funds receive equity in return and have the right to claim a part of the company's profits (Klöhn and Hornuf 2012). However, this form of equity is not listed on exchanges and therefore of limited tradability.

3.1.2 Digital Investments

Digital Investments support individuals or institutions in investment decisions and in arranging the required investment transactions on their own by use of the respective devices and technologies. Digital Investments include mobile trading, social trading, online brokerage, and online trading in the B2C area and high-frequency and algorithmic trading in the B2B context.

Mobile trading refers to the trading of securities using mobile devices, such as smart phones or tablets, through special software and applications. Platforms for mobile trading offer real-time access to financial markets and the possibility to trade independently from location and human advisors or brokers (Tai and Ku 2013; Zhang and Teo 2014). Still—compared to other mobile services—mobile trading is at a rather early stage (Tai and Ku 2013). Several factors, for example, small displays of smart phones or bad image resolution, difficult data input, and low computing power make mobile trading less convenient than trading on desktop computers (Kim et al. 2007; Tai and Ku 2013).

Social trading describes securities trading via Internet platforms that combine social media networking with investment strategies. Besides offering products that are tradable on traditional exchanges, social trading platforms also focus on over-the-counter products, like foreign exchange or commodities (Doering et al. 2015; Pan et al. 2012). Social trading evolved as a promising alternative to banks and investment advisers, specifically as the 2008 financial crisis challenged investors' confidence in traditional service providers. The search for investment information and strategies shifted partly to social media platforms, such as Facebook and Twitter. Building upon the idea of investment information exchange among individuals, entrepreneurs founded the first social trading network start-ups (Doering et al. 2015) that offer three main functions (eToro Ltd 2016; Ayondo markets Ltd 2016; Pan et al. 2012): First, the possibility to observe trading strategies of traders that want to share information on their investments; second, the function of "following" one or multiple traders as known from other social media platforms, i.e., selecting and subscribing to traders in order to monitor details and changes of their investment strategies; and, third, copying the investment strategies of traders to one's own portfolio, i.e., performing buying and selling operations in real-time and precisely according to the selected traders investments (the core function of social trading platforms). Traders serve a similar function to a portfolio manager and receive a monetary compensation (Doering et al. 2015). Still, each investor takes responsibility for his own portfolios and for the selection of traders to follow—under exclusion of followees' liability for following traders as well as claims for financial damages against followed traders. Ultimately, social trading constitutes a

promising alternative to individual investment decisions because investors that follow experienced traders can reach impressive above-average returns (Gottschlich and Hinz 2014).

Online brokers fulfill the same tasks as human brokers but operate independently from time and location, they need less staff and can accomplish more orders at lower costs than traditional "brick-and-mortar" brokers. Retail investors use specialized trading software provided by the broker to access multiple markets including charts, economic and stock specific information, analytics and trading tools comparable to professional trading software (Forex Capital Markets 2016; OANDA Corporation 2016; Lechner and Nolte 2009). Typically, there are no face-to-face interactions between customer and the broker concerning additional agreements, special instructions, or custom execution conditions. This can lead to imprudent decisions and self-directed trading, and can cause overconfidence regarding own abilities and competence (Barber and Odean 2001, 2002).

High-frequency trading and algorithmic trading enable institutional traders to implement pre-defined trading decisions in software that automatically initiates and manages orders on electronic trading venues without human intervention. These topics were intensively debated due to the May, 6th 2010 flash crash and received high attention by the public and regulators discussing pros and cons and required regulatory measures. This debate also triggered intensive academic research on the impact of high-frequency trading and algorithmic trading on market quality, and especially on market stability and integrity. As multiple academic papers already provide systematic literature analysis in the field and due to space restrictions, these topics are excluded from the analysis in the current study. The interested reader is referred to the existing extensive literature reviews of, e.g., Biais and Foucault (2014), Chordia et al. (2013), Gomber et al. (2011), Menkveld (2016), O'Hara (2015), and SEC (2014).

3.1.3 Digital Money

The terms digital currency, virtual currency, e-money, and cryptocurrency describe a type of currency that fulfills (more or less) all typical functions of money but exists only electronically and is mainly used on the Internet. Such *Digital Money* serves as a medium of exchange, unit of account, and store of value but—unlike traditional money—exists only digitally (Dodgson et al. 2015). In the following, we refer to Digital Money in the context of digital currencies that are newly established, while Digital Payments refer to electronic payments using traditional currencies (fiat currencies) that are issued and regulated by central banks. Digital Money functions as a virtual medium of exchange on the Internet independent from fiat currencies, bank accounts, and transactional detours as necessary for exchanging foreign currencies (FATF GAFI 2006). According to the European Central Bank, virtual currencies are non-regulated Digital Money that is distributed from and controlled by their creators. Usually, there is no central instance (like a central bank) but the currency is based on a decentrally organized network (European Central Bank 2012).

Cryptocurrencies are decentralized, freely convertible, virtual currencies that are based on encryption technology (FATF 2014). The use of cryptography shall ensure a secure currency system that enables an exchange of currency units without a mediating instance (Nakamoto 2008). Its value is based on demand and supply on respective digital currencies exchanges and is not regulated through decisions of a superordinate instance, like a central bank (Velde 2013).

The most successful cryptocurrency is *bitcoin*, introduced in 2008. Bitcoin is not backed by assets or commodities, e.g., gold, and its emission is not controlled by any central institution (Grinberg 2012). However, the cryptographic mechanisms ensure a decentralized control of circulating currency units and a verification of transactions (Nakamoto 2008). This is achieved by a public transaction system and a shared ledger which comprises all encrypted account numbers and balances, i.e., it provides information on who owns how many bitcoins. This data is updated by a decentral network consisting of private computers of individuals that participate in the bitcoin network (Kaplanov 2012). Even the ledger is not centrally managed but stored at many nodes in the network.

3.1.4 Digital Payments

Hartmann (2006) defines *electronic payment* as "all payments that are initiated, processed and received electronically". The demand for e-payment has emerged due to the rise of online shops. First electronic payment solutions, e.g., online banking, are strongly inspired by the established account-based bank transfer. Since then, there have been innovative and easy-to-use solutions that better fit the needs of merchants and customers (Dahlberg et al. 2008). The process of e-payments covers the transfer of a certain amount of money from the payer to the payee through an electronic, location-independent payment mechanism (Lim 2008; Weir et al. 2006).

Mobile payments can be seen as a sub-category of e-payments. de Bel and Gâza (2011) define mobile payment as "a transfer of funds in return for a good or service, where the mobile phone is involved in both the initiation and confirmation of the payment". The "location of the payer and supporting infrastructure is not important: he may or may not be 'mobile' or 'on the move' or at a Point of Sale (PoS)" (de Bel and Gâza 2011). Mallat (2007) defines mobile payment as "the use of a mobile device to conduct a payment transaction in which money or funds are transferred from payer to receiver via an intermediary, or directly, without an intermediary". After the initial focus on deploying mobile devices for using existing online banking and shopping opportunities, now, it has shifted towards the introduction of new mobile applications that function as a substitute for established payment structures, like cash, card payment, or checks. Not only financial institutions engage in new mobile payment structures but also big Internet companies, like Google or Amazon (Contini et al. 2011). Such developments are especially interesting for less developed countries because mobile banking is a promising and feasible alternative to non-reliable bank structures (Contini et al. 2011; Merritt 2010).

Peer-to-peer payments, person-to-person payments, private-to-private, or P2P payments are another sub-category of Digital Payments. These terms label payments between private individuals (Hartmann 2006), e.g., family members or friends. A

representative of this category is PayPal, which originally has been introduced to execute and verify payments on eBay. While money transfers to a bank account take some time, P2P payments provide immediate transactions. The moment the payment has been initiated, the service provider validates the payment so that the receiver can trust in receiving the money although it has not yet been added to the bank account. Further, there is no need to distribute bank account data and banking information to unknown people anymore, which increases the perceived level of security (Bradford and Keeton 2012). Today, three models of peer-to-peer payments can be differentiated (Bradford and Keeton 2012). Firstly, a *nonbank-centric model* where "an individual instructs a nonbank intermediary such as PayPal to transfer funds to another consumer". A disadvantage of this model is the fact that customers need to sign up and register using their real banking information—which may results in additional work and safety concerns towards a yet unknown service provider. Secondly, a *bank-centric model* where "the individual interacts directly with a bank to request a transfer from the bank account of the individual to the bank account of the recipient". Here, users need not to sign up with another service provider but make use of services of their bank so that safety concerns are rather low. However, customers of banks that do not offer such services would have to change their bank. Thirdly, a *card-centric model* where "the payment is processed entirely over a credit card or debit card network". A disadvantage of this model is that both parties of a transaction need to have a card that works with the network on which the service is based.

The terms *e-wallet* and *digital wallet* describe a digital storage for money that fulfills most tasks of a physical wallet: holding identification information (e.g., ID card, driver's license), facilitating cash and credit payments, and storing temporary tokens (e.g., vouchers, bus tickets). These functions can be implemented digitally so that an e-wallet is able to replace a physical wallet (Ebringer et al. 2000). A digital wallet integrated to a mobile device, e.g., a smart phone, has the potential to replace not only traditional payment functions but also analog wallet items, like identity cards, tickets, and other content items (Contini et al. 2011; Shetty et al. 2014).

3.1.5 Digital Insurances

Arumugam and Cusick (2008) assumed already in 2008 that the peer-to-peer concept could spread to the insurance market, enabling for *Digital Insurances*. They consider it likely that individuals which seek for insurance ally with family members and friends instead of turning to insurance companies. Moenninghoff and Wieandt (2012) argue that such alliances reduce information asymmetry and moral hazard. One of the established providers is friendsurance.com founded in 2010. On this platform, individuals can ally to reduce insurance costs at the same level of protection. Each member of the group has to effect an insurance and pays a certain amount of money to the platform. This monetary contribution is split up in two parts: one part that is forwarded to the insurance company and another part that is stored in an account which is available to the group. In case of small insurance events, the damage is remedied using money from the group account. Hence, the insurance company can avoid high administration expenses for small insurance

cases. In case of serious big insurance cases, the insurance company steps in and arranges the monetary compensation. If no or only few cases of insurance occur, the group is repaid a part of the money that has been stored in the group account. This principle can lead to lower insurance contributions for the insurees. The platform receives a compensation for handling small cases of insurance from the insurance company that is involved (Friendsurance 2016).

3.1.6 Digital Financial Advice

Multiple review sites and comparison portals are available for products and services, like computer equipment, traveling shops, or medical services. On these platforms, products and services are rated, scored, ranked, evaluated, and compared. Research has already shown that such ratings have an actual influence on the behavior of customers (Hu et al. 2008). Also in the financial sector, platforms providing such services exist and can be differentiated based on two characteristics: firstly, providers that primarily provide *financial product reviews* (e.g., seekingalpha.com), and, secondly, providers that focus on *financial product comparisons* (e.g., comparethemarket.com), e.g., based on figures and features. Some providers apply a mixture of both elements (e.g., creditkarma.com).

The terms *trading community, investment community, and stock community* describe communities that discuss and share information on stocks and investments. Often, such discussions and information exchange happens in Internet fora. Well known fora are, for example, Yahoo Finance, Google Finance, ragingbull.com, or aktienboard.com (Lu et al. 2010). Research has shown that the exchange of information among investors can have an influence on investment behavior. Wysocki (1998) found an influence of online information exchange on the trading volumes of the next day. Antweiler and Frank (2004) showed that investors let themselves to be swayed by the opinions of others.

A new development in the area of financial advice is algorithms that provide investment proposals with no or minimal human intervention based on pre-defined parameters regarding investment goals, financial background and risk aversion. These *robo-advisors* currently focus on portfolio management and investment strategies based on established theories like modern portfolio theory and limited asset classes like equities or exchange-traded funds. Mostly, they are not designed to consider the more personal aspects of financial investments like real estate or individual tax situations.

3.2 Digital Finance technologies and technological concepts

The second dimension of the Digital Finance Cube encompasses technologies and technological concepts that enable Digital Finance business functions. As of today, key technologies and concepts that drive the recent changes and developments in the field of Digital Finance are: block chain technology, social networks, near field communication (NFC), peer-to-peer technologies, big data analytics, and further technological enablers, like mobile devices, intuitive user interfaces, and security technologies.

The *block chain* concept has its origin in the invention of the cryptocurrency bitcoin (Nakamoto 2008). Here, the block chain "provides Bitcoin's public ledger, [which is] an ordered and timestamped record of transactions" (bitcoin.org 2016). The entire history of verified and valid transactions between users of the network is contained in this "chain" (Nakamoto 2008). Principally, block chain technology was envisaged for transactions of digital currencies—"Block Chain 1.0". However, beyond this application, the technology has potential and reveals features that are relevant for other areas as well. Block chain technology can also be used in contracting, crowdfunding, and e-wallets—becoming "Block Chain 2.0". The third state, "Block Chain 3.0", focuses on applications in areas beyond business and money, for example, in "areas of government, health, literacy, culture, and art" (Swan 2015).

The Internet connects users and allows for social interaction. Boyd and Ellison (2007) define *social network* sites as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system". On such websites, people share their opinions and experiences and inform themselves, ask specific questions, or initiate discussions on specific topics.

NFC, *near field communication*, is a "short-range wireless point-to-point interconnection technology" that enables two devices to "communicate without any further configuration steps when (…) brought very close each other" (Nagashree et al. 2014). NFC is standardized and operates in an unlicensed radio frequency (Nagashree et al. 2014). One Digital Finance application is the use of NFC to process payment transactions. Therefore, a mobile device, e.g., an NFC-enabled smart phone (Want 2011), is brought close to a cash desk NFC device. Through NFC communication between the two devices, the payer is identified, the payment transaction is initiated, and the transfer of money from the payer's account to the payee's account is arranged.

Steinmetz and Wehrle (2005) formulate that a *peer-to-peer* (P2P) system is a "self-organizing system of equal, autonomous entities (peers) [which] aims for the shared usage of distributed resources in a networked environment avoiding central services". Such distributed resources mean that "participants share a part of their own hardware resources (processing power, storage capacity, network link capacity, printers)" (Wang 2009). The peers in such a self-organizing architecture are also called nodes. These nodes maintain an "acceptable connectivity and performance, without requiring the intermediation or support of a global centralized server or authority" (Androutsellis-Theotokis and Spinellis 2004).

There has been considerable increase in data storage and processing capabilities over the last years. Therefore, big data is defined as "data whose size forces us to look beyond the tried-and-true methods that are prevalent at that time" (Jacobs 2009) and is specifically characterized by an enormous volume of data to be analyzed, high processing velocity, and a variety of data sources to be taken into account (McAfee and Brynjolfsson 2012). *Big data analytics* should be able to deal with very large amounts of data, i.e., they have to be able to scale to big data volumes, support analytic modeling, fulfill data loading and the calculation of

answers to requests in an appropriate time span, use CPU power efficiently, and manage visual display of data and results (Russom 2011).

Besides these technological concepts, that we deem most important in the context of Digital Finance, we found a number of *further technological enablers* that have important functions in Digital Finance as they render possible or facilitate financial processes, functions, and business models. Important enablers are, e.g., fast and mobile Internet, artificial intelligence, worldwide connectivity, mobile devices, intuitive user interfaces, and security technologies.

3.3 Digital Finance institutions

The third dimension of the Cube is Digital Finance institutions. They embrace both FinTech companies, i.e., start-ups and established IT companies entering the financial domain as well as traditional service providers. FinTech companies have adopted finance topics and functions that initially have been viewed as niche topics. But this has changed as growing parts of the business functions of traditional financial service providers are seized by these companies. However, not just FinTech companies drive the changes in Digital Finance. Also, the traditional financial service providers have started initiatives to adopt new technologies and Digital Finance business functions becoming more innovative.

Financial services encompass a broad range of services related to finance and banking. The most important banking and financial services are: cash accounts, savings, money management, investment management, money transfer and payments (e.g., credit cards), portfolio management, financial advice, money loaning and lending (e.g., mortgages, consumer loans, credits), foreign currency exchange, equity trading, brokerage, insurances, and pension planning (e.g., Tönnesmann 2015; Ministry of Business, Innovation & Employment of New Zealand 2015). Conclusive enumerations of banking/financial services can be found in the respective national legislations. For example, the German Banking Act (Deutsche Bundesbank 2014) lists both banking business and financial services. Institutions that offer such services are called financial service providers. In the context of this paper, *traditional financial service providers* are referred to as institutions that are neither start-up nor technology or FinTech companies. Traditional ("brick-and-mortar") financial service providers are, for example, asset management companies, banks, insurance companies, and brokerage firms. Established institutions that have digitalized their services and offer online services (e.g., traditional banks with online-offerings or automobile banks) are also classified among traditional financial service providers.

On the other hand, there is the group of *FinTech companies*. These have emerged either as FinTech start-ups or technology companies without history in banking business and/or financial services. In order to remain in place, new entrants as well as traditional service providers need to address the needs of the present-day customers. Lee (2015a) claims that especially new entrants and start-ups apply business models that promise more flexibility, security, efficiency, and opportunities compared to traditional financial services providers. New entrants cannot rely on an already existent client base. Therefore, their solutions must have the potential to

convince new customers. Furthermore, there are hurdles that cannot be overcome easily for non-bank entrants, which are, for example, regulatory burdens and the demand for bank licenses. Nevertheless, discussions often infer that especially FinTech start-ups have disruptive power and reveal a high level of innovativeness and flexibility. Against this backdrop, research on aspects related to Digital Finance and FinTech is of high interest for practitioners and academics as well.

4 Research methodology

In order to identify the state of research and possible future research directions in the field of Digital Finance, a literature review was conducted following the methodology proposed by Webster and Watson (2002). The literature review shall match the goals of accuracy, reliability, clarity, and brevity to enable the reader perform an efficient analysis of the current state of research (Hart 1999).

The literature review was conducted as a multi-stage process. Figure 2 presents an overview of the procedures applied. As a first step, Digital Finance was determined as the relevant research area. We value Digital Finance as a field of innovative, powerful, and influential dynamics that bears much potential for companies and research as well. Therefore, in the next step, the field of Digital Finance was systemized by the development of the Digital Finance Cube. The research goal was to provide an overview of the relevant and current research literature that touches the typical business functions of institutions in the financial industry. As it is not possible to present every research work that has been published up to now, a scope was defined that limits the number of publications but ensures to capture the most relevant and current research. This enabled us to deal with research articles in more detail and to provide the important results and findings. The scope

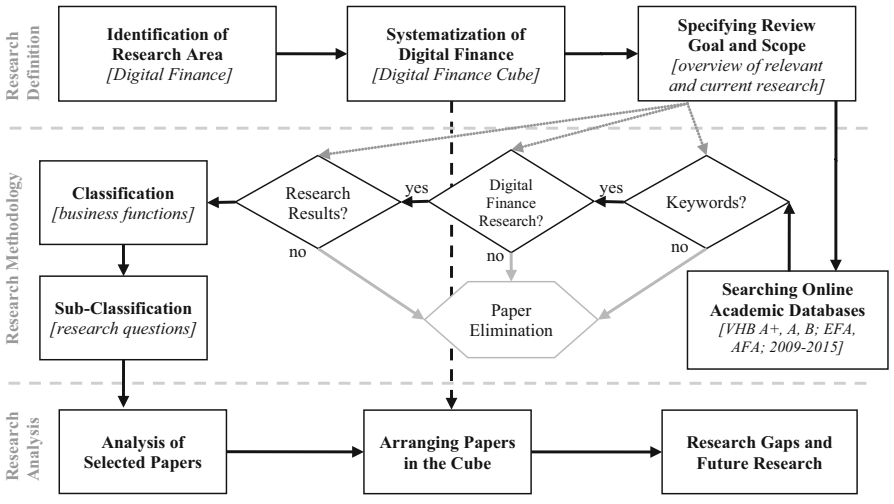

Fig. 2 Process diagram of our research review (based on Ngai et al. 2011)

was translated into specific parameters, e.g., concerning the set of journals and conference proceedings used for the search and the time period.

For this search, we use databases of academic literature such as Ebscohost, Springer, Sciencedirect, or Google Scholar as well as the journals' websites if a journal cannot be accessed via one of the literature databases. In order to identify the articles that fit our research area and eliminate all irrelevant articles, a search and selection procedure was determined based on pre-defined criteria. We focus on papers which have been published in high-quality journals and conference outlets, i.e., having undergone a peer-review process. As a measure of outlet quality, we consider the ranking that is regularly published by the "Verband der Hochschullehrer für Betriebswirtschaft", i.e., the German Academic Association for Business Research (VHB 2015). Here, all journals and conference proceedings ranked A+, A, and B in the areas of (i) business administration, (ii) financial research, and (iii) information systems research were selected in order to take into account a comprehensive number of outlets representing the interdisciplinary nature of the Digital Finance field. Regarding these three areas (i–iii), we selected from the VHB ranking (VHB-JOURQUAL3) the following domains: business administration ("ABWL"), banking management and financing ("BA-FI"), small- and medium-sized businesses ("KMU"), technology, innovation, and entrepreneurship ("TIE"), information systems ("WI"), and entrepreneurship ("Entrepreneurship"). Due to the importance of finance research in this context, the most important finance conferences that are not contained in the VHB ranking were also considered. As counterparts to the relevant information systems conferences that are included in the VHB ranking, i.e., the International and European Conference on Information Systems (ICIS & ECIS), in the finance area, the Annual Meetings of the American and the European Finance Association (AFA & EFA) were considered as well. To achieve current results, only publications published between 2009 and 2015 were regarded.

We only selected articles that fit to specific keywords within a keyword list referring to the six business functions of our Cube (Table 1). In this search, these keywords have been considered for the complete research articles, i.e., title, abstract, and text. These keywords fulfill the task to keep the focus of this review on aspects that are of relevance concerning Digital Finance and FinTechs. Therefore, by intention, we did not include keywords that would lead to an inclusion of topics that are not part of the contemporary FinTech discussions, e.g., ATMs or credit cards.

Out of the papers identified based on these key word lists, in a second step, we eliminated all papers that are not relevant for Digital Finance research. For instance, sometimes research articles only refer to specific terms without addressing these in detail. Third, all editorial and viewpoint papers, research-in-progress papers of conference proceedings as well as teaching cases were excluded because papers of these specific categories typically do not contain complete investigations and final results. This methodology yielded 83 research articles in total. Then, all publications were classified according to the first dimension of the Digital Finance Cube and sub-classified within each business function according to specific sub-categories of research questions that build baskets of topics (e.g., user behavior).

Table 1 Search keywords of the Digital Finance business functions

Digital Finance business function	Keywords
Digital Financing	Crowdfunding, crowdlending, peer-to-peer lending/P2P lending, person-to-person lending, peer-to-peer business lending/P2P business lending, online business lending, online alternative finance/online alternative financing, social lending, crowdinvesting, equity-based crowdfunding digital factoring, e-factoring/electronic factoring, online factoring, e-invoicing/electronic invoicing, invoice trading, digital leasing, e-leasing/electronic leasing, online leasing
Digital Investments	Mobile trading, social trading, online broker
Digital Money	Digital money, e-money/electronic money, digital currency, virtual currency, cybercurrency, cryptocurrency, bitcoin
Digital Payments	Digital payment, e-payment/electronic payment, mobile payment, peer-to-peer payment/P2P payment, digital wallet, e-wallet/electronic wallet
Digital Insurances	Digital insurance, e-insurance/electronic insurance, peer-to-peer insurance/P2P insurance, friendsurance, online business insurance
Digital Financial Advice	Trading community, investment community, stock community, financial product review, financial product comparison, robo-advice

In the research analysis, we analyzed each article of our set of publications thoroughly. According to their topic and contents, the papers were arranged in the Cube in order to identify research gaps and potential for future research.

5 Analysis of current research in Digital Finance

In the following Sect. 5.1, we provide meta-analyses on the articles selected according to our review methodology. Thereafter, the detailed research findings of the identified papers are presented in Sect. 5.2. In a third step, potential open research topics that help academics to identify interesting topics are dealt with in Sect. 5.3.

5.1 Meta analyses

In total, 142 venues were screened, i.e., journals and conferences, according to the search procedure described in the research methodology section. These 142 venues are composed of 13 venues that are ranked A+, 31 venues that are ranked A, and 96 venues that are ranked B—plus AFA and EFA (that are not included in the VHB ranking). After elimination of irrelevant articles, the search resulted in a set of 83 relevant articles consisting of 49 journal articles and 34 conference articles.

We observe an increasing number of articles concerning Digital Finance topics over time (Fig. 3). While in the years 2009–2011 only very few articles addressed one of the six Digital Finance business functions, from 2012 on, numbers began to rise. In 2015, already 30 relevant articles were published. Digital Financing, Digital Investments, and Digital Payment showed already publications in 2009 (Table 2).

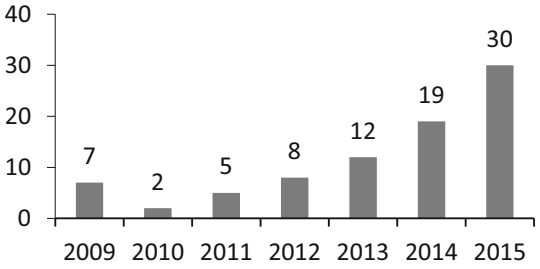

Fig. 3 Publications per year

Table 2 Classification of articles by Digital Finance business functions and publication year

Year	2009	2010	2011	2012	2013	2014	2015	Total
Total	7	2	5	8	12	19	30	83
Digital Financing	3	1	3	6	6	8	14	41
Digital Investments	2	–	–	–	1	–	4	7
Digital Money	–	–	–	–	–	1	6	7
Digital Payment	2	–	1	2	2	5	5	17
Digital Insurance	–	–	–	–	–	–	–	–
Digital Advice	–	1	1	–	3	5	1	11

The first identified paper relating to Digital Financial Advice was published in 2010, with more activity on this topic observed in the last years. Concerning Digital Money, we find the first relevant article in 2014. However, Digital Insurance has not been addressed at all among the selected journals and conferences.

The search resulted in a set of articles that contains 11 articles of publication venues that are ranked A+, 26 articles of A-ranked venues, and 38 articles of B-ranked venues (Fig. 4). Moreover, our set contains 8 papers that were presented at AFA or EFA.

Regarding the various sub-categories of VHB-JOURQUAL3, six relevant disciplines have been identified. Table 3 presents the classification of articles by their disciplines. The numbers do not add up to 83 because some journals and conference proceedings are assigned to more than one sub-category of the ranking. All AFA or EFA articles were allocated to the "BAFI" category.

The articles were also analyzed concerning their main methodology applied. Hence, it was discovered that the majority of the articles apply an empirical methodology. Among these 58 empirical articles, we find 50 that were based on archival data which had been acquired, for example, from data bases, repositories, or platforms. Furthermore, 8 papers were based on survey data. Table 4 presents this classification of articles by their main methodology. The set of methodologies is based on Creswell and Plano Clark (2010) as well as Recker (2013) and has been adapted to the specific case.

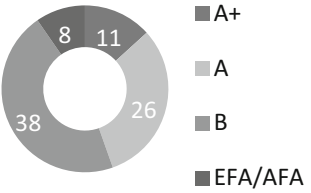

Fig. 4 Ranking of identified articles

Table 3 Classification of articles by Jourqual3 disciplines

Jourqual3	Discipline	Articles
WI	Information systems	49
BAFI	Banking management and financing	15
ABWL	Business administration	9
Entrepreneurship	Entrepreneurship	9
TIE	Technology, innovation, entrepreneurship	9
KMU	Small- and medium-sized companies	0

Table 4 Classification of articles by (main) methodology

Methodology	Articles
Empirical	58
Thereof, articles using archival data	50
Thereof, articles using survey data	8
Qualitative (case study/interviews/qual. analysis)	12
Experimental	4
Conceptual	3
Simulative	2
Theoretical	2
Design science	1
Literature review	1

In conclusion, several interesting findings are revealed by this meta-analysis. Particularly in the last 2 years, topics regarding Digital Finance have been addressed more intensively in research. The relevant papers are mainly published in Information System (IS)-related journals and conference proceedings. Comparing the numbers of the A+, A, and B ranked venues that were screened for papers with the number of relevant papers identified, it can be stated that the topic is addressed relatively more often by higher ranked outlets. Finally, methodologies other than empirical are relatively under-represented.

5.2 Detailed analysis of contents

In order to further structure the papers within a business function, papers that analyze similar or related topics were grouped together by developing specific sub-categories per business function. Within a sub-category, the research findings of the respective publications are presented in detail. Furthermore, additional overview tables of the literature identified in our study are provided online.[2] These tables per business function, which are not included in this paper, present the respective author(s), year, and title of all 83 publications based on the business function and respective sub-categories. Furthermore, they show the publication venue and its ranking, the applied methodology and the respective discipline of the paper based on the VHB classification. To keep focus in the presentation of the aggregate research findings, obviously not all 83 publications are detailed in the following chapters.

5.2.1 Research on Digital Financing

Digital Financing embraces all digital types of acquiring and making available capital. There is a large literature on Digital Financing (41 papers)—about half the number of all relevant literature identified (83 papers). However, within this business function, nearly all articles (40 papers) deal with crowdfunding. The different types of crowdfunding, i.e., donation-based, reward-based, lending-based, and equity-based crowdfunding, are not addressed by research equally. For the years 2009–2010, in the set of papers, we only find articles that focus on crowdlending. From 2011 on, research also considered reward-based crowdfunding. The first paper of our set on equity-based crowdfunding was published in 2014. Research on equity-based crowdfunding is still rather scarce (5 papers) while reward-based crowdfunding (20 papers) and lending-based crowdfunding (20 papers) make up the biggest part of crowdfunding research. This might be explained by the fact that fewer equity-based crowdfunding campaigns have been conducted. Moreover, three papers on donation-based crowdfunding have been identified. Only one paper regarding digital invoicing has been discovered. This is the only example of research regarding other types of Digital Financing than crowdfunding in our set. There was no article on factoring or leasing. Here, numbers mentioned need not to add up to the total number of papers because some articles address more than only one type of crowdfunding.

The 41 papers regarding the business function Digital Financing can be classified into three sub-categories: *platforms and models*, *user behavior* of participants, and *performance* of crowdfunding campaigns. Here, and for the subsequent business functions, the sub-categories are developed based on the content of the papers and their research questions.

There are four papers that deal with *platforms and models* in the set of publications. Hereof, one paper addresses electronic invoicing. Electronic invoicing helps firms to acquire money by arranging fast settling of open accounts. Kuehne

[2] Online appendix: http://www.efinance.wiwi.uni-frankfurt.de/forschung/jbe-tables.html.

et al. (2015) discerned that there are no formal rules concerning the format of electronic invoices. In their paper, they addressed the critical success factors regarding an adoption of XML-based standards for electronic invoices. They concluded that there are several technological, organizational, and environmental issues that drive the acceptance and adoption of XML-based invoice standards.

The other three papers of this sub-category are related to crowdfunding. They do not focus on specific processes in crowdfunding but regard crowdfunding more generally and discuss its underlying models and potential. Amit and Zott (2015) investigated the antecedents of business model design. They derived four antecedents that need to be considered in order to generate value-creating business designs: the goals to create and capture value, templates of incumbents or others, stakeholder activities, and environmental constraints. Although platforms might have similar antecedents for their business models, platforms differ substantially regarding parameters. Therefore, Haas et al. (2014) developed an empirical taxonomy to cluster crowdfunding intermediaries. Based on five unique categories, they discovered three generic archetypes of crowdfunding intermediaries, the topics of which are 'hedonism', 'altruism', and 'for-profit'. Research has investigated the potential of donation-based crowdfunding in which potential funders are not incentivized by material and/or financial rewards. Burtch and Chan (2014) found that crowdfunding has helped to "prevent between 114 and 136 bankruptcies across the US, per quarter" in the years 2006–2011. This shows that crowdfunding has the potential to help the society even if no explicit rewards are offered. The authors explained this by the "utility of giving from one's own acts of charity (i.e., warm glow effect)".

We have identified two further important streams of research addressing *user behavior* in crowdfunding and the overall *performance of campaigns*, e.g., whether crowdfunding campaigns reach their funding goal or what levels of interest rates are reached in crowdlending.

21 papers can be attributed to the *user behavior* sub-category. Here, the first important issue is the question of why individuals take part in crowdfunding. Gerber and Hui (2013) discovered that raising funds is not the only motive for capital-seekers. Further motivations are to expand the awareness of their work, form connections, gain approval, and to learn fundraising skills. Another advantage of crowdfunding is that capital-seekers "maintain control over their work rather than forfeiting control to the investor" (Gerber and Hui 2013). Funders' and investors' motivations are collecting the rewards, helping others, being part of a community, and supporting a cause.

As many individuals are involved that are concerned with opinion formation and decision making, there is a high interest in understanding decisions, actions, and reactions in crowdfunding processes. Before creating or funding a campaign, individuals need to choose the type of funding model. Belleflamme et al. (2014) argue that reward-based crowdfunding is a good means for price-discrimination and claim that entrepreneurs prefer reward-based crowdfunding ("pre-ordering") in the case of low initial capital requirements of the project and lending-based or equity-based crowdfunding ("profit-sharing") otherwise. In reward-based crowdfunding, entrepreneurs can identify individuals that are highly interested in the products,

thus, are willing to buy the product in a pre-selling offer in the context of the campaign. However, in case of high fixed up-front costs, it is better to choose a lending-based or equity-based type of crowdfunding. Applying experimental research, Cholakova and Clarysse (2015) discussed whether the possibility of equity-based crowdfunding might even lead to a crowding out of reward-based investments on the same platform. They found that investors of a project in equity-based crowdfunding are also likely to pledge money if they receive a project reward (e.g., the final product or a symbolic reward) instead of equity. Finally, Lee and Persson (2012) addressed the paradox that entrepreneurs often reject financing through family or friends although this would be much cheaper than choosing formal finance, like bank credits. The authors used theoretical models and predict that "(i) family finance discourages risk taking, (ii) this happens because of aversion to both social risk and social frictions, (iii) defaults harm the quality of social relations, and (iv) formal finance alleviates these effects". Finally, they concluded that such findings can help to explain behavior in peer-to-peer lending. However, there is no literature in the set that captures possible influences of family and friends in the context of risk taking yet. Therefore, future research could consider whether creators of riskier campaigns reveal a different behavior when it comes to choosing the funding model or to inviting family and friends to support their campaign.

Furthermore, research in the *user behavior* sub-category has analyzed what projects are selected for funding by the financial backers. For lending-based crowdfunding, lenders prefer projects of borrowers that are culturally similar and geographically proximate (Burtch et al. 2012, 2014). Furthermore, the authors discover that the negative effect of cultural differences on pledging activities of lenders is decreasing for higher distances. Paravisini et al. (2012) identified that investors show different risk aversion in their decision behavior. Although counter-intuitive, their analysis reveals that wealthier investors have a higher risk aversion and, more intuitive, that investors in crowdfunding behave in a more risk averse manner after negative wealth shocks.

Research has also investigated how backers provide financial resources to projects. Agrawal et al. (2015) argued that crowdfunding has reduced distance-related frictions but pointed out that there are still significant differences between local and distant financial backers. The authors explained that local funders tend to fund earlier and are less responsive to the amount of cumulative funds raised and attributed this effect to campaign founders' family and friends who often live spatially close to the founders. Burtch (2011) discovered that higher (observable) numbers of funders increase the effect of herding and discovered a negative association between the effect of herding and the optimal investing decision of funders and, thus, concluded that herding can be characterized as a negative network externality. Burtch et al. (2013b) found that contributors use the information on previous pledges as an orientation for their own contribution ("anchoring effect"). If the funding contribution is hidden, this anchoring effect vanishes. While these studies focus on reward-based crowdfunding platforms, herding effects have also been discussed regarding lending-based platforms. Zhang and Liu (2012) found that well-funded borrowers attract more funding as a consequence of herding behavior. If campaigns show negative characteristics (e.g., poor credit ratings), the herding

effect is even stronger. While Burtch (2011) judged herding to be a negative network externality, Zhang and Liu (2012) concluded that herding behavior is rational. They explained that lenders do not just mimic others but "engage in active observational learning". Burtch et al. (2013a) found that funding contributions are subject to a partial crowding-out effect. If the collected funding approaches the funding goal, the contributors seem to experience a decreased marginal utility from making contributions and reduce their funding activities.

Herding builds on the visibility of other individuals' behavior. However, the visibility of information cannot be taken as granted. Burtch et al. (2013b) found indications for the fact that individuals tend to hide pledging information, especially if they are under greater scrutiny or to conceal undesirable behavior, like extreme funding amounts or self-pledging. Burtch et al. (2015) showed that giving contributors the possibility to hide pledging information leads to a (net) increase in the amount of pledged money and argued that this is the result of two competing effects. While each contributor chooses smaller amounts of contributions (negative effect), more contributors are willing to pledge (positive effect) if information hiding is offered by the platform hiding previous pledges.

Social networks are an important factor influencing individual behavior. Based on Pierre Bourdieus' (1986) concept of four forms of capital, Lehner (2014) explained that entrepreneurs start the project and, then, boost funding of their campaign by using their social capital. The funding ("economic capital") is the result of the interplay of social capital, cultural capital (e.g., common language), and symbolic capital (e.g., high reputation). The influence of social connections on funding behavior is also demonstrated by Thies et al. (2014). They found a positive effect of campaigns' social buzz on individuals' pledging behavior and that higher backing activities reduce social buzz. Wessel et al. (2015) addressed the behavior in social media and discovered that fake Facebook likes have a positive short-term effect on the number of backers. However, this effect is followed by a period of noticeably lower participation. Therefore, in the long run, fake Facebook likes do not have the potential to boost campaigns funding.

In lending-based crowdfunding, additional parameters, like interest rates and credit scoring, are relevant. Some platforms provide the opportunity for borrowers to form groups to communicate, help, and encourage each other. Here, group leaders have a special moderating task and signal borrower quality to potential lenders by pledging money to group members publicly and visibly. Hildebrand et al. (2011) found that borrowers organized in such groups "have a significantly higher likelihood of receiving a loan, pay significantly lower interest rates, and default less often than comparable borrowers outside groups". The authors discovered that, if group leaders are rewarded, they are incentivized to signal higher quality of group members with lower creditworthiness. As a consequence, default rates are significantly higher in the case of rewards for group leaders. Without rewards, group leaders are much more cautious about which group members they provide money to and evaluate accessible information more carefully.

Finally, Xu (2015) provided evidence for entrepreneurial learning in lending-based crowdfunding and argued that entrepreneurs "update beliefs based on feedbacks from the crowd". Furthermore, entrepreneurs that engage in

crowdfunding make "choice decisions based on what they learned". Such learning processes even help entrepreneurs to improve funding outcomes.

As an interim conclusion, it can be summed up that research identifies individual behavior to be the most important driver of crowdfunding processes. Research has revealed several behavioral phenomena, and behavior has been successfully connected to specific actions and decisions. Based on such findings, platform operators can optimize their models in order to prevent negative effects. Moreover, campaign founders find advice to understand how to address funders and to understand how they behave. And, finally, funders learn, for example, how campaign founders signal true quality and trustworthiness.

The 16 papers of the last sub-category concentrate on *performance* aspects of campaigns. Performance refers to all aspects of successfully reaching the funding goal, reducing costs of lending (interest rates), and delivering rewards or repaying loans reliably.

The authors of these papers have discovered interesting factors that support the successful collecting of money. Zvilichovsky et al. (2013) concentrated on reciprocity in crowdfunding. They found that having helped other founders on the platform by pledging money has a positive effect on successful funding and provided evidence for direct and indirect reciprocity. Mollick (2014) suggested that personal networks and project quality are factors that support funding success. Colombo et al. (2015) supported that backing others ("internal social capital") is important for funding success. They explained that this effect "is fully mediated by the capital and backers collected in the campaign's early days". Koch and Siering (2015) analyzed the influence of project- and founder-specific aspects on funding success and concluded that the use of media (like texts, pictures, and videos) is an important factor supporting success. They also captured the idea of reciprocity and supported its positive influence on funding results. For equity-based crowdfunding, Ahlers et al. (2015) argued that keeping a part of the equity instead of selling the entirety of equity has a positive influence on funding success as this is interpreted as a quality signal and proposed that detailed information about risk and the internal governance (e.g., board structure) also influence funding success.

Allison et al. (2015) analyzed crowdlending data and found that campaigns described as opportunities to help others are more successful than campaigns framed as business opportunities, and explained that highlighting business aspects undermines the effect of funders' intrinsic funding motivation. Other positive influences on funding success in crowdlending are the economic status of borrowers, social capital, and listing quality (Greiner and Wang 2010). However, social capital does not seem to help all borrowers equally. Greiner and Wang (2009) revealed that especially campaigns of high-risk borrowers profit from social capital. Lin et al. (2009) explained that social networks are a good means of signaling trustworthiness because deceiving unknowns has much lower costs than deceiving friends and family. Defaults in the latter case would cause social pressure and, therefore, the borrowers are incentivized to repay their loans. Moreover, Moss et al. (2015) explained that entrepreneurs' narratives on crowdlending platforms are also supportive for funding success and that narratives signaling autonomy, competitive aggressiveness, and risk-taking have higher chances of being successfully funded.

Duarte et al. (2012) used photographs of borrowers from the platform to address the question of whether borrowers appearance has an influence on funding success. They showed that campaigns of borrowers who appear more trustworthy are more likely to become funded. However, the authors also showed that resulting interest rates of loans are not low enough to fully account for borrowers' true trustworthiness. According to lenders' willingness to provide money and their estimation of borrowers' trustworthiness, different levels of interest rates result from the crowdlending campaigns. As borrowers prefer lower interest rates, research has investigated what factors contribute to lowering interest rates. Berger and Gleisner (2009) found that group leaders can lower borrowers' cost of credit by signaling quality through pledging money to the borrower of the group. Lin et al. (2013) pointed out that online friendships can also help to reach lower interest rates of loans.

While these aspects consider the performance of campaigns regarding acquiring money, literature has also analyzed the performance of campaigns regarding results, e.g., the delivery of rewards or repayment of loans. Mollick (2014) stated that there are cases of fraud in reward-based crowdfunding where campaign founders do not deliver the rewards nor refund. About 2.3% of the successfully funded projects are fraudulent. About 25% of the campaigns deliver rewards in time while the orther deliveries are delayed. For funders, it is important to infer from the available data and information to the chance of receiving rewards or loan repayments. While Greiner and Wang (2009) argue that social capital is not a good predictor for loan re-payments, Lin et al. (2013) found that online friendships are a valid signal of lower default rates. Moss et al. (2015) discovered that borrowers who rhetorically signal proactiveness, conscientiousness, courage, warmth, or zeal in their texts are less likely to repay their loans. However, Mild et al. (2015) argued that lenders are not able to sufficiently transform data and information into proper lending decisions and propose a decision-support-tool to better estimate the default rates of borrowers. Also, cultural differences concerning crowdfunding campaigns were analyzed. For a Chinese platform, Zheng et al. (2014) found that reciprocity has a greater positive effect on funding success compared to a US crowdfunding platform. Moreover, the social networks and a higher level of information provided have stronger positive influences for Chinese crowdfunding.

As an interim conclusion on performance aspects, we infer that crowdfunding success, i.e., reaching funding goals or lowering interest rates, depends mainly on behavioral aspects and the way information is interpreted and processed by the potential funders. Research has helped campaign founders to understand the underlying processes to optimize campaigns and to reach better results. Moreover, literature has discussed reward delivery and loan repayment as important matters of funders' concern and has proposed solutions of how to better predict trustworthiness and quality of campaigns.

Among the 40 papers on crowdfunding, we find a striking number of over 130 cross references which shows that research in this domain has successively developed. However, not all articles were cited equally. The seven papers that were mostly referred to by the other publications of this category are: Agrawal et al. (2015), Ahlers et al. (2015), Belleflamme et al. (2014), Burtch et al. (2013a), Lin

et al. (2013), Mollick (2014), and Zheng et al. (2014). In general, the papers focus on data from different platforms. Mostly papers referred to Prosper (10 papers) and Kickstarter (9). These are followed by Kiva (4), Indiegogo (4), and ASSOB (2). All other platforms are addressed by only one paper: i.e., Chuffed, CircleUp, Crowdcube, Demohour, GiveForward, LendingClub, MYC4, PPDai, RocketHub, Seedmatch, Sellaband, and Symbid.

Interestingly, few research can be found on equity-based crowdfunding. This fact provides opportunities for future research opportunities to analyze whether findings are also valid for the case of equity-based crowdfunding. There is no research that analyzes the influence of crowdfunding on the banking system, and existing research has not addressed the competition among crowdfunding platforms. Therefore, interesting research questions in this context can be identified: Are crowdfunding platforms competitors or complements to banks instead of substitutes? How do platforms compete? According to which factors do campaign creators choose the platform? And, finally, many findings have only been shown for one type of crowdfunding. We regret the absence of research that judges or verifies findings across the different types of crowdfunding.

5.2.2 Research on Digital Investment

In the field of Digital Investment, seven relevant research articles were identified—less than in the case of other business functions. The research papers identified can be categorized into articles dealing with online *platforms and providers*, articles focusing on *user behavior* as well as articles focusing on *performance* of users.

The papers concerning *platforms and providers* evaluate the interplay of new entrants, the market itself and market regulation as well as regulatory processes. By means of a qualitative case study, Reynolds et al. (2009) investigated an Australian online discount stock broker from the beginning of operation to becoming the leading market participant. The authors found that, enabled by technology, critical success factors can be seen in a clear business strategy, customer value proposition, and an aggressive pricing strategy. In contrast to this business-model oriented view, the case study by Ernkvist (2015) focuses on a pioneering electronic options exchange and specifically considers the role of the new market entrant related to the regulatory process as well as market supervision. In specific, the author shows that, through proactive political strategies, regulation can be shaped in order to resemble the needs of a new business model.

In the field of *user behavior*, Lee (2009) built upon the technology acceptance model to explain which factors drive the adoption of a trading platform. The analysis of the replies of more than 300 participants shows that especially perceived risks influence the adoption of a trading platform, even more than perceived benefits. Consequently, online brokers have to apply risk-reducing technologies to increase trust towards their platforms and to foster success. Next to the adoption of a trading platform itself, Heimer and Simon (2013) analyzed a social trading platform for individual investors and focused on the adoption of trading strategies. They showed that interaction increases popularity of investment strategies and that especially traders with good short-term performance initiate communications.

Finally, three studies investigated the investment and trading *performance* of users active on related platforms and thereby mainly focused on the impact of platform configurations. First of all, Teschner et al. (2015) investigated whether an increase of information displayed to users of a trading interface has an impact on trading performance and found that the more information displayed, the lower the performance achieved. The authors explained this result by means of increased cognitive load in the case of additional information displayed. Furthermore, the study by Kranz et al. (2015) also revealed that detailed information displayed in a trading context can have negative influences on trading behavior. The authors attribute this effect to an increase in behavioral biases caused by additional information: traders suffer from the disposition effect, where they hold losing stocks for too long and sell winning stocks too early. Furthermore, Heimer (2015) showed that the interaction between traders on a social trading platform also increases the disposition effect.

To sum up, the papers analyzed in the field of Digital Investment focus on the business models of trading platforms and their success factors, the acceptance of these platforms including the factors leading to platform adoption as well as the performance achieved by users active on these platforms depending on the information displayed. Research confirms that Digital Finance technology leads to new business models and that technological configurations can have a direct impact on trading performance. Most importantly, the question of whether the information displayed has an influence on user performance and the corresponding research results provide interesting insights for the future design of FinTech applications. Previous research in this field has shown that there is no general "the more, the better" rule. More information displayed can even have negative influences. It is suggested that the simplicity of FinTech applications is not only advantageous in order to reduce the users' time to come to a decision, but that simple applications can also lead to increased trading performance. Moreover, the study by Ernkvist (2015) outlines another important point that is relevant for many FinTechs: the regulations of the markets where FinTechs are operating as well as the possibilities to shape the regulatory process. This is of special importance if new business models are created that need tailored regulations.

Most strikingly, previous studies in the field of Digital Investments only partially focus on the recently emerged social trading platforms. These new platforms offer relevant research questions. For instance, it remains unclear whether there are differences between users who decide for trading on social trading platforms and users who trade on traditional platforms. Furthermore, it is of high interest whether the trading performance on social trading platforms differs compared to other platforms. Except one reference of Heimer (2015) to Heimer and Simon (2013), no other references could be identified between the authors of this category.

5.2.3 Research on Digital Money

Digital Money is a rather recent topic of research in the field of business administration. While there is already extensive academic literature in computer science that focuses on technical issues around cryptocurrencies, e.g., concerning

the use of advanced encryption techniques, the respective research around business models and success factors of adoption by individuals, merchants, or even governments is rather sparse. In the systematic literature analysis, only seven papers were identified that match our search criteria and keywords in the context of Digital Money. These seven identified papers can be categorized into articles investigating the *behavior* of individuals using cryptocurrencies, studies investigating whether cryptocurrencies should be used to increase trading *performance*, and papers providing *conceptual* discussions about cryptocurrencies.

One study investigated the *behavior of users* of cryptocurrencies and examined whether bitcoin is used for speculative or payment purposes by analyzing the users' intentions when changing their domestic into a digital currency (Glaser et al. 2014). The results revealed that particularly uninformed users apply cryptocurrencies as an alternative investment vehicle rather than using them as an alternative transaction system. The authors claim that individuals buying bitcoin for the first time likely keep them in their exchange wallet for speculation purposes without the intention to pay for goods or services which is supported by the reaction of bitcoin returns on related news events.

The majority of research articles investigating Digital Money focuses on the question of whether cryptocurrencies and, in specific, bitcoin can be used for trading purposes in order to increase the *performance* of trading strategies, for instance, by using bitcoin to increase portfolio diversification (Brière et al. 2015) and for hedging (Dyhrberg 2015a, b). Finally, Polasik et al. (2015) empirically investigated the drivers of bitcoin returns and conclude that these returns can be explained primarily by its popularity, the sentiment in newspaper reports, and the total number of transactions. This paper also addresses merchants' adoption of bitcoin which they attribute to determinants like company features, use of other payment methods, customers' knowledge about bitcoin, and the size of both the official and unofficial economy. Although this aspect of Polasik et al. (2015) also covers *user behavior* aspects, the main contribution is on trading *performance*.

All these papers focus on the properties of Digital Money and its potential usage for specific purposes, e.g., investment (asset), transactions, portfolio diversification, or portfolio performance. However, no input is given for Digital Finance business models providing services around cryptocurrencies, e.g., the offering of bank accounts denoted in bitcoin or other cryptocurrencies, or the partnering with e-commerce companies to enable end users to conduct payments via cryptocurrencies. Also topics like the potential to ease financial inclusion based on the low entrance barriers and low costs of the distributed ledger technologies that are underlying cryptocurrencies such as bitcoin are not addressed up to now. A further interesting yet untouched economic topic is the question of how and whether governments could view cryptocurrencies as an alternative to fiat currencies given the high costs for running monetary systems and high transaction costs of handling fiat currencies not only for governments (e.g., printing and distribution of banknotes), but also for the banking system (e.g., storage of physical notes and coins in vaults and handling of counterfeit money), and for individuals (e.g., theft protection).

There are two *conceptual* articles in the field of Digital Money. The first paper provides a classification of decentralized consensus systems (Glaser and Bezzenberger 2015). The authors state that such decentralized consensus systems "are based on peer-to-peer principles rather than central authority and rely on cryptography for network-wide verification (by consensus) of a systems state". The second paper discusses fraudulent activities around cryptocurrencies (Brenig et al. 2015). Brenig et al. (2015) analyze and structure the contextual and transactional factors that might incentivize criminals to apply cryptocurrencies as money laundering instruments. They concluded that only limited acceptance and price volatility of cryptocurrencies reduce the attractiveness of using them for money laundering–while all other investigated factors directly or indirectly increase the efficiency (e.g., time and cost efficiency) and effectiveness (e.g., in erasing traces) of the money laundering process compared to traditional financial instruments and services.

From our point of view, the future of academic research in this area will not primarily focus on cryptocurrencies as such, but on its underlying innovative technological concept, i.e., the block chain technology, as well as the concept of decentralization. While six of the seven papers identified in the literature review focus merely on cryptocurrencies as such, an importing starting point in this direction is given by the paper of Glaser and Bezzenberger (2015) who differentiate decentralized consensus systems from cryptocurrencies. Their main contribution is the development of a taxonomy (Nickerson et al. 2013) that reveals the structural and hierarchical similarities, differences, and interdependencies between different decentralized consensus systems enabling researchers to easily classify innovative concepts, artifacts, and applications based on six dimensions. These decentralized consensus systems provide the basis for the creation and exchange of diverse types of assets that are not only representing the asset and its respective value as such (like in the case of cryptocurrencies) but even feature dynamic aspects and automatic properties, like automatic dividend or coupon payments, which is captured by the term "smart contracts" that was already introduced in earlier literature (Szabo 1997) but largely neglected since then. The concept of decentralized consensus systems lays the foundation of facilitating complex financial applications in areas like payment, trading, or clearing and settlement. The development of theories and applications as well as the identification of related business models and services is a very promising avenue for academic research and for concrete FinTech business models.

One additional aspect that can be concluded from the above analysis is the fact that most of the existing research articles in this field are actually related to the most prominent cryptocurrency, i.e., bitcoin. Therefore, future research in this field might rather focus on so far neglected cryptocurrencies as well as the relation of and interchangeability between different cryptocurrencies.

There is only one paper (Glaser et al. 2014) that has been referred to by other publications (in total two times). This might be due to its interesting findings and its publication date: it is the first paper published in this category and the only paper of the year 2014.

5.2.4 Research on Digital Payments

Beginning from around the year 2000, advances in information and communication technology have paved the way for new forms of Digital Payment, like mobile payment or e-payment. Especially due to lower transaction costs compared to traditional payment channels, like cheques or credit cards, a lot of experts attributed huge potential to these new payment technologies and services. However, a lot of mobile and e-payment solutions failed to live up to expectations. Consequently, most academic research around Digital Payments strives to analyze and explain these failures and to provide design and business strategy recommendations for wider adoption.

In our set of research literature, the business function Digital Payment covers the second highest number of articles (17) which can be attributed to the fact that this business model in Digital Finance was one of the first to be implemented, discussed, and researched. We identified three main streams of research in this field: First of all, there are multiple studies investigating Digital Payment *platforms*. A second stream of research deals with the *behavior* of users of Digital Payment systems, and specifically, with the adoption decision. Finally, a third stream investigates the market for Digital Payments at a broader level and analyzes the *competition* between different Digital Payment systems.

Concerning Digital Payment *platforms*, many papers apply the methodology of single or multiple case studies to propose designs and business strategies for both payment incumbents and disruptors that enable to boost the initially two-sided platforms to multi-sided Digital Payment platforms by incorporating third-party services and non-payment applications (Kazan and Damsgaard 2014). Also, the growth and evolution of new Digital Payment systems and the interplay and processes between technology and society are investigated to identify potential venues and routes to transitions from traditional to Digital Payment platforms (Hjelholt and Damsgaard 2012). The authors recommended that disruptors should not just focus on the innovation as such but should try to connect to and seek the attention of institutional actors to transform from niche innovation into the socio-technical regime. Furthermore, recommendations to reach a critical mass by different levels of openness of a platform are provided. Specifically, Ondrus et al. (2015), based on case studies of mobile payment platforms, investigated the openness in the context of payment platforms by examining openness at the provider, technology, and user level to explain the link between openness at these three levels and market potential. They concluded that openness at the provider level to firms from the same industry, openness at the technology level based on interoperability, and openness at the user level tend to increase market potential. In contrast, openness at the provider level to firms from other industries tends to decrease market potential. Wiechert et al. (2009) showed that, based on a quantitative analysis of real-world data, the implementation of NFC technology would increase a retailer's payment costs due to the substitution of low cash payments by expensive card payments. A meta-analysis and literature overview including a discussion on how mobile payments—also called m-payments—will develop due to technological changes (e.g., availability of NFC) is given by

Dahlberg et al. (2015). It is worth noting that all identified papers on Digital Payment platforms were published in "WI" (information systems) outlets and that five out of six papers were (co-)authored by Scandinavian researchers; which is reflecting the high level of innovation in this area in northern countries.

Most of the research on Digital Payment focuses on *user behavior* and especially on the decision to adopt a Digital Payment system. Based on established IS models, like the Unified Theory of Acceptance and Use of Technology Model, the Technology Acceptance Model and Innovation Adoption Models, all eight papers rely on empirical data to explain the drivers and inhibitors of (mostly) mobile payment solutions. As a common result, these papers identify trust and ease of use as the most important factors influencing the adoption decision (e.g., Gao and Waechter 2015; Lu et al. 2011). As a consequence, vendors and service providers are advised to clearly explain to users how their data is secured and how their privacy is protected and to offer high quality in terms of services, information, and systems (e.g., O'Reilly et al. 2012; Zhou 2013). Besides trust and ease of use, the most important additional factors that impact customers' intention to use Digital Payment services are compatibility, relative advantage, image as well as network externalities (Qasim and Abu-Shanab 2015).

Three papers address *competition* in Digital Payment markets. Martikainen et al. (2015) investigated the convergence of payment instruments in European markets and discovered that the pace of convergence in all Digital Payment instruments besides cheques and e-money increased since the introduction of the Euro currency. Based on a multiple case study of the mobile payment market, Ozcan and Santos (2014) revealed that slow market emergence of mobile payment solutions can be explained by the lack of willingness of historically dominant firms to reach agreements on the new market architecture. Choudhary and Tyagi (2009) identified another inhibitor to alternative forms of payment (like cybercash or digicash) compared to established payment forms (like credit cards): although sellers might save costs by these new payment forms, competitive considerations and sellers' desire not to intensify price competition may lead to a disincentive to pass these cost savings to consumers.

In summary, the literature review and the set of identified papers reveal a clear focus on technological developments and on the adoption of Digital Payment services by customers. Most papers either apply case studies in the field of Digital Payments—with a clear dominance in the area of mobile payments—to derive proposals on business designs and business models or empirical research to explain inhibitors to user adoption and acceptance. The result that trust and ease of use are highly important for consumers' adoption as well as the recommendation that service providers should focus on the prevention of security risks and on the mitigation of privacy concerns in this area are not really surprising. However, there is a clear underrepresentation of research investigating the adoption on the side of the merchants and especially of papers around the institutional, regulatory, and monetary issues. Also papers covering the important role of standardization in this field are largely missing. It is striking that among the 17 papers identified according to our criteria, only seven cross-references were discovered which gives some

explanation why similar results were identified without a clearly visible path of evolution in this stream of literature.

There are also a lot of recent developments in the Digital Payments industry that offer promising areas for future research and Fin Tech offerings. This might include the currently very successful global peer-to-peer money transfer systems (e.g., transferwise or azimo), that dramatically reduce transaction costs compared to standard cross-country bank transfers, and the new possibilities to integrate NFC solutions in devices beyond traditional credit cards, which not only includes smartphone payments but also other forms of wearables like smartwatches, rings, or even biometric methods to payment.

5.2.5 Research on Digital Insurances

In our literature review, we did not identify any research articles related to the field of Digital Insurances. Consequently, topics like the adoption of Digital Insurance concepts or user behavior in the field of Digital Insurance remain underexplored so far. Especially with access to user data of a Digital Insurance platform, many promising research areas might be explored. For instance, future research might investigate whether clients of a peer-to-peer insurance platform behave more responsibly and thus generate a lower number of insurance events than customers of traditional insurance products.

5.2.6 Research on Digital Financial Advice

The research papers published in the field of Digital Financial Advice can be grouped into papers focusing on the *behavior* of users in trading communities and into papers analyzing such communities in order to relate the communication within the community to financial markets and, thereby, to make *predictions of market reactions*.

In the field of *user behavior*, it is of great interest how users of trading communities take into account other users and how they react on their actions (e.g., Gu et al. 2014; Park et al. 2013). Park et al. (2013) revealed that investors being active on a stock message board specifically take into account messages that support their prior beliefs. This effect is shown to be stronger in the case of investors with higher perceived knowledge and stronger beliefs towards a specific stock. In addition, Gu et al. (2014) analyzed an investment community and considered the interactions between the different participants. They found that investors seek interactions with other investors who have similar opinions concerning a specific stock, which is especially amplified by stock volatility.

The articles which focus on *performance*, i.e., the influence on and prediction of market reactions, analyze stock recommendations, either extracted from user generated content or specifically expressed by users of trading communities, and try to relate them to financial market trends and returns.

Several articles link information expressed in social media to market reactions. Lu et al. (2010) analyzed a stock message board as well as subsequent market reactions and discovered interactions between stock returns and posting volumes.

Furthermore, Xu and Zhang (2013) found that information aggregation on Wikipedia can moderate voluntary management disclosure of earnings disappointments as well as moderate negative investor reactions to bad news.

Some papers have a specific focus on the prediction of market reactions. Chen et al. (2014) focused on all opinion articles published from 2005 to 2012 on the stock community seekingalpha and calculated the sentiment of messages based on negative terms. When relating sentiment to daily returns and controlling for news published in the Dow Jones News Service, they found that opinions expressed on seekingalpha predicted future stock returns. Li et al. (2014) proposed a decision support system that takes into account sentiment expressed in stock communities during a 3-month period and also observed a good predictive performance. Finally, Benthaus and Beck (2015) analyzed messages related to S&P 100 companies posted on twitter within a 4-month time period in 2014 and extracted message sentiment. The authors revealed that messages posted as well as discussions which occurred predicted trading activity.

Several papers specifically address recommendations expressed by users of trading communities. In specific, Crawford et al. (2013) analyzed an online community exclusively open to professional buy side analysts and investigated whether the recommendations of these analysts have investment value. Based on data as of 2010, they found that sell recommendations are followed by price declines and buy recommendations by price increases. Nofer and Hinz (2014) also analyzed stock recommendations posted on an online community, which is open to all groups of investors from 2007 to 2011, and compared the performance of investments based on the user's stock recommendations with the performance achieved by trading on the recommendations of professional analysts. They found that the user recommendations outperform such professional analysts. In case of recommendations related to the constituents of the S&P 500, Hill and Ready-Campbell (2011) also discovered that trading on the recommendations of the crowd outperforms the underlying stock price index. Finally, Gottschlich and Hinz (2014) used stock recommendations posted by members of a stock community from 2009 to 2010 in order to build a decision support system that aggregates user opinions, generates trading decisions on a daily basis, and is able to outperform different benchmarks.

To summarize, in the field of Digital Financial Advice, the majority of research articles focuses on trading communities and the relation of user-generated content and prices of financial instruments. Especially focusing on the field of predictive analytics, different studies try to forecast financial market movements by analyzing user generated content. In contrast, there is a lack of research regarding the impact of automated tools for financial advice that suggest specific portfolio structures to retail clients which are currently discussed in the field of robo-advice. Furthermore, the specific dynamics between different news channels have been disregarded until now, whereas future research might analyze how information flows between stock message boards, microblogging services, and financial news.

5.3 Future research directions

Our literature review allows us to identify those areas that are represented by research and those areas that have not yet been addressed by academic discourse so far. Using the Digital Finance Cube, the following can be identified: (i) research potential concerning each business function, (ii) concerning combinations between business functions, technologies, and technological concepts as well as institutions, and, (iii) research potential concerning Digital Finance beyond the Cube.

(i) Within the dimension of business functions, several remarkable findings are revealed. Most interestingly, no top-ranked research article concerning the business function of Digital Insurances was identified. Surely, the concept of Digital Insurances can be referred to as a rather novel concept. However, it is striking that research did not address this concept more intensively although the first platforms in the field of Digital Insurances were already established more than 6 years ago (e.g., friendsurance has been established in 2010). Next, we found that 41 articles, which is nearly the half of all articles in our set, contribute to the business function of Digital Financing, thereof even 40 papers relate to crowdfunding, only one paper relates to electronic invoicing and no articles relate to electronic factoring or electronic leasing. While donation- and reward-based crowdfunding as well as crowdlending have been addressed by a number of research articles, crowdinvesting is comparably scarce in academic literature. Furthermore, the business functions of Digital Investment (7 articles), Digital Money (7 articles), and Digital Financial Advice (11 articles) have been investigated relatively sparsely.

Concerning the identified sub-categories, we found aspects of *user behavior* in each of the five researched business functions. Authors obviously have well noticed the importance of a user focus in these business functions. Furthermore, aspects on *performance* are addressed in four of the business functions. However, performance takes different views. While in Digital Financing the performance of campaigns is investigated, in Digital Investment the performance of users' investments, in Digital Money the performance of bitcoin, and in Digital Financial Advice the performance of return predictions are analyzed, respectively. We did not find any performance analyses in the area of Digital Payments. Moreover, there are specific aspects of performance in each business function that are not addressed so far, e.g., the performance of different crowdfunding models in the area of Digital Financing. The sub-category of *platforms and providers* is present in three business functions. There exists no top-ranked paper that addresses the platforms and providers in the area of Digital Money. For example, although data from cryptocurrency exchanges is used in some papers (e.g., Glaser et al. 2014), the platforms themselves, i.e., cryptocurrency exchanges, are not investigated likely due to the novelty of cryptocurrencies. As the main focus is on bitcoin, which represents the most important existing cryptocurrency, further research on other cryptocurrencies or the interrelation of cryptocurrencies, e.g., concerning arbitrage is missing so far. Also concerning the business function Digital Financial Advice, platforms have not been investigated yet, leaving potential for future research.

(ii) Concerning the relation of business functions and technologies, it was revealed that some technologies and technological concepts are regularly connected

with certain business functions. For example, research in the area of Digital Payments particularly regards NFC and research on Digital Financial Advice includes aspects on social networks. As a result, by far, not all technologies are found in all business functions yet. Here, research has the opportunity to investigate how technologies and technological concepts could serve in other business models and what potential an expanded field of application might bear. In this respect, one very promising research and/or business topic could be, e.g., the application of the block chain technology for providing secondary markets for crowdinvesting.

Nowadays, IT-based technologies enable a far-reaching automatization of processes. For example, besides Digital Financial Advice that is based on social media and fora, robo-advice is another topic that is very promising. Robo-advice is a new tool that is based on "algorithms to develop automated portfolio allocation and investment recommendations tailored to the individual clients" (Vincent et al. 2015). Here, intelligent algorithms enable an automatic acquisition of information, processing of data, and, finally, the generation of tailored investment advice. However, its academic analysis is still outstanding due to the novelty of such business models and of FinTechs that are providing this new concept. Nevertheless, some working papers and white papers that do not match our ranking/publication criteria exist (e.g., Arwas and Soleil 2015; Fein 2015; Vincent et al. 2015). In this field, research could address various aspects, e.g., optimizing algorithms used, analyzing the performance of investment advice given, or users' adaption of such advice.

Concerning the Digital Finance institutions dimension of our Cube, it can be stated that while most individual business functions have already been investigated, the question of whether the respective business function is offered by traditional service providers or FinTech start-ups in specific is not investigated in academic literature so far. Furthermore, in the current competitive environment among traditional service providers and FinTechs, the potential of co-operation among both groups of institutions is often debated. Such a co-operation could, for example, be realized by providing the bank license or regulatory background of a traditional institution to a FinTech start-up. Here, research could contribute, e.g., by case studies focusing on the success of such co-operations. Given the very different background and cultures in FinTech companies and traditional financial service providers, an analysis of those cultures and their impact on the provided business models and on business success promises very interesting results.

(iii) In general, the impact of regulation on FinTechs and new technologies, e.g., on block chain technologies (Jones 2016), cannot be found among the papers in our literature analysis. Against the backdrop of the dynamic rise of FinTechs and respective technologies applied, especially such regulatory aspects become more and more important. Therefore, research can contribute to upcoming discussions, e.g., concerning security aspects and customer/investor protection. An important current debate refers to the so-called "regulatory sandboxes" that are set up, e.g., in the UK, Singapore or Hong Kong, to enable firms to experiment with FinTech solutions and to test them within a well-defined space and duration. Comparative academic analyses of national FinTech ecosystems that are supported by initially

lighter regulation for FinTech companies and ecosystems that do not allow for regulatory sandboxes would be highly relevant for the future of FinTech regulation.

6 Conclusion

Although the financial industry has traditionally been an early adopter and intensive user of new developments in information and communication technology, the emergence of innovative business models and the rise of new competitors have a tremendous influence on current industry dynamics. In a rapidly changing economic environment and in the light of challenging and cost-intensive regulatory requirements, incumbent providers of banking business and financial services are facing a substantial transformation: Digital Finance. A more technology-savvy clientele across generations, new technologies, and the digitalization of the industry challenges business models of traditional service providers. Both novel forms of disintermediation and new competitors can be observed in all relevant business functions in financial services. Against this background, most players in the industry try to design customized, intelligent, and flexible, however cost-efficient, financial products and services and strive to achieve new levels of customer centricity.

Academic research in the area of Digital Finance and FinTech is successively incorporating this trend and the related topics into scientific investigations. This paper provides a systematic analysis of the top-published research around Digital Finance with a focus on business functions that are adapted by FinTech companies. To base the literature review on a structured approach, the newly developed Digital Finance Cube was applied. This Digital Finance Cube encompasses the main Digital Finance business functions, the Digital Finance institutions, and the underlying technologies and technological concepts. For each business function, important keywords were specified that serve to identify relevant academic papers in various fields of business administration published in highly ranked outlets. 83 papers were identified and were classified into various sub-categories within each Digital Finance business function. This investigation shall both provide researchers a structured overview of existing research in this field and identify untapped, yet promising areas for future research.

It was found that the number of articles published in journals and conference proceedings increased noticeably over the last years. Nearly half of the articles address Digital Financing and nearly all of the articles in this group focus on crowdfunding. However, relatively few articles deal with crowdinvesting. Concerning Digital Insurances, no relevant research article could be identified. As a result, research to investigate this business function and to close this research gap is recommended. Moreover, we identified specific sub-categories of research that are addressed more often, i.e., user behavior, platforms/providers, and aspects of performance. However, there are some business functions that do not reveal any research on specific sub-categories. For example, concerning Digital Money, we could not discover any research article that addresses the relevant platforms, i.e., bitcoin exchanges. Another aspect that is under-researched is robo-advice. It is suggested that research should discover the potentials and opportunities of this

novel type of advice in more detail. For example, techniques of acquiring and processing data could be compared in order to find preferable designs for generating investment advice.

In our view, research has not yet succeeded in revealing the specific roles of FinTech companies and traditional service providers in Digital Finance. Here, research could investigate the potentials for both types of institutions and could reveal how they will compete and how they could co-operate, respectively. The future of FinTech solutions will be driven both by innovations on the technology level and by the reaction of politicians and regulators to the new developments. Customers will appreciate technological solutions that ease usage and reduce transaction costs. Global peer-to-peer money transfer systems, improved smartphone usage in financial transactions and the ability to use wearables also for financial transactions are interesting research topics and provide the basis for future FinTech business models. Beyond this, given the high dynamics in this field and the need for fast, nevertheless efficient regulatory answers, any academic insights on the impact of regulatory measures in the FinTech arena will be highly appreciated.

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