Digitization tendencies in the traditional financial services industry – Evidence on changes, consequences and implications for the traditional German banking sector

- Doctoral thesis -

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List of abbreviations

Australian Securities and Investments Commission	ASIC
Average variance extracted	AVE
Bundesanstalt für Finanzdienstleistungsaufsicht	BaFin
Comparative fit index	CFI
Compound annual growth rate	CAGR
Consumer Financial Protection Bureau	CFPB
Convenience	C
Digital Financial Advice Solutions	DFAS
Digital Financing Solutions	DFS
Digital Insurance Solutions	DInS
Digital Investment Solutions	DIS
Digital Money Solutions	DMS
Digital Payment Solutions	DPS
Economic benefit	EB
European Central Bank	ECB
Financial Conduct Authority	FCA
Financial risk	FR
Financial Services Innovation Office	FSIO
Financial Technology Companies	FinTechs
Fintech Supervisory Sandbox	FSS
Habit	H
Hedonic motivation	HM
Hong Kong Insurance Authority	IA
Hong Kong Monetary Authority	HKMA
Hong Kong Securities and Futures Commission	SFC
Information Technology	IT
Legal risk	LR
Monetary Authority of Singapore	MAS
Operational risk	OR
Partial least squares	PLS
Perceived benefit	PeB
Perceived risk	PeR
Performance expectancy	PE

Root mean square error	RMSEA
Securities and Futures Ordinance	SFO
Security risk	SR
Social influence	SI
Standardized Root Mean Square Residual	SRMR
Structural equation model	SEM
Technical conditions	TC
Technology acceptance model 2	TAM2
Technology acceptance model	TAM
Theory of reasoned action	TRA
Tucker-Lewis index	TLI
U.S. Commodity Futures Trading Commission	CFTC
Unified theory of acceptance and use of technology 2	UTAUT2
Unified theory of acceptance and use of technology	UTAUT
Variance inflation factors	VIF

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1 Introduction

Currently, the traditional financial services industry in Germany faces tremendous challenges, which result in structural developments that are of substantial nature. In order to remain competitive on both a national and international level, it is inevitable for the affected financial institutions to focus on and understand the factors that drive these developments. Otherwise, it is impossible to derive and implement necessary and constructive implications timely. In this regard, the following dissertation aims at the identification, derivation and discussion of potential strategic and managerial measures, which facilitate and empower policy makers as well as managers and employees of financial institutions to implement essential, effective and efficient provisions regarding two of the identified factors that drive the current developments. The continuing regulatory tightening on the one hand and the ongoing digitization tendencies on the other hand, however, represent these two factors. Thus, a further objective of this dissertation is to contribute to a successful accomplishment of challenges that are of great relevance for the sustainable competitiveness of the entire German financial services industry and its individual institutions. In this regard, the rational for this dissertations' focus on the German banking sector, even though the hereinafter-addressed drivers are not only relevant within the German context, results from the authors' industry specific knowledge. Correspondingly, this enables the utilization of the German financial services industry as a concrete example and thus to become as precise as possible. Ultimately, it is possible to use this dissertations' contributions for further research and discussions that consider other than the German banking sector.

In order to achieve and approach this aim of research systematically, the remainder of this dissertation is structured as follows: First of all, it is necessary to introductory derive and highlight the motivation of this dissertation. This is conducted by outlining the before-mentioned structural developments within the traditional financial services industry in Germany, since these highlight the relevance and importance for the traditional banking sector to identify and implement productive measures. Then, the motivational section gives a brief review on each factor that drives the substantial developments, i.e. the expansionary monetary policy, regulatory tightening, increasing digitization, continuing globalization and the demographic changes. Following the motivational section and based on the identified drivers, this dissertations' research approach as well as the corresponding scope of research are outlined. In doing so, this introductory section briefly introduces the hereinafter-incorporated four scientific studies, which commonly contribute to the overall objective and thus the respective

and arising research questions of this dissertation. Then, this dissertations' introduction concludes by outlining its overall, both academic and practical contributions. Finally, subsequently to the four academic studies, this dissertation concludes by offering some final remarks.

1.1 Motivation

With regard to the following motivational section, it is reasonable to outline that, in order to achieve the greatest possible methodological consistency, transparency and comparability, the utilized financial institutions-related data throughout this section are unified to the period of 1995 to 2018. This is due to the facts that this period incorporates the greatest data consistency and availability and ultimately quality among the utilized sources. At the same time, this period incorporates several times of financial crises and economic cycles and thus is long enough to prevent the affectation of the illustrated trends and argumentations by seasonal or short-term impacts.

1.1.1 Structural developments within the traditional financial services industry in Germany

As already mentioned, the traditional financial services industry in Germany faces enormous challenges that result in significant structural developments. These developments however are characterized by both continuing consolidation tendencies and organizational restructurings. In this regard, one firstly need to constitute that the German financial institutions' return on equity, one of the most important key performance indicators, decreased tremendously from an average of 14.00% in 1995 to an average of only 3.74% in 2018 (Deutsche Bundesbank, 2019c). However, this development outlines that the whole industry faces continuing and substantial profitability issues. Consequently, it is inevitable to admit that the traditional financial services sector in Germany faces enormous strategic and managerial challenges.

Moreover, the continuing and worsening profitability issues are accompanied by substantial organizational downsizings, thus consolidation tendencies. These are, for instance, outlined by the development of the number of financial institutions as well as their number of operating branches or salaried employees. In this regard, the number of financial institutions decreased by 52.89% from 3,785 in 1995 to only 1,783 in 2018. This development equals a compound annual growth rate (CAGR) of -3.22%, which illustrates the mentioned consolidation trends nicely (Deutsche Bundesbank, 2000a; Deutsche Bundesbank, 2019a). Moreover, considering

the downsizing of the organizational structures it is to state that both the number of branches and employees decreased significantly, too. Whereas the number of branches grew by a CAGR of -3.76% from 71,715 in 1995 to less than 30,000 in 2018, the total number of employees decreased from 734,950 in 1995 to less than 572,000 in 2018, which equals a CAGR of -1.09% (Deutsche Bundesbank, 2000a; Deutsche Bundesbank, 2000b; Deutsche Bundesbank, 2019a; Deutsche Bundesbank, 2019e).

Finally, in order to illustrate the highlighted developments, the following figure summarizes both the key structural developments (indexed, left hand side) and the continuing and increasing profitability issues (industry average, right hand side) within the German banking sector from 1995 to 2018:

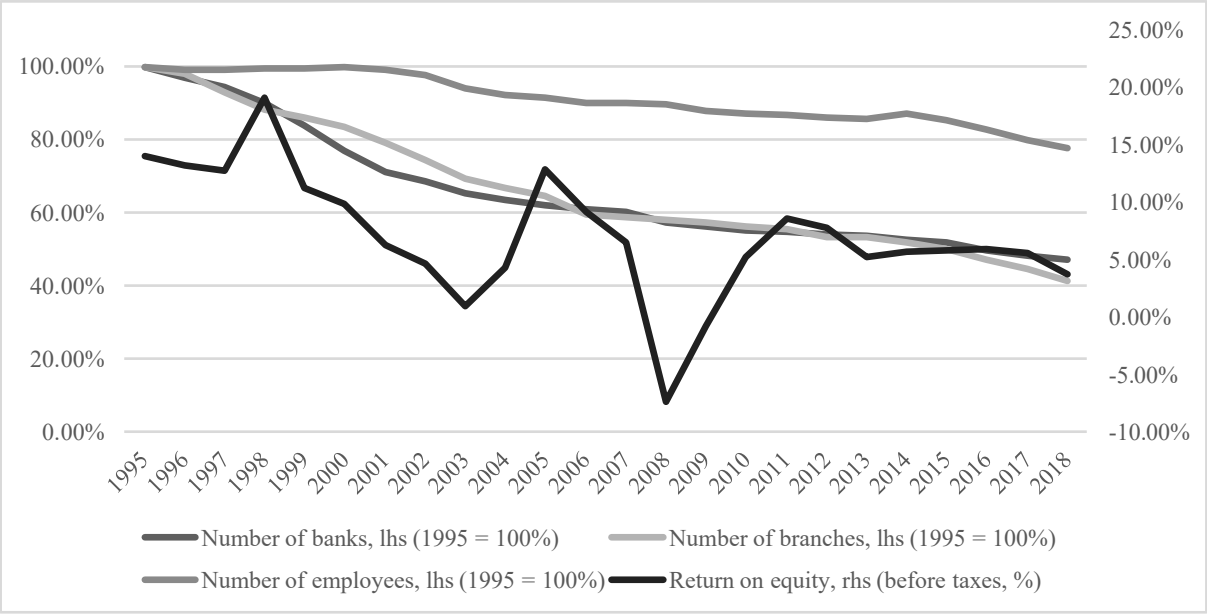


Figure 1: Structural developments and continuing profitability issues within the traditional German banking sector from 1995 until 2018[1]

At this point, it becomes clear, that in order to remain competitive on a national and international level, it is inevitable to both identify and understand the drivers behind these substantial developments. Thus, the pivotal questions, which factors are responsible for the continuing profitability issues and finally drive the outlined structural developments, arise. Yet, it is insufficient to identify these factors. Rather, from a scientific perspective, it is indispensable

[1] Source of data (Deutsche Bundesbank, 2000a; Deutsche Bundesbank, 2000b; Deutsche Bundesbank, 2002; Deutsche Bundesbank, 2004; Deutsche Bundesbank, 2005; Deutsche Bundesbank, 2008; Deutsche Bundesbank, 2010; Deutsche Bundesbank, 2011; Deutsche Bundesbank, 2014; Deutsche Bundesbank, 2016a; Deutsche Bundesbank, 2017; Deutsche Bundesbank, 2019a; Deutsche Bundesbank, 2019c; Deutsche Bundesbank, 2019e).

to conduct comprehensive research on all of the identified drivers in order to enable managers and employees of financial institutions as well as policy makers to identify and implement necessary, effective and efficient strategic and managerial measures regarding the recent developments.

1.1.2 Identified drivers

Considering former research and current industry studies, numerous factors, which can be merged into five trends, drive the recent structural developments within the traditional German financial services industry. Most importantly, the persisting expansionary monetary policy with its corresponding low interest rate environment as well as the continuing regulatory tightening and the ongoing digitization tendencies with their corresponding innovative developments pose significant drivers. These three trends, however, are expected to have the potential to worsening the financial institutions' return on equity by six percentage points, which would cause three quarters of the German banking sector becoming unprofitable. Due to the outstanding potential economic impacts, these three factors commonly are considered as the main drivers among the identified ones (McKinsey, 2016; Oliver Wyman, 2018; Nellis et al., 2000). Additionally to these main factors, the financial services industries worldwide are confronted with ongoing globalization tendencies and, particularly in Germany, demographic changes that are of great relevance and thus pose drivers, too (Oliver Wyman, 2018; Nellis et al., 2000). However, since the expansionary policy, regulatory tightening and increasing digitization commonly pose the main drivers, these are considered to be reviewed by the following paragraphs at first. Subsequently, the universally valid and worldwide relevant factor globalization and finally the particularly in Germany valid demographic changes, follows.

Expansionary monetary policy

As a direct reaction to the global financial crisis of 2007 to 2009, central banks worldwide started to implement both conventional and unconventional expansionary monetary policy measures. These, however, are up for discussion not only continuously but also controversially. In this regard, among other measures, putting key interest rates to historical lows and the implementation of even negative interest rates pose one of the main challenge and thus driver of the continuing profitability issues and structural developments within the traditional financial services industry (Deutsche Bundesbank, 2016b). For instance, the European Central Bank (ECB) decreased the rate for main refinancing options, one of the key interest rates, from 4.25%

in 2000 to 0.00% since 2016. Moreover, the deposit rate of interest turned even negative since 2014 (European Central Bank, 2019).

As a result, the interest margin within the German banking industry, defined as the net interest income as percentage of the total balance sheet, decreased from 1.78% in 1995 to 1.15% in 2010 and even further to (preliminary) 1.08% in 2018 (Deutsche Bundesbank, 2019b). However, the following figure highlights the developments of important and interest rate-related performance indicators:

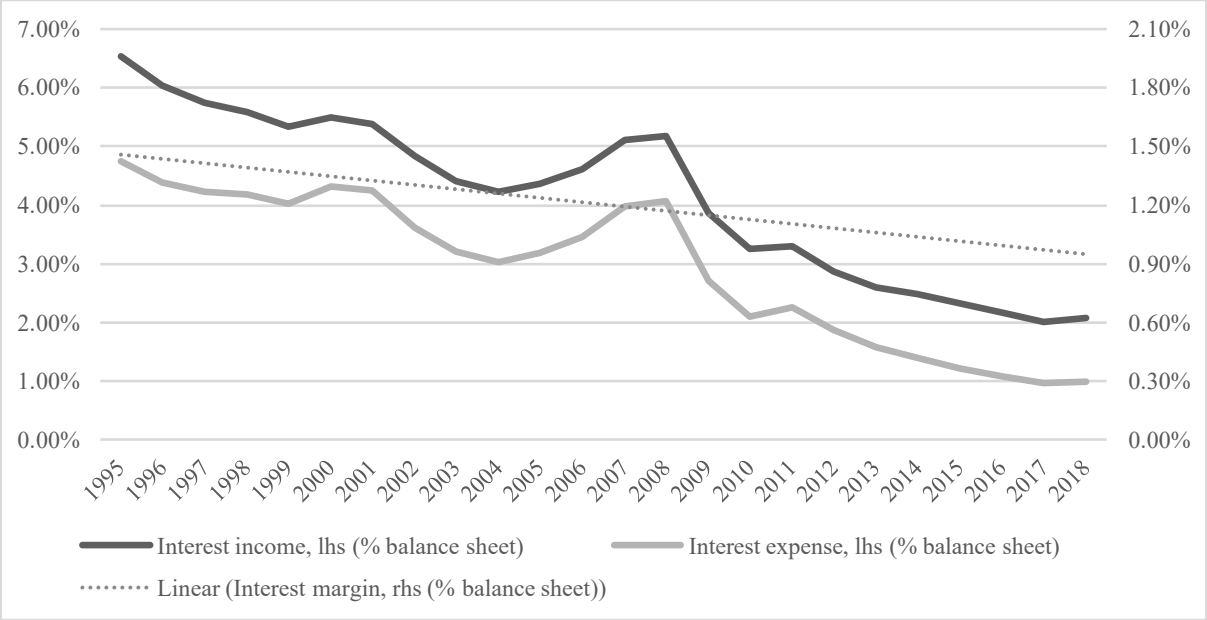


Figure 2: Development of interest income, expense and margin from 1995 until 2018[2]

The impact of these developments on the profitability of the financial services industry becomes even more obvious, if the share of the net interest income to the operating income is considered. In 1995, the net interest income accounted for 81.01% of the German banks' operating income. This share, however, decreased to 74.12% in 2010 and even further to only 72.26% in 2018 (Deutsche Bundesbank, 2019c). Consequently, the interest income as the most important source of income is breaking away and thus eroding, which potentially causes significant negative effects for the profitability of financial institutions. Not enough, the consequences of the low interest rate environment are expected to worsening in the future and are already observed to facilitate the development of systemic risks within the banking industry: Due long-term assets with higher rate of returns need to be substituted by less attractive assets continuously. Thus, the share of the net income that is provided by the conducted maturity transformation is likely

[2] Preliminary data for 2018. Source of data (Deutsche Bundesbank, 2019b).

to even further decrease in the future. As a result, traditional financial institutions currently widen their conducted maturity transformation in order to generate at least reasonable interest margins. This behavior is for instance illustrated by the increasing share of property credits with long-lasting fixed interest periods (above 10 years), which accounted for around 20.00% in 2003 and increased to around 50.00% in 2019. Moreover, financial institutions currently expand not only their lending behavior in general but also particularly to companies with a supposable less soundness. All in all, these developments briefly indicate the potential risks that arise from the continuing expansionary monetary policy and eventual changes to a less expansionary or even contractionary monetary policy as well as from potential economic downturns in the future (Bain & Company, 2015; Deutsche Bundesbank, 2019d).

Anyhow, at this point it is reasonable to briefly mention that it may be rashly to hold central banks with their conducted expansionary monetary policy alone responsible for the historical low interest rate environment. In fact, there is an ongoing discussion considering secular stagnation and thus, independently from expansionary monetary policy measures, potentially declining equilibrium real interest rates (Summers, 2014; von Weizsäcker, 2014). However, this discussion is, on the one hand, of purely economic nature and thus out of this dissertations' scope. On the other hand, for the purpose of this dissertation, it is circumstantial, since the expansionary monetary policy measures with their corresponding historical low interest rate environment are existent, in fact.

Regulatory tightening

Also resulting from the global financial crisis of 2007 to 2009, there is an ongoing discussion about the reformation of supervisory structures and approaches for the financial services industries worldwide. Consequently, the banking sector faces an actual tightening of regulatory requirements that pose significant challenges, which are of organizational, financial and personnel nature for both incumbent banks and potential new entrants. In this regard, the linkage between the financial services industry and the real economy as well as the potential contagion of stock markets and the real economies across countries and sectors illustrate the great relevance and importance of the banking industry and thus the rationale for its regulation (Jokipii and Monnin, 2013; Baur, 2012).

Anyhow, not only the financial crisis but, among others, the current digitization tendencies and thus financial innovations drive the current regulatory developments, too (Melecky and Podpiera, 2013; Maume, 2017). Irrespectively of the discussion about the justification, necessity or extent of the regulatory intensifications and the rational of regulation in general, one need to constitute that these represent significant market entry barriers. Consequently, the regulatory intensifications potentially pose and increase major hurdles for innovation and thus potentially favorable economic growth, innovative developments and customer welfare (Fratzscher et al., 2016; Melecky and Podpiera, 2013; Arner et al., 2016; Brummer and Gorfine, 2014; Gerlach et al., 2016; Herger, 2016; Maume, 2017). As a result, a trade-off between a sound regulation on the one hand and innovation support on the other hand arises. In this respect, the German regulator itself recognized a "need for action", too (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016).

Anyway, the extent of the ongoing regulatory tightening can be illustrated by the German financial institutions' average share of the general administrative expenses to the operating income, which increased from 63.83% in 2010 to 73.05% in 2018 (Deutsche Bundesbank, 2019c). Hereby, the general administrative expenses are used as a proxy for the costs of the increasing regulatory tightening (Bain & Company, 2015):

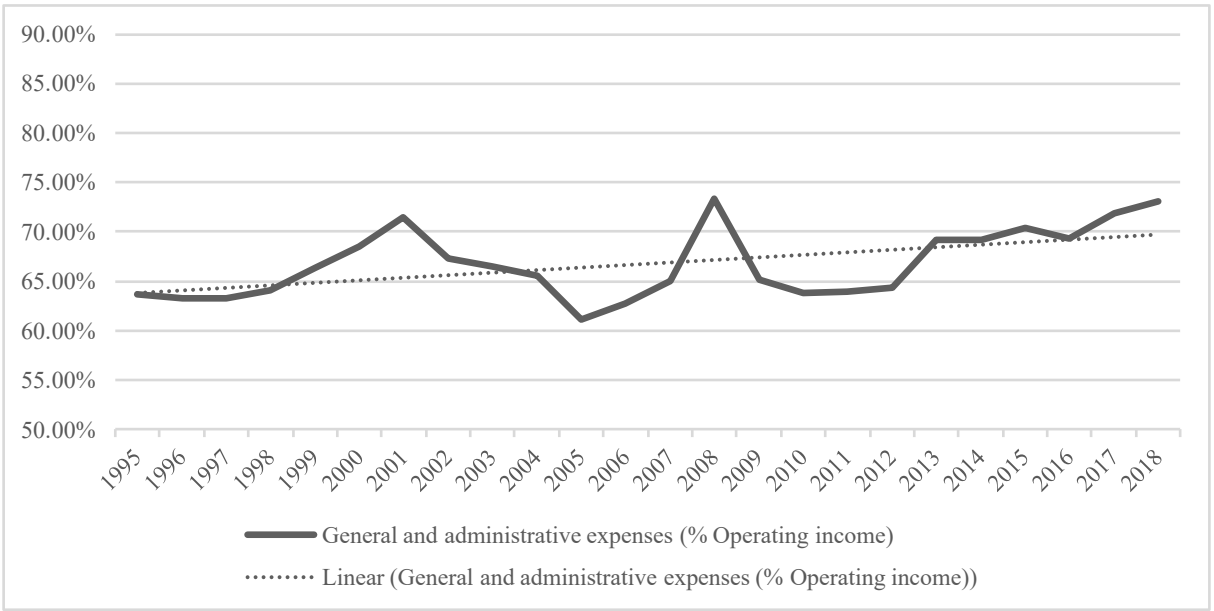


Figure 3: Development of the share of general administrative expenses to operating income from 1995 until 2018[3]

[3] Source of data (Deutsche Bundesbank, 2019c).

Digitization

In a narrower sense, digitization reflects the conversion of in any form analogous stored information (e.g. photographs, text, voice) into a binary electronic (digital) form. This process is carried out by using suitable electronic devices like scanners, cameras or computer chips. Finally, the digitized information can be processed, stored and transmitted digitally (BusinessDictionary, 2019; Pearce-Moses, 2005; Khan et al., 2015). In a broader context, digitization comprehends the development and continuous improvement of semiconductor technologies like computers, laptops and mobile devices, software applications as well as network access (Katz and Koutroumpis, 2013). In this regard, one need to state that the current digitization tendencies have the potential to reshape business models in many traditional industries (Loebbecke and Picot, 2015). Thus, it is inevitable that companies of all industries, respectively their managements and employees, rethink business activities as for instance brand building, the way how customers are attracted, product development and quality control as well the whole supply chain design (Dellarocas, 2003).

However, with regard to the traditional financial services industry one can observe that both retail and corporate customers' preferences are continuously shifting towards digital channels. Consequently, customers are willing and expect to use innovative, reinvented and digitized products and services. Moreover, competitive as well as market landscapes are changing continuously. As a result, traditional financial institutions are facing new challenges regarding the servicing and retaining of customers (McKinsey, 2016). Against this background of changing customer expectations, it is inevitable to continuously identify and analyze the rising challenges, to assess product portfolios and distribution channels as well as finally to implement productive strategic and managerial measures in a timely manner.

Anyhow, the percentage of individuals using the internet illustrates the rising trend of digitization and its extent nicely: Worldwide, this number increased from 0.05% in 1990 to almost 50.00% in 2017. For the same period the percentage of individuals using the internet in Germany grew from 0.13% in 1990 to 84.40% in 2017 (The World Bank Group, 2019). Additionally, the soaring interest in digitization is reflected by continuously increasing research activities in this field. For instance, since 2001 the World Economic Forum (in partnership with INSEAD and Cornell University) publishes "The Global Information Technology Report". Therein, based on a comprehensive set of 53 indicators, of which the above used "percentage of individuals using the internet" is one indicator, the authors calculate "The Networked

Readiness Index", which points out the digitization-level for each of the 139 covered economies. In the current report, Singapore is the leading country, whereas Germany is ranked 15th (World Economic Forum, 2016b).

Globalization

In general, globalization is understood as the rising interconnectedness and interdependence, thus integration, of the world in differing dimensions as for instance in environmental, social and cultural as well as economic ones (Wolfensohn, 2001; Obadan, 2006). With regard to the financial services industry, the banking sector globalization is characterized by increasing cross-border interdependencies of the financial markets and institutions, basically. These imply, among others, a rising share of banks with considerable foreign positions and business activities, an increasing number and volume of international transactions and capital flows as well as more diversified and international ownership structures of financial institutions (Goldberg, 2009; Lane and Milesi-Ferretti, 2008). However, from an economic point of view, these tendencies pose both potential positive and negative outcomes: On the one hand, positive outcomes may result from increasing international trade and foreign direct investments, technology transfers and productivity enhancements as well as wage spillovers (Goldberg, 2009). On the other hand, the enhancement of the transmission of international shocks, driven by increasing interdependencies and the resulting potential contagion and spillover effects, which not exclusively but particularly occur within the financial services industry, pose significant risks of the increasing globalization tendencies (Goldberg, 2009; Leitner, 2005; Kaufman, 1994).

As a result, it becomes clear that the rising globalization tendencies imply increasing complexities as well as changing competitive frameworks. Ultimately, both opportunities and threats for conducted businesses in general and thus the financial services industry as well, arise. As a result, one need to constitute, that the continuing globalization tendencies pose both strategic and managerial challenges for the traditional German banking sector that are of great relevance, too.

Demographic changes

In addition, the financial services industries worldwide and particularly in Germany face demographic changes. In Germany, an overall decreasing population, which is accompanied by an increasing share of elderly, characterizes the demographic-changes. To become more

concrete, a base case scenario (Statistisches Bundesamt, 2019) estimates that the total population decreases from 82.9 million in 2018 to only 74.4 million in 2060. At the same time, the share of people aged under 20 is expected to remain relatively stable (2018: 18.46%; 2060: 17.88%). In contrast, the working population (aged 20 to under 67) is awaited to decrease both in absolute and relative terms from 51.8 million (62.48%) in 2018 to 40.0 million (53.76%) in 2060. Correspondingly, the share of retired people (67 and older) is estimated to increase from 19.06% (15.8 million) in 2018 to 28.36% (21.1 million) in 2060. However, the potential economic and societal consequences of these developments are, for instance, outlined by the calculation of a certain coefficient: In 2018, 100 people aged 20 to under 67 accounted for 60 people aged under 20 or 67 and older. Thus, in 2018, 100 people were financially responsible for 60 young and retired people. Until 2060, this coefficient is expected to increase to 86. Thus, in 2060, 100 people are expected to be financially responsible for already 86 young and retired people.

Anyhow, from the perspective of the financial services industry, these developments are of great relevance. On the one hand, the decreasing number and share of the working population implies an increasing competitive intensity with regard to highly qualified employees. On the other hand, the total number of retail customers not only decreases but their aging structure changes as well. Consequently, demand behavior, customer needs and expectations are changing, too. Moreover, potential implications for, among others, the average wealth, credit demand or transaction volumes and numbers need to be analyzed carefully. However, there is no doubt that the demographic developments affect current and potential sources of income and thus the way of how business should be conducted. As a result, from the German financial institutions' perspective, demographic developments need to be taken into consideration continuously in order to derive and implement appropriate measures with regard to both human resources activities and the customer-related businesses.

1.2 Research approach

As already mentioned, it is inevitable to both identify and understand the drivers that are responsible for the highlighted structural developments within the traditional financial services industry in Germany, which are characterized by ongoing and worsening profitability issues, consolidation trends as well as continuing organizational restructurings and downsizings. Yet, it is scarce to identify these. In fact, from an academic perspective it is mandatory to provide comprehensive research on the identified determinants, i.e. the expansionary monetary policy,

the regulatory intensifications and increasing digitization tendencies as well as the ongoing globalization and, particularly in Germany, the demographic changes. Otherwise, indispensable knowledge, which facilitates managers, policy makers and employees to derive and implement necessary, effective and efficient measures timely, would have yet be explored.

However, as already outlined, due to their outstanding potential economic impacts, the three factors expansionary monetary policy, regulatory tightening and the increasing digitization tendencies commonly represent the main drivers among the identified ones. Moreover, since this dissertation focuses primarily on more business and less purely economic related issues, the hereinafter presented, scientific contributions address two of the three essential drivers, i.e. the regulatory tightening and the increasing digitization, respectively their intersection. These, however, represent the scope of research of the herewith-presented dissertation and thus the incorporated scientific contributions. In doing so, this dissertation aims to provide comprehensive research and discussions as well as the derivation of implications on how to manage these two challenges, respectively their intersection, successfully:

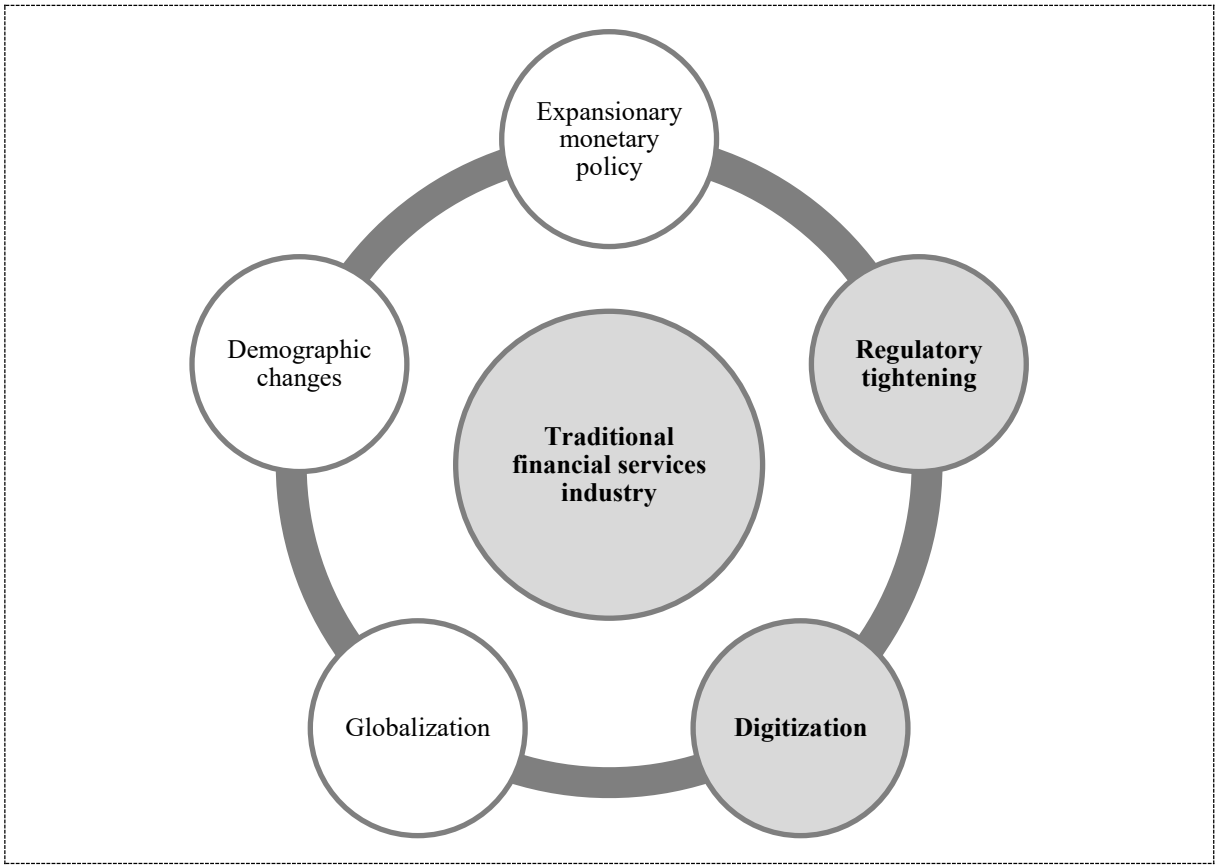


Figure 4: This dissertations' area of research

More specifically, the first study of this dissertation ("The Predicament of FinTechs in the Environment of Traditional Banking Sector Regulation – An Analysis of Regulatory Sandboxes as a Possible Solution") addresses the difficulty that regulatory requirements pose significant market entry barriers. Consequently, the market entry of new competitors that potentially contribute to economic growth, innovative developments and customer welfare becomes more difficult. Based on a detailed analysis, this studies' objective is to develop an own set of recommendations for the implementation of a regulatory sandbox concept that addresses the mentioned market entry barriers and thus enables respective companies to test new products, services and business models in a live, but supervised environment (He et al., 2017; Financial Conduct Authority, 2015b). However, even though this study focuses on the German regulatory landscape, the results may potentially build the basis for further discussions on an international level. Ultimately, this study addresses the intersection of the two drivers regulatory tightening and digitization.

Afterwards, the second study of this dissertation ("Evidence on Usage Behavior and Future Adoption Intention of FinTechs and Digital Finance Solutions") aims at the identification and discussion of determinants of the current use behavior and future usage intention of customers regarding Financial Technology Companies (FinTechs) and digitized financial products and services, i.e. Digital Finance Solutions. It is of great relevance to gain knowledge about whether and how potential drivers affect the customers' decision-making as well as whether and why customers of traditional financial institutions are likely to shift to FinTechs as alternative service providers. Ultimately, it is inevitable to evaluate the identified determinants and to develop both strategic and managerial implications from the viewpoint of the traditional financial services sector. Consequently, the second study focuses on the increasing digitization tendencies as one of the identified main drivers for the observable structural developments.

Following this, the third study ("Digital Financial Advice Solutions – Evidence on Factors Affecting the Future Usage Intention and the Moderating Effect of Experience") also addresses the increasing digitization tendencies. However, it aims to concretize the previous findings by not focusing on the institutional level (second study) but rather addressing the digital developments within a specific financial services area, i.e. Digital Financial Advice Solutions (DFAS). In doing so, the specific aim is to identify and evaluate the effect of perceived benefit and risk on the future usage intention of DFAS, to provide knowledge on factors that determine perceived benefit and risk and to research on the potential moderating effect of experience.

Finally, the derivation of strategic and managerial implications from the viewpoint of the traditional banking sector is given a central importance, again.

Furthermore, the final and fourth study of this dissertation ("User Perception of Digital Money Solutions – Impact of the Complementary Usage to Fiat Currencies on Prospective Use Behavior") also aims to substantiate the findings on the institutional level (second study) on the level of one specific financial services area, i.e. Digital Money Solutions (DMS). In this regard, the fourth studies' objective is to identify determinants of the intention to use cryptocurrencies parallel to fiat currencies in the future. Thus, in this study, the identification of barriers to use cryptocurrencies is of great relevance. In doing so, as with all other studies, the identification of both strategic and managerial implications is of central importance.

Finally, as the previous sections highlight, this dissertation identified the continuing regulatory intensifications and the current digitization tendencies as two of the three main factors that drive the current structural developments and thus pose major challenges for the German financial services industry. Consequently, as the presented research approach and its scope outline, the incorporated studies address the intersection of these factors as well as particularly the current digitization tendencies. In this regard, the overall research aim of this dissertation is to identify, derive and discuss potential strategic and managerial measures that enable and empower policy makers as well as managers and employees of German financial institutions to implement necessary, effective and efficient measures timely. In doing so, this dissertation further aims to contribute to the successful management of challenges, which are of great relevance for the sustainable competitiveness of the traditional German banking sector in its entirely as well as its individual institutions. Commonly, the hereinafter-incorporated studies contribute to this dissertations' aim of research and thus the corresponding and arising research questions.

1.3 Contribution

First of all, it is important to mention that the following dissertation, respectively its four studies, contributes to identified research gaps, matters and discussions that are of great relevance from both an academic and practical perspective. However, from the scientific viewpoint, this dissertation contributes to several strands of literature: Firstly, it adds to the current literature on the development of FinTechs. Thus, it contributes to the general understanding of FinTechs as well as the various areas of operations and the corresponding products and services, particularly with regard to DFAS and DMS (Arner et al., 2016; Zetzsche

et al., 2017; Gomber et al., 2017). As it moreover incorporates both the theory of reasoned action (TRA) and the unified theory of acceptance and use of technology 2 (UTAUT2), this dissertation also contributes to the literature on behavioral intention and the acceptance or adoption of technology (Ajzen and Fishbein, 1977; Venkatesh et al., 2012).

The combination of these different strands of literature, however, results in more comprehensive sets of variables. Consequently, compared to former studies, this combination enriches the corresponding analyses, results and discussions. Furthermore, by identifying certain fields of interest and the derivation of corresponding strategic and managerial implications from the viewpoint of traditional financial institutions, this dissertation moreover contributes to the practical solution of current challenges that are of great relevance for practitioners, too. This incorporates, for instance, rising challenges from FinTechs that emerge as alternative service providers as well as from the continuous digitization of financial products and services, particularly with regard to DFAS and DMS.

Moreover, this dissertation also contributes to the recent discussion of an optimal design of regulatory sandbox concepts from the perspective of both the regulatory authorities and FinTechs. In doing so, within the German landscape, it further adds to the recent literature concerning existing regulatory frameworks and their approaches to govern FinTechs (Scholz-Fröhling, 2017; Maume, 2017; World Economic Forum, 2016a). Consequently, the systematically derived propositions have the potential to contribute to the solution of the identified trade-off between sound regulation on the one hand and innovation support on the other hand. Since the German regulator itself identified a “need for action” in this regard, this study also contributes to current practical challenges that both regulators and affected companies, i.e. traditional financial institutions and FinTechs, face (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016).

Finally, even though all of the herein incorporated studies focus primarily on the German financial sector, all of the results, discussions and implications can be used as a basis for further research and discussions that focus on other than the German banking sector. This is, in particular, due to the fact, that both of the hereinafter-addressed drivers, i.e. the regulatory tightening and the increasing digitization tendencies, represent significant challenges for financial services industries worldwide. However, as already mentioned, the rational for this dissertations’ focus on the German financial services industry refers to the authors’ industry

specific knowledge. Correspondingly, the possibility to utilize the German banking sector as a concrete example and thus to become as precise as possible motivates this geographical focus. Nevertheless, the author would hereby like to once again encourage to use this dissertations' contributions for further research and discussions that refer to other than the German financial services industry. In this regard, all of the hereinafter-incorporated studies contain the derivation of limitations and future research opportunities and requirements. Moreover, since the following scientific studies comprise not only both secondary research (the analysis of existing regulatory sandbox frameworks) and field research (two comprehensive surveys) but do also apply differing theoretical (conceptual analysis) and quantitative empirical (logistic regression design, structural modelling) approaches, this dissertation contributes through its theoretical and empirical variation to the recent literature.

2 The Predicament of FinTechs in the Environment of Traditional Banking Sector Regulation – An Analysis of Regulatory Sandboxes as a Possible Solution

2.1 Abstract

Recently, Financial Technology Companies are increasingly changing the financial services industry worldwide and impose considerable challenges for regulators tasked to solve the arising trade-off between sound regulation and innovation support. In this regard, regulatory sandboxes, which were recently introduced in several jurisdictions, provide a promising solution, as they imply a liberalization of regulatory requirements in order to enable FinTechs to test their innovative services. However, we observe that no comparable initiative exists in Germany, even though the German regulator identified a need for action on this subject in order to maintain its international competitiveness. Thus, based on a detailed analysis of various sandbox models worldwide, this paper develops a set of own recommendations as a basis for the implementation of a sandbox concept which might be applicable in the German regulatory environment. In doing so, we identify current theoretical as well as practical regulatory issues within the context of the rapid FinTech evolution. To the best of our knowledge, this paper represents the first study on key international sandboxes as a basis to design guidelines specifically for the German financial market. Thereby, we contribute to the literature as we evolve an effective regulation within the new setting of innovative financial technologies. Moreover, our findings contribute to the practical solution of current challenges faced by both regulators and affected companies. Even though our derived implications focus on the German financial sector, the results may potentially be applicable in further jurisdictions with similar regulatory requirements.

Keywords: FinTech, financial sector, financial regulation, FinTech regulation, financial stability, regulatory sandbox, financial services industry, digital finance

JEL Classification: G21, G28, M13

2.2 Introduction

FinTechs are increasingly changing the financial services industry worldwide, as their novel business models do not only result in increasing competition within the financial markets (McKinsey, 2016), but also pose considerable challenges to regulators' core mandates to ensure regulatory compliance and financial stability. Through their application of new technologies, FinTechs – comprising both incumbents and start-ups – already provide the entire range of financial services traditionally covered by established banks (Arner et al., 2016; Arner et al., 2017) and have become a significant segment within the traditional financial services sector in the meanwhile.

Besides their various opportunities to enhance efficiency and competition within the markets (Bank for International Settlements, 2017; Ernst & Young, 2017a; He et al., 2017), these highly innovative entities may also pose considerable risks to financial stability. This is because there is still uncertainty about how regulators should best apply their strict banking regulations to the novel settings of FinTech business models without simultaneously creating a major hurdle for innovation (Maume, 2017; Michaels and Homer, 2018; Gerlach et al., 2016; Herger, 2016; Brummer and Gorfine, 2014). Regulatory Sandboxes, which are recently developed and tested in several jurisdictions, provide a promising solution to the occurring trade-off between sound regulation and innovation support, without threatening financial stability or degrading consumer protection. This new approach typically implies a temporary liberalization or even exemptions from regulatory requirements to facilitate FinTechs to test their new services in a supervised environment (Financial Conduct Authority, 2015b; He et al., 2017).

Despite the diversity of successful[4] and potentially beneficial[5] sandbox solutions already elaborated worldwide, we observe that to date no comparable initiative exists in Germany. Therefore, the emigration of entrepreneurs to more dedicated economies could negatively affect the innovativeness and thus competitiveness as well as eventually the national economies' condition. In fact, so far only one legislation, which specifically addresses FinTech concerns, was implemented (Maume, 2017). However, Germany's status as one of the major FinTech markets as well as the rapid diffusion of FinTechs in the highly regulated German financial sector (Dorfleitner et al., 2016) clearly indicate the growing need for the (local) regulator to provide explicit regulatory guidance for FinTechs by creating a contemporary and flexible

[4] In terms of usage and successful market entries of participating FinTechs.
[5] In terms of the suitability of sandboxes to reduce market entry barriers for (potential) new entrants.

solution. Based on the identified need for action in the German context and the high interest of the federal supervisory authority – the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) – in this topic (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016), we aim to develop a sandbox framework that is, from the regulators' point of view, applicable in the German regulatory environment without compromising core regulatory objectives. Building on a detailed analysis of the various sandbox models worldwide, a major objective of this paper is to develop an own set of recommendations as a basis for an accessible and sustainable sandbox implementation for both, the regulator and the FinTechs. Moreover, even though our derived implications focus on the German financial sector, the results may be applicable in further jurisdictions with similar regulatory requirements. Additionally, our analysis of various sandbox models worldwide can be used as a basis for further research, which focuses on other than the German financial markets. Finally, emphasized by taking into account the empirically and theoretically discussed implications of market entry barriers as well as potential issues arising from the principal-agent theory, i.e. adverse selection and moral hazard, it seems favorable to address this topic not only from a practical but also from a theoretical point of view.

Several articles have already examined the similarities and differences among national sandbox solutions (Zetzsche et al., 2017; Jenik and Lauer, 2017). In contrast, our paper represents to our best knowledge the first study on key international sandboxes as a basis to design guidelines for a regulatory sandbox specifically for the German market. Thereby, we contribute to the current discussion of an optimal design of sandbox concepts from the perspectives of both the regulator and FinTechs. If successfully implemented, the proposed regulatory sandbox framework has the potential to lower regulatory barriers for FinTechs and to create a level playing field while safeguarding the stability of the financial system as a whole. Furthermore, it potentially strengthens the dialogue between financial firms and the competent authorities, giving the former the opportunity to clarify (emerging) regulatory questions and the latter to assess the inherent opportunities and risks. In the second place, we add to the recent literature on the evolution of FinTechs and thereby contribute to the general understanding of FinTech services and their various areas of operations (Arner et al., 2016; Zetzsche et al., 2017). Finally, by focusing on the German banking system, we contribute to the literature concerning existing regulatory frameworks and their approaches to govern FinTechs (Scholz-Fröhling, 2017; Maume, 2017; World Economic Forum, 2016a).

In order to achieve our objective as well as to emphasize the need for action in the German context, this paper is structured as follows: Section 2.3 builds the theoretical framework of this paper. Herein, we firstly discuss our understanding of financial technologies and identify major representative FinTech markets worldwide. In order to explain the trade-off between sound regulation and innovation support, we address theoretical fundamentals of financial services regulation, specifically focusing on the German market and the lack of specialized FinTech regulation and supervision in Germany. After we introduced the regulatory sandbox as a concept that may contribute to the solution of this trade-off, section 2.3 concludes by systematically deriving relevant countries, which built the scope of our further analysis. From this basis, section 2.4 then provides a detailed analysis of regulatory sandbox concepts already implemented in those countries, which we identified as relevant for our study. Building on this, section 2.5 suggests our framework for the implementation of a regulatory sandbox concept in Germany. Finally, the paper concludes by offering deductive remarks, limitations of this study and proposed future research.

2.3 Theoretical background and definitions

2.3.1 Digital Finance and FinTech

Regarding the term "FinTech", we observe that so far no unique definition could be established (Dorfleitner et al., 2016; Ryu, 2018a; Schueffel, 2016). Albeit the lack of agreement regarding the terms' meaning there is consensus that "FinTech" is a composition of the words "Financial" or "Finance" and "Technology" (Arner et al., 2016; Dorfleitner et al., 2016; Gomber et al., 2017; Kim et al., 2016; Kuo Chuen and Teo, 2015; Ryu, 2018a). However, regarding the meaning of FinTech some authors propose a functional, product or service oriented definition (Arner et al., 2016; Kim et al., 2016; Kuo Chuen and Teo, 2015; Philippon, 2016; Ryu, 2018a) whereas others use an institutional oriented definition. Since this paper addresses the regulation of financial institutions as well as new competitors entering the financial services sector, it follows the institutional approach for defining FinTechs. Thus, for the purpose of this study, a FinTech is referred to as a company or entity, both start-up or established, that develops and offers innovative financial services by using new technology. Accordingly, FinTechs usually represent some kind of innovator or disruptor (Dorfleitner et al., 2016; Gomber et al., 2017).[6]

[6] Entities that, by developing revolutionary products and services with powerful displacement potentials, threaten established competitors. For further details see Deloitte (2014); AGV Banken (2015); Christensen et al. (2015).

Furthermore, based on offered products and services as well as underlying technological concepts, it is possible to systemize FinTechs. For instance, using the comprehensive "Digital Finance Cube-theory", Gomber et al. (2017) systemizes FinTechs regarding the business functions digital financing, investment, money, payments, insurances and financial advice as well as regarding the used technological concepts such as Blockchain, Near Field Communication and Big Data Analytics. In fact, numerous authors propose differing systemization approaches, even though one has to state that all approaches are similar to each other (Arner et al., 2017; Bank for International Settlements, 2017; Maume, 2017; Brummer and Gorfine, 2014; Clifford Chance, 2017; He et al., 2017; Financial Stability Board, 2017; Arner et al., 2016; Philippon, 2016; Schindler, 2017; Dorfleitner et al., 2016).

From the traditional financial institutions' point of view, there are ongoing discussions on how to deal with these new competitors. In general, both competitive and co-operative strategies are eligible (Gomber et al., 2017). However, one thing remains to be sure: Leaving FinTechs or digital movers unchecked could be quite dangerous for traditional financial institutions. Based on a 2016 study this may traditional banks cause to suffer a loss of 5.0% to 15.0% of their customer based interest and fee income within the next five years (McKinsey, 2016).

2.3.2 Developments and major representative FinTech markets worldwide

The FinTech sector has become a considerable segment within the traditional financial services sector, continuing to evolve rapidly. The development of FinTech markets worldwide can be illustrated by using different kind of data. For instance, the annual global FinTech funding volumes can be used to point out the FinTechs' growth. According to "The Pulse of FinTech", a regular study by KPMG, the annual global FinTech investments grew with a CAGR of more than 53.0% from 2011 (USD 2.4 billion) to 2017 (USD >31.0 billion), even though slowing down during the years 2016 and 2017 (KPMG, 2016; KPMG, 2017; KPMG, 2018). Moreover, the rising interest in FinTechs can be illustrated by using Google Trends' data, which can be used to analyze the relative worldwide frequency of the search term "fintech" within a specific time frame:

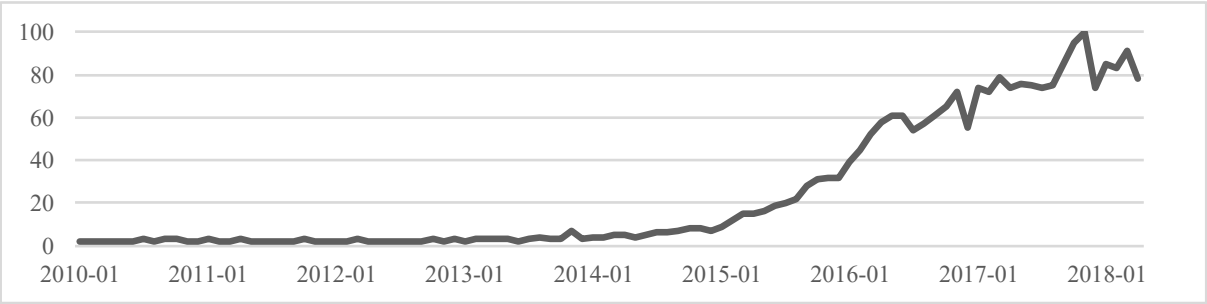


Figure 5: Relative world wide frequency of the search term "fintech" from January 2010 until April 2018[7]

Furthermore, since 2015 Ernst & Young publishes the "EY FinTech Adoption Index", which aims at analyzing, comparing and illustrating the worldwide adoption of FinTech services. One key finding of the current 2017 report is that on average 33% of all digitally active consumers across the surveyed 20 markets use FinTech services, compared to 16% in 2015.[8] This development outlines the strong growth and current market penetration of FinTechs, which now achieve levels of market presence that can influence both industry standards and customer expectations. Having a closer look at the 2017 data, one can assert that particularly emerging countries (China, India, Brazil, Mexico and South Africa) have high adoption rates (46.4% on average), which may be due to the facts that these countries are characterized by not only having growing economies and tech-literate populations but also poor financial infrastructures and financially underserved populations (Ernst & Young, 2017b). Regarding the anticipated development of FinTechs, Ernst & Young (2017b) estimates show that global FinTech adoption may increase to 52% on average, with particularly strong developments in South Africa, Mexico and Singapore. However, the following table summarizes and compares the 2015 and 2017 FinTech adoption rates:

[7] Source of data (Google Trends, 2018).
[8] In 2015, the study covered six markets.

	FinTech adoption (%)	
	2015	**2017**
China		69
India		52
UK	14	42
Brazil		40
Australia	13	37
Spain		37
Mexico		36
Germany		35
South Africa		35
US	17	33
Hong Kong	29	32
South Korea		32
Switzerland		30
France		27
Netherlands		27
Ireland		26
Singapore	15	23
Canada	8	18
Japan		14
Belgium & Luxembourg		13
Average	**16**	**33**

Table 1: FinTech adoption rates 2015 and 2017[9]

Finally, based on the illustrated development of FinTech markets worldwide, it is possible to identify major FinTech markets, which are used as the basis for the further research in this paper. This identification process is conducted according to the following methodology and criteria, in which those countries covered by the EY FinTech Adoption Index represent the universe of potential major FinTech markets:

- Firstly, we classify countries with average and higher-than-average FinTech adoption rates in 2017 as major FinTech markets.
- Secondly, we classify countries with particularly strong expected growth rates for FinTech adoption as major FinTech markets (Ernst & Young, 2017b).
- Thirdly, we classify Hong Kong, Japan and South Korea as major FinTech markets, since these countries have a considerable meaning for the global financial industry and are considered as Financial Hubs.[10]

As a result, we identify the following countries as major FinTech markets, thus building the basis for the following research in this paper:

[9] Source of data (Ernst & Young, 2017b).

[10] Also financial center, meant as a city or region with a high concentration and variety of major financial institutions, which provide the entire range of high-end banking and financial services on a national or international basis. For further details see Zhao et al. (2004).

Major FinTech markets		
Criteria	**Markets**	**Total**
Average and higher-than-average FinTech adoption rates	Europe: Germany, Spain, UK America: Brazil, Mexico, US Asia: China, India Other: Australia, South Africa	10
Particularly strong expected growth in FinTech adoption rates	America: Mexico Asia: Singapore Other: South Africa	3
Financial Hubs	Asia: Hong Kong, Japan, South Korea	3

Figure 6: Major FinTech markets

2.3.3 Resulting regulatory predicaments

As already noted by the Financial Stability Board, FinTechs may have a "material effect on financial markets and institutions and the provision of financial services" (Financial Stability Board, 2017). In fact, FinTechs already provide the entire range of financial services and products traditionally covered by established banks (Arner et al., 2016; Arner et al., 2017). As well as the widespread adoption of new technologies offers various opportunities, such as contributing to increasing innovation and enhancing efficiency in the financial services sector (Maume, 2017; Ernst & Young, 2017a; He et al., 2017; Bank for International Settlements, 2017), the exceptional rate of development of new business models[11] also poses considerable challenge to regulators, supervisors and policymakers worldwide. Despite the fact that many FinTech activities and business models fall within the scope of traditional banking regulations (Financial Stability Board, 2017), there are still considerable uncertainties about how to apply the regulatory requirements, i.e. consumer protection, anti-money laundering, compliance and licensing, to FinTechs (Maume, 2017; Michaels and Homer, 2018). Complying with these stringent regulatory requirements would pose not only financial, but also organizational as well as personnel challenges to FinTechs, particularly in the case of start-ups, and thus represent not only significant market entry barriers but also major hurdles for innovations (Gerlach et al., 2016; Maume, 2017; Herger, 2016; Brummer and Gorfine, 2014; Arner et al., 2016).

On the other hand, FinTechs also operate in business segments not yet covered by regulatory frameworks, thereby avoiding regulatory costs and oversight (Bank for International Settlements, 2017; Financial Stability Board, 2017; Accenture, 2016; Michaels and Homer, 2018). The resulting "regulatory gaps" (Bank for International Settlements, 2017) however, clearly contradict the core mandate of regulation to ensure a level playing field for incumbent

[11] Largely led by start-ups.

firms and newcomers (He et al., 2017) and may moreover lead to new risks like the creation of a shadow-banking market.

Governments and regulatory authorities are aware of the need to provide clear regulatory guidance and thus are targeting an "optimal regulation" (Ernst & Young, 2017a) that promotes beneficial innovations and market competition without threatening financial stability and oversight or degrading consumer protections (Schleussner, 2017; Arner et al., 2016; Bank for International Settlements, 2017; Financial Stability Board, 2017; Arner et al., 2017; Treleaven, 2015; He et al., 2017; Brummer and Gorfine, 2014; Zetzsche et al., 2017; Dombret, 2016). Moreover, this regulatory trade-off is not only relevant in the financial services industry, but is also – from an economic point of view – relevant on a national basis: In order to remain competitive, national economies and its politicians should be aware of the positive relatedness between (technological and organizational) innovation and economic growth (Freeman, 1995; Brown et al., 2009). To address this (economic) trade-off between sound regulation on the one hand and fostering innovation on the other hand, policymakers worldwide are currently developing and testing different approaches.

2.3.4 Regulatory requirements of FinTech business models

The banking sector is considered to be one of the most heavily regulated sectors worldwide (Clifford Chance, 2017; Schleussner, 2017). The fundamental mandates of financial regulation are to ensure the stability of the financial system, to create a level playing field between market participants and to protect consumers and investors (Arner et al., 2016; Bundesanstalt für Finanzdienstleistungsaufsicht, 2018b; Fest, 2008; He et al., 2017; Schleussner, 2017; Zetzsche et al., 2017). With regard to FinTechs, four main types of regulation are of particular importance: Consumer protection, anti-money laundering, compliance and licensing (Maume, 2017; Schneider et al., 2016; Bank for International Settlements, 2017). From a theoretical point of view, the rationale for consumer protection is based on the assumption that consumers have limited capacity to effectively assess and monitor the safety and soundness of financial institutions, which is due to information asymmetries as well as potential moral hazard-issues (i.e. unobservable behavior) in the financial markets (Goodhart et al., 2013; Kim et al., 2013; Llewellyn, 1999). Thus, in this context, the purpose of regulation is to adjust the system for market imperfections and to prevent market failures that ultimately would impair consumer welfare (Llewellyn, 1999).

Under German law, FinTechs become subject to regulation and supervision, if they operate businesses, which require a permission (i.e. a banking license) by the responsible regulators (§ 32 KWG). Those businesses include the provision of banking businesses (§ 1 sec. 1 KWG) and financial services (§ 1 sec. 1a KWG).[12] To obtain a banking license, an entity is required – amongst others – to comply with specific capital requirements and to meet suitable organizational measures (e.g. internal risk-management) to run operations properly (§ 33 KWG). Subsequent to completed license-granting, ongoing organizational and reporting obligations, e.g. capital and liquidity requirements according to §§ 10, 11 KWG as well as the required adoption of internal safeguards concerning money laundering (§ 25h KWG) and compliance (§ 25a sec. 1 no. 3c KWG), must be complied with.[13] Depending on the business model, a FinTech can also be subject to the license requirements of payment service providers (§ 1 sec. 1 ZAG) and electronic money issuers (§ 1 sec. 2 ZAG) according to §§ 10, 11 ZAG. However, in all cases licensing and supervision is exercised by the BaFin (§ 6 sec. 1 KWG, § 4 sec. 1 ZAG) (Deutsche Bundesbank, 2018).[14] The majority of FinTechs is expected to be subject to licensing in any way. For instance, if a FinTech takes deposits from customers or becomes a contracting party to a credit agreement, it requires a license in accordance to § 1 sec. 1 no. 1 or 2 KWG. For those FinTechs that offer investment advisory as in the case of robo advice, again a license according to § 1 sec. 1a KWG is necessary (Scholz-Fröhling, 2017). If, however, a FinTech acts with negligence and provides banking services without the required license, the entity can be fined or the management may even face imprisonment of up to five years (§ 54 KWG). In Germany only § 2a VermAnlG represents a legislation specifically adopted for the FinTech business, which excludes a FinTech in the crowdfunding sector from the publication requirement of an investment prospectus (Maume, 2017).

This analysis outlines several regulatory challenges in dealing with FinTechs: The current regulatory framework poses significant market entry barriers for (potential) start-ups in the financial services industry. This is not in line with the BaFins' statement that regulation must neither be exploit as entry barrier for newcomers and to protect incumbents, nor to (constantly) privilege newcomers. Also, the German regulator itself identified the need for action in this

[12] The requirement of a banking license is linked to the provision of banking businesses and financial services, independently of the use of new technologies and the innovativeness of products and services.
[13] § 2 sec. 1 no. 1-3 GWG.
[14] Within the Single Supervisory Mechanism however, those financial institutions which meet the definition according to Art. 4 sec. 1 no. 1 Capital Requirements Regulation and additionally meet the European Central Banks' (ECB) criteria of "significant institutions", are directly supervised by the ECB. For further details see European Central Bank (2014).

regard (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016; PwC, 2017).[15] Anyhow, this issue is not only found to be discussed by practitioners but also experiences great relevance within the academic literature: In order to compete and contribute to innovative developments in a market, a new entrant needs to be able to enter it. In general, the conditions to enter a market depend on the height and number of barriers to entry. In the economic literature, numerous definitions of barriers to entry were developed (Bain, 1956; Stigler, 1968; Ferguson, 1974; Fisher, 1979; von Weizsacker, 1980; Gilbert, 1989; Carlton and Perloff, 1994; McAfee et al., 2004). Many of these define an entry barrier as a factor beneficial to incumbents, as it makes market entry unprofitable for (potential) new entrants and consequently reduces or limits competition (Bain, 1956; Ferguson, 1974; Stigler, 1968). Generally, barriers to entry are based on conditions that are either of strategic or structural nature. Strategic barriers result from deliberated behavior or tactical actions by incumbents, which have the purpose to hinder the entry of new competitors. In contrast, structural barriers, which arise exogenously, are due to conditions of the industry such as cost and demand structures or technology. Consequently, these are the same for both incumbents and newcomers (OECD, 2006; OECD, 2007). However, in the context of FinTechs, the definition of Fisher (1979), which defines a barrier to entry as any condition that hampers entry although it would be socially beneficial, seems to be the most appropriate. For though the addition of FinTechs to the banking industry could promote competition and hence increase consumer welfare, in particular regulatory entry barriers in the form of capital, liquidity and licensing requirements pose a great hurdle for their entry in the industry (Financial Services Authority, 2013). Actually, particularly regulatory requirements in terms of capital and licensing requirements[16] are identified as two out of six (structural) regulatory barriers to entry (Porter, 1979; OECD, 2006), which can distort effective competition and stifle innovation as FinTechs may, due to financial or operational issues, not be able to comply with them (Financial Conduct Authority, 2015a). Instead, particularly incumbent banks benefit from these regulations, as they result in a "grandfathering" of their established business models.

Economic growth and customer welfare, increasing supply and thus consumer choice as well as potentially lower prices in the course of an entry of new FinTechs may yet be restricted (Bennett and Estrin, 2013; Schleussner, 2017). In fact, empirical evidence shows that the number of regulations and the amount of license fees may negatively affect the rate of entry,

[15] In this respect, it is noteworthy, that the increasing regulatory challenges imply an increasing demand for supportive services, which drives the "RegTech" developments. For further information see e.g. PwC (2017).
[16] In this respect also named "government policy" (Porter, 1979).

especially for small and medium firms (Scarpetta et al., 2002; Bennett and Estrin, 2013). Moreover, Molyneux et al. (1994) find a relationship between the number and size of banks and barriers to entry, whereas other authors identify a interrelation between the extent of (regulatory) entry barriers and other market participants' welfare (Besanko and Thakor, 1992), the competitive intensity (Hannan and Prager, 1998) or degree of oligopolistic interaction (Spiller and Favaro, 1984). Anyhow, one has to note that concerning the extent and strictness of financial regulation, contrasting views in the academic literature exist: While Eichengreen and Portes (1987) demand strong regulations to reduce moral hazard problems in the banking sector, Barth et al. (2004) find evidence that high constraints on bank activities may instead contribute to financial crises. Thus, it is to conclude that regulation necessitates a trade-off between its resulting costs and benefits. An "over-regulation" (Llewellyn, 1999) that may compromise competition and creates entry barriers needs to be avoided.

Moreover, with regard to academic literature financial regulation in the form of laws and supervisory actions can be understood as a set of contracts within a principal-agent relationship, where financial institutions in general and FinTechs in particular represent the regulated agents. The objective of the principal, i.e. the regulator, is to create incentivizing rules, which induce the agents to comply with the objectives of consumer protection and systemic stability (Llewellyn, 1999; Freixas and Santomero, 2003). Typical principal-agent problems, like adverse selection and moral hazard, which could arise from informational advantages possessed by the agents, are counteracted through a comprehensive set of regulations. The failure of unregulated firms, on the other side, may have an adverse impact on regulated institutions, inducing a potential cascade of banking failures in the financial system. Therefore, macroprudential banking regulations aim to implement substantial rules (e.g. capital adequacy requirements according to Basel III) and risk management procedures (Alexander, 2006; Neuberger, 1998).

To conclude, entrant firms certainly need to meet central standards, which prevent risks to customers or the financial system as a whole, and thus have their legitimation. However, those regulations that may inadequately impede market entries must be addressed. Even though regulatory requirements provide a level playing field between incumbents and new entrants as well as they guard against potential issues arising from typical principal-agent-problems, they should not result in a preclusion of FinTechs and thus hindering innovation in the industry.

2.3.5 Regulatory Sandbox as potential solution

In developing new regulatory approaches for FinTech businesses, several jurisdictions, including the UK, Australia, the US, Hong Kong, Singapore, the Netherlands and Canada launched so called regulatory sandboxes (Accenture, 2016; Jenik and Lauer, 2017). These sandboxes typically imply a temporary liberalization or even exemptions from regulatory requirements to provide a "safe space" for FinTechs to test their new products, services and innovative business models in a live, but monitored environment under direct regulators' supervision (He et al., 2017; Financial Conduct Authority, 2015b). While testing their business models under this unburdened regulatory regime, FinTechs are moreover in a constant dialogue with the regulators, facilitating a mutual knowledge exchange (Bank for International Settlements, 2017; Maume, 2017). The collaborative concept is an attempt to strike a balance between the regulators' competing objectives to promote innovation in financial services while safeguarding the financial regulations' core mandates (Financial Stability Board, 2017; He et al., 2017; Bank for International Settlements, 2017). Thus, the sandbox concept may be a part of the solution of the above-mentioned trade-off between sound regulation and fostering innovation as well as reducing (regulatory) market entry barriers, which ultimately may contribute to sustainable competitiveness and economic growth.

Besides regulatory sandboxes, innovation hubs represent a second category of "innovation facilitators". These hubs can be understood as a preliminary stage to a more sophisticated sandbox concept and as a first contact point for FinTechs, where they can raise questions to competent authorities and receive elementary, non-binding regulatory guidance (European Banking Authority, 2018). To implement a holistic approach for regulators and FinTechs, however, the sandbox concept constitutes an indispensable element and thus represents this papers' focus.[17]

Historically, the theoretical basis of sandbox concepts originates from the Information Technology (IT) sector. Primarily in the context of software development, sandboxes provide an isolated testing environment for new codes before merging into the "live" system. This approach facilitates the identification of and protection against malfunctions or other changes that could inflict damage to the overall system resulting in potentially high costs (Oktavianto and Muhardianto, 2013; Goldberg et al., 1996; Wahbe et al., 1993). The migration of those

[17] For further details on Innovation Hubs see European Banking Authority (2018).

sandbox concepts into the financial regulatory environment was pioneered by the UK's Financial Conduct Authority (FCA) in November 2015 as a core component of its "Project Innovate" initiative (Financial Conduct Authority, 2017b). Afterwards, the application of sandbox concepts spread rapidly across various countries (Financial Stability Board, 2017). However, most introduced sandboxes are not constructed uniformly nor are they at the same stage of implementation (Bank for International Settlements, 2017; He et al., 2017), reflecting the differing size and maturity of the particular financial sectors and the flexibility of the regulatory frameworks already in place (Ernst & Young, 2017a; Financial Stability Board, 2017).[18] However, albeit the diversity of existing models, the majority of sandboxes share some key characteristics and design components (Zetzsche et al., 2017; Bank for International Settlements, 2017; He et al., 2017; Jenik and Lauer, 2017). If successfully implemented, regulatory sandboxes have the potential to lower regulatory barriers and help to speed up the market introduction of a wide range of new services. Furthermore, the gathered information and valuable insights during the test period might assist regulators to gain better understanding of risks and how to adapt current and future regulation to FinTechs without stifling innovation (Financial Conduct Authority, 2015b; Zetzsche et al., 2017; He et al., 2017; Jenik and Lauer, 2017; Ernst & Young, 2017a).

Despite the benefits, to date no comparable initiative exists in Germany. However, the regularly organized workshops („BaFinTech") and the creation of an internal FinTech task force,[19] clearly express the high interest of the BaFin in this topic (Bundesanstalt für Finanzdienstleistungsaufsicht, 2017). Moreover, since the German Federal Ministry of Finance identified the opportunities and challenges that financial technologies entail for society, politics and economy, it consequently launched the "FinTechRat" in March 2017. This initiative is composed of FinTechs, banks and scientists and aims at strengthening the dialogue between politics and economy, supervising trends in the financial technologies area, advising the Federal Ministry of Finance and finally establishing Germany as the "FinTech-Hub No.1" within the European Union (Bundesministerium der Finanzen, 2017; Bundesministerium der Finanzen, 2019). Furthermore, the German Government is recently developing a blockchain-strategy in which it advocates the creation of a flexible regulatory framework for crypto-assets on both an

[18] i.e. rule-based vs. principle-based regime; for further details see Brummer and Gorfine (2014).
[19] See https://www.bafin.de/SharedDocs/Veranstaltungen/DE/180410_BaFinTech_2018.html for further details (Accessed: 12.07.2018).

European and international level (FinTechRat, 2019).[20] Against this background, one can conclude that these current political efforts once again fortify the relevance of the FinTech markets for the German competitiveness as well as the corresponding urgency and importance to develop a suitable regulatory framework.

Therefore, building on the above derived list of major FinTech markets, a detailed analysis of the respective sandbox solutions shall serve as a foundation to develop a set of recommendations for the concept of a regulatory sandbox specifically for the German market, which is in line with the regulatory framework and objectives. For this purpose the intersection of the above derived major FinTech markets with jurisdictions that already introduced an operational sandbox approach (Jenik and Lauer, 2017), represent the scope of this papers' further analysis on the various sandbox designs:

[20] See https://www.bundesregierung.de/breg-de/themen/digital-made-in-de/blockchain-strategie-1546662 for further details (Accessed: 08.05.2019).

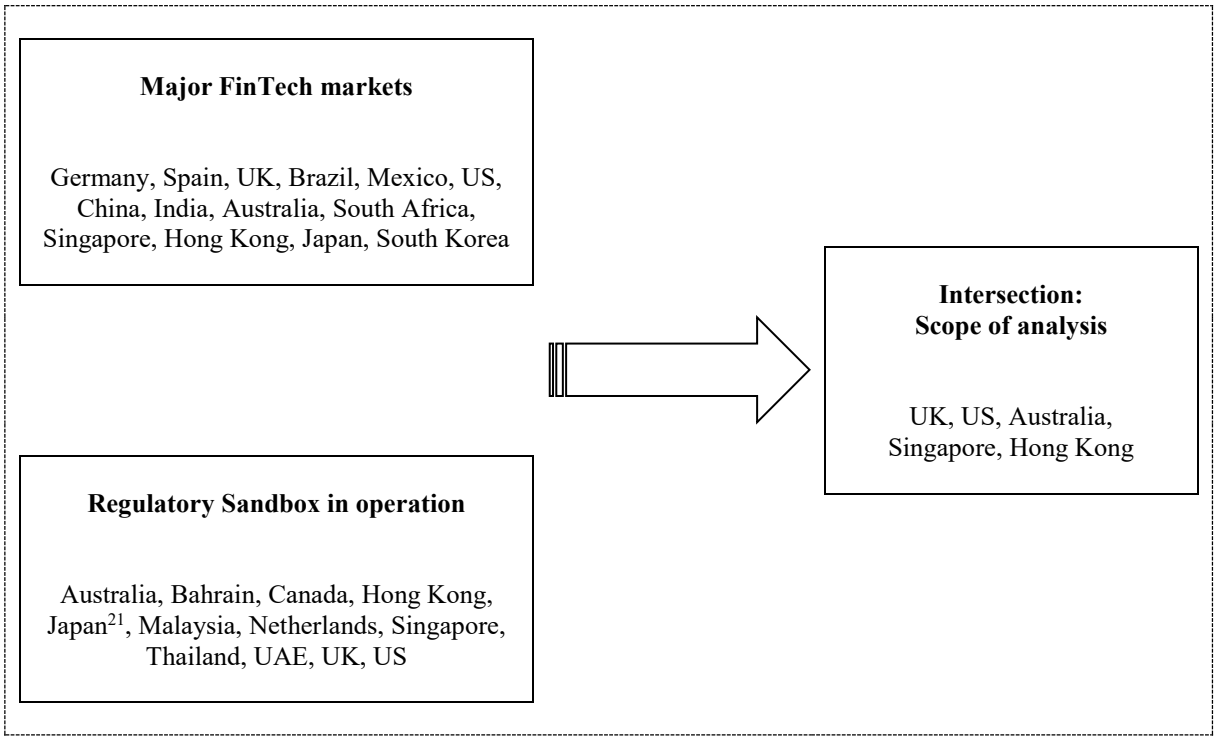


Figure 7: Major FinTech markets in scope of regulatory sandbox analysis

2.4 Analysis of Regulatory Sandboxes

In order to analyze the as relevant identified regulatory sandbox concepts systematically, we focus on certain assessment criteria: If provided, we focus on the sandboxes' *objective*, the *effective date* and *stage of implementation*. Furthermore, we highlight specifications regarding the *application process*, *eligibility criteria* and *limitations* (e.g. participants, offered services, type and maximum number of clients, restrictions regarding the maximum exposure, customer safeguards, and disclosure). Finally, we emphasize the *duration* of the test as well as *applicable regulatory "tools"* and the questions whether and how the responsible authority provides *assistance* and *collaborates* with participating firms during the test period and when transitioning out of the sandbox. As mentioned above, the following analysis of the respective sandbox solutions serves as a best practice foundation for the development of a set of recommendations for a regulatory sandbox concept specifically for the German market, which

[21] Even though the Government of Japan introduced a sandbox framework in June 2018, it is hardly comparable to other sandboxes in scope, as it is not limited to a specific industry or area of regulation (https://www.jetro.go.jp/ext_images/en/invest/incentive_programs/pdf/Detailed_overview.pdf). Moreover, the official documentation is largely available only in Japanese (http://www.kantei.go.jp/jp/singi/keizaisaisei/regulatorysandbox.html). Consequently, as the paper focusses exclusively on banking sector regulations, Japans' rather unspecific and in foreign-language documented approach is excluded from the following analysis. However, it should be noted that Japans' Financial Services Agency introduced a "FinTech Proof-of-Concept Hub" in September 2017 to provide continuous support (https://www.fsa.go.jp/en/newsletter/weekly2017/262.html). However, its documentation is again in Japanese (https://www.fsa.go.jp/news/29/sonota/20170921/20170921.html). (All links in this footnote were accessed: 08.05.2019).

is in line with the regulatory framework and objectives. Beyond that, a comprehensive table, which – using the above-mentioned criteria – both summarizes and compares characteristics of the various sandbox approaches, is provided in appendix A.

2.4.1 Regulatory Sandbox: UK

As mentioned above, the FCA launched a comprehensive "Regulatory Sandbox" concept as a core component of its "Project Innovate". The overall aim of Project Innovate is to foster competition and growth in the financial services industry by supporting small and large businesses that are developing products and services which could improve consumers' experience and outcomes (Financial Conduct Authority, 2015b). On this basis, the objective of introducing the regulatory sandbox is to promote competition through (disruptive) innovation. The projected framework shall offer the possibility to test products and services in a controlled environment, thereby reducing the time-to-market at potentially lower cost. Moreover, it strives to support the identification of appropriate customer safeguards for new products and services and achieving better access to finance (Financial Conduct Authority, 2015b; Financial Conduct Authority, 2018c; Financial Conduct Authority, 2017b; Financial Conduct Authority, 2018b). In this regard, the FCA developed its sophisticated regulatory sandbox, which was introduced in November 2015 and launched in June 2016 (Financial Conduct Authority, 2018a; Financial Conduct Authority, 2018c; Financial Conduct Authority, 2017b). The sandbox is open to both start-ups and incumbents as well as authorized and unauthorized firms. However, potential companies need to undergo an application process and meet certain criteria to participate in this concept (Financial Conduct Authority, 2018c). Moreover, the sandbox works on a cohort basis with two cohorts per year, thus offering two six-month test periods per year. For the first two cohorts the FCA received 146 applications of which 18 firms (cohort 1) and 24 firms (cohort 2) participated in the sandbox. Furthermore, 61 firms applied for participating in cohort 3 of which 18 were accepted by the FCA. Finally, in each case 29 firms participated in cohort 4 and 5, whereas 69 respectively 99 firms applied to participate. (Financial Conduct Authority, 2017b; Financial Conduct Authority, 2017a; Financial Conduct Authority, 2018d; Financial Conduct Authority, 2018e; Financial Conduct Authority, 2019a; Financial Conduct Authority, 2019b).

In more detail, applying companies need to explain its proposition, whether it is eligible and how it meets the FCAs' default standards (Financial Conduct Authority, 2018a). The required eligibility is based on certain criteria: First of all, firms must be in scope, which means that the companies' planned innovation is designed for or supports the financial services industry. The

new solutions need to be genuine innovations, thus differing significantly from existing ones. Furthermore, directly or indirectly through increasing competition, the companies' innovations must lead to identifiable consumer benefit and the companies need to make clear why there is a "need for sandbox". Finally, in order to be eligible, potential participants need to have done sufficient research regarding its innovation and need to be ready for testing it with real customers in real markets (Financial Conduct Authority, 2015b; Financial Conduct Authority, 2018a).

Applicants must not only meet the required eligibility criteria but also a number of default standards, which were defined by the FCA. These encompass regulations regarding the duration for testing (three to six months), number of clients, customer selection, customer safeguards, disclosure, data and testing (Financial Conduct Authority, n/a). Finally, the FCA expects the testing companies to have a clear objective with the intended sandbox test (e.g. reducing costs to consumers) (Financial Conduct Authority, 2018c).

After reviewing the applications, the FCA decides which companies participate in the following cohort of the sandbox test. For each firm approved, the FCA dedicates a case officer who supports the participating company regarding the designing and implementing of the test. In general, the FCA works closely with participants in order to ensure appropriate customer safeguards being in place and to mitigate potential harm during and after the test-period (Financial Conduct Authority, 2017b). Also, the FCA designed multiple tools to provide assistance during the test period and participation in the regulatory sandbox: First, the FCA designed a tailored authorization process specifically for unauthorized firms (restricted authorization). As a result, participating firms are allowed to test the agreed products and services (only), even though they are not able to meet the full requirements for a general, thus unlimited authorization. Moreover, the FCA can provide participating firms with no enforcement action letters, individual guidance or waivers. A no enforcement letter may be issued, if the FCA believes that the participating firms' activities do not breach the FCAs' requirements or harm its objectives and where the FCA is not able to assist with individual guidance and waivers. In this case, the FCA states that, as long as the test period lasts, no enforcement action against the company, respectively its intended activities, will be taken. Moreover, participating firms may often face uncertainties regarding existing regulatory requirements and whether and how they need to be applied in light of the intended activities. In these cases, the FCA gives individual guidance regarding the interpretation of applicable

regulations. Finally, in the case of unduly burdensome rules, the FCA may be able to waive or modify specific rules for testing companies. However, this tool is limited to the FCAs' power and authority regarding the particular, questioned regulation (Financial Conduct Authority, 2015b; Financial Conduct Authority, 2018c; Financial Conduct Authority, 2017c). At the end of a sandbox test and before transitioning out of the sandbox, all participants have to submit a final report. The report should summarize the outcomes and findings of the sandbox test as well as the next steps planned (e.g. regarding product development) (Financial Conduct Authority, 2017b).

2.4.2 Regulatory Sandbox: Australia

In 2015, the Australian Securities and Investments Commission (ASIC) launched an Innovation Hub to support FinTechs in managing the relevant regulatory requirements. To achieve this objective, its key initiative was the creation of the ASIC's regulatory sandbox framework in December 2016 (Australian Securities and Investments Commission, 2017b). This sandbox approach consists of a licensing exemption allowing FinTechs to test their products or services without the requirement of financial services or credit licenses (Australian Securities and Investments Commission, 2017a; Australian Securities and Investments Commission, 2018), while ensuring adequate consumer protection (Australian Securities and Investments Commission, 2017b). A further objective of the sandbox is the facilitation of innovation (Australian Securities and Investments Commission, 2017a) by accelerating time-to-market and access to capital (Australian Securities and Investments Commission, 2017b). Despite these benefits, by the end of April 2019 only six businesses had used the regulatory sandbox (Australian Securities and Investments Commission, 2019). Similarly, a current survey reveals that only 1% of Australian FinTechs are currently using the regulatory sandbox, while 9% plan to use it in the next twelve months (Ernst & Young, 2017c).

To rely on the sandbox exemption, a FinTech must not be banned from providing financial services or from engaging in credit activities. Furthermore, the regulator explicitly excludes license-holders (i.e. established financial institutions) and is consequently eligible to early-stage financial institutions (i.e. start-ups) (Australian Securities and Investments Commission, 2017a; Ernst & Young, 2017a; He et al., 2017). A significant difference between the licensing exemption and the sandbox requirements of other financial regulators worldwide is the Australian "whitelist" approach, implying an automatic admission to the sandbox without an individual review by ASIC (Australian Securities and Investments Commission, 2017b).

According to this, no formal application is required. Instead, the only requirement is a written notification and provision of certain information to the ASIC, before relying on the licensing exemption (Australian Securities and Investments Commission, 2017a). In contrast to this unique and comparatively flexible "whitelist" approach, the regulator prescribes strict qualitative as well as quantitative limitations concerning the operations of certain financial services or credit activities within the sandbox (Australian Securities and Investments Commission, 2017a). Amongst others, the ASIC provides a detailed list of financial services and credit activities that FinTechs are allowed to provide when utilizing the licensing exemption. However, issuing financial products or acting as a credit provider is not allowed under the exemption (Australian Securities and Investments Commission, 2017a; Australian Securities and Investments Commission, n/a).

Besides these product-specific requirements, further conditions have to be met to be able to rely on the relief of the licensing exemption. During the limited testing period of twelve months, the businesses may only provide services to up to 100 retail clients, while there are no limitations for wholesale or sophisticated clients. Yet, the total customer exposure may not exceed AUD 5 million. To maintain consumer trust and avoid systemic risk, the sandbox does not intend to waive any consumer protection requirements. Therefore, it specifies that every participant needs to comply with key consumer protection provisions and meet the disclosure and conduct requirements. In addition, the FinTechs must notify their clients that they rely on the licensing exemption and thus operate without license. Finally, the prescribed arrangement of adequate compensation schemes in case of losses as well as the implementation of dispute resolution procedures shall further ensure consumer protection (Australian Securities and Investments Commission, 2017a; Australian Securities and Investments Commission, n/a). Despite these strict specifications, the ASIC preserves the possibility to extent the testing period and/or the client limit (Australian Securities and Investments Commission, 2017a).

At the end of the sandbox period, the FinTechs can no longer rely upon the exemptions and are no longer allowed to continue operations, unless they have been granted a financial services or credit license. Similarly, they may proceed, if they have entered into an arrangement to provide services on behalf of a financial services or credit licensee, or if the ASIC has given individual relief extending the testing period (Australian Securities and Investments Commission, 2017a). Subsequent to the sandbox test, the participants are required to provide a short report of their experiences during the testing period (Australian Securities and Investments Commission,

2017a). However, neither does the regulator engage with the FinTechs prior to entering the sandbox, nor is a knowledge exchange officially stipulated between both parties during the testing (Zetzsche et al., 2017).

2.4.3 Regulatory Sandbox: Singapore

Over the past few years, the Monetary Authority of Singapore (MAS)[22] has made some substantial investments to accelerate growth of the FinTech sector and implemented a range of supporting programs, positioning Singapore as a significant FinTech market (Monetary Authority of Singapore, 2018b). One key initiative was the formation of the FinTech & Innovation Group in August 2015, responsible for the development of regulatory policies and strategies relating to FinTechs (Monetary Authority of Singapore, 2018a). Finally in November 2016, the MAS released its ”FinTech Regulatory Sandbox Guidelines” to provide a safe space for innovative firms to test their products and services while relaxing specific legal and regulatory requirements without deteriorating consumer protection and financial stability (Monetary Authority of Singapore, 2016a; Monetary Authority of Singapore, 2016b). The Sandbox is applicable for trials of new financial services by both (unregulated) FinTech start-ups and large (regulated and licensed) financial institutions (Monetary Authority of Singapore, 2016b; Monetary Authority of Singapore, n/a; Monetary Authority of Singapore, 2016c). Moreover, it is open to all interested firms with innovative financial services with no sectorial restriction on financial institutes (Monetary Authority of Singapore, 2016a). As there is no cohort scheme, applications to the sandbox can be submitted anytime (Baker McKenzie, 2017), so that by May 2019, two participants were actively using the sandbox whereas two already exited the sandbox without obtaining the relevant regulatory status (Fintech Singapore, 2017; Monetary Authority of Singapore, 2019).

Based on the regulators’ precondition to solely offer financial services which include new or emerging technology, or which use existing technology in an innovative way, the temporary relaxation of specific legal and regulatory requirements is conducted on a case-by-case basis (Monetary Authority of Singapore, 2016a; Monetary Authority of Singapore, 2016b; Monetary Authority of Singapore, n/a). Examples of those requirements that may be relaxed apply to cash balances, credit rating, financial soundness, fund solvency and capital adequacy. However, the MAS emphasizes that the sandbox should not be understood as a mean to circumvent legal and

[22] Singapore’s central bank and regulator of the financial services sector (see http://www.mas.gov.sg/About-MAS/Overview.aspx (Accessed: 04.07.2018)).

regulatory requirements and further clarifies that it will not compromise on requirements concerning consumer protection, prevention of money laundering and financing of terrorism (Monetary Authority of Singapore, 2016a). A further criterion, which the regulator will evaluate before granting permission to enter the sandbox, is the applicants' intention and ability to deploy the service in Singapore on a broader scale. To achieve the aspired well-defined space for experimentation, the test scenarios and boundary conditions, as well as the exit and transition strategy have to be clearly defined before entering the sandbox. The applicants are furthermore obliged to assess and mitigate significant risks and shall install appropriate safeguards to limit the consequences of failure for consumers and the financial system in collaboration with the regulator (Monetary Authority of Singapore, n/a; Monetary Authority of Singapore, 2016a). Similar to the Australian approach, the participants must notify its customers about the sandbox conditions and disclose the key risks, which the customer has to confirm. Despite these strict requirements, detailed specifications of the sandbox like the time frame, the maximum number as well as the type of customer and the maximum exposure are not predetermined by the guidelines. Instead, they are agreed on a case-by-case basis resulting in a cooperative and individually tailored solution (Monetary Authority of Singapore, 2016a). During the testing period, which may optionally be extended, the sandbox can be discontinued by the regulator, if the participants are not capable to fully comply with the legal and regulatory requirements at the end of the sandbox period or in case of a breach of the agreed sandbox conditions (Monetary Authority of Singapore, 2016a; Monetary Authority of Singapore, 2016b; Monetary Authority of Singapore, 2016c). To prevent a forced termination of the sandbox, the participants are required to report to the MAS on agreed intervals (Monetary Authority of Singapore, 2016a). At the end of the sandbox period, the relaxation of the legal and regulatory requirements will expire, and the participants must exit the sandbox. However, the participants may proceed to deploy its financial services on a broader scale, if they fully comply with the relevant legal and regulatory requirements and both MAS and the participants are satisfied that the sandbox has achieved its intended outcomes (Monetary Authority of Singapore, 2016a).

2.4.4 Regulatory Sandbox: Hong Kong

Hong Kong's regulator and supervisor of the banking business,[23] the Hong Kong Monetary Authority (HKMA), launched its Fintech Supervisory Sandbox (FSS) in September 2016 (Hong Kong Monetary Authority, 2019; Hong Kong Monetary Authority, 2016). Further initiatives by

[23] See https://www.hkma.gov.hk/eng/key-functions/banking-stability.shtml for further details (Accessed: 04.07.2018).

the HKMA, like the FinTech Facilitation Office, were implemented to enable a solid development of the local FinTech sector and to promote Hong Kong as a major FinTech hub in Asia (Hong Kong Monetary Authority, 2018).

The HKMAs' sandbox is exclusively eligible for authorized financial institutions (i.e. license holders) and their partnering technology firms and consequently precludes start-ups and non-bank institutions (Hong Kong Monetary Authority, 2019; Hong Kong Monetary Authority, 2016). It allows participants to conduct pilot trials without fully complying with the HKMAs' supervisory requirements. Thereby they can gather real-life data and user feedback within a controlled environment, which furthermore reduces time-to-market of new technology products as well as their development costs (Hong Kong Monetary Authority, 2019; Hong Kong Monetary Authority, 2016). Similar to the Singaporean approach, the HKMA does not release an extensive list of supervisory requirements that may be relaxed. Instead, relaxations will be discussed on a case-by-case basis with every individual applicant. Generally, all innovative FinTech products and services such as mobile payment services, biometric authentication, blockchain, robotics and augmented reality are in the focus of the sandbox, if they are intended to be launched in Hong Kong. In addition to external customers, also company staff members can be in the focus groups of targeted customers during the testing phase. From September 2016 to March 2019, 48 pilot trials were conducted in the sandbox, whereby 32 participants already exited and successfully rolled out their products and services. The tested FinTech products related largely to biometric authentication, application programming interfaces, Regtech and mobile application enhancements (Hong Kong Monetary Authority, 2019; Hong Kong Monetary Authority, 2016).

For the participation in the sandbox, the HKMA requires clearly defined terms concerning the scope, the timing and the termination of the pilot trials. Similarly, the HKMA strictly maintains on sufficient customer protection measures and reasonable risk management controls to mitigate risks that arise from the incomplete compliance with supervisory requirements. Therefore, the HKMA clarifies that the sandbox shall not be understood as a mean to bypass applicable supervisory requirements. Finally, the regulator requires the readiness of the systems and processes for the trial, which is moreover subject to close monitoring. The duration of the sandbox, exit arrangements, client limitations as well as the maximum exposure are not specified by the HKMA, but are instead agreed upon a case-by-case-basis in individual discussions (Hong Kong Monetary Authority, 2019; Hong Kong Monetary Authority, 2016).

Alongside the HKMA's sandbox approach, the Hong Kong Securities and Futures Commission (SFC)[24] (i.e. SFC Regulatory Sandbox) and the Hong Kong Insurance Authority (IA) (i.e. Insurtech Sandbox) each launched their respective sandbox solutions in September 2017 (Securities and Futures Commission, 2017b; Insurance Authority, 2018). While the HKMA's sandbox only applies to authorized financial institutions, the SFC's sandbox is applicable to both, corporations licensed by the SFC and start-up firms that intend to operate a regulated activity and utilize innovative technologies. Further requirements largely correspond to the HKMA, as also key investor protection requirements are not permitted to be relaxed (Securities and Futures Commission, 2017b; Securities and Futures Commission, 2017a). Likewise, the SFC can impose licensing conditions that limit the type and maximum exposure of those clients the firms plan to serve. Additionally, it can impose requirements to install adequate compensation schemes for investors, or to submit to periodic supervisory audits, facilitating a closer monitoring and supervision by the SFC (Securities and Futures Commission, 2017b; Securities and Futures Commission, 2017a). Lastly, the target audience of the IA sandbox are insurers authorized by the IA seeking for a controlled environment to test their Insurtech and other technology initiatives, which they intend to launch in Hong Kong. The IA prescribes analog principles applicable for the sandbox and does not publish an exhaustive list of supervisory requirements that may be relaxed, as each application will be evaluated on a case-by-case basis (Insurance Authority, 2018).

2.4.5 Regulatory Sandbox: US

In the US, no comprehensive regulatory sandbox concept as compared to the UK exists. Rather, authors and representatives do not agree whether there is a regulatory sandbox in operation or not (Bologna, 2017; Jenik and Lauer, 2017; Accenture, 2016). However, independently from whether or not a regulatory sandbox exists in the US, one has to state that this issue is not only discussed frequently[25] but also that several regulatory initiatives, addressing innovation in the financial services sector, exist.

First of all, the Consumer Financial Protection Bureau (CFPB), one of many regulatory authorities in the complex and fragmented US financial regulatory system (Gerlach et al., 2016), launched its "Project Catalyst" in November 2012. This initiative is based on the CFPBs' belief

[24] Regulator of the Hong Kong's securities and futures markets; see https://www.sfc.hk/web/EN/about-the-sfc/our-role/ for further details (Accessed: 04.07.2018).
[25] For instance, discussions regarding the benefits and downsides of regulatory sandboxes in general and the question whether and how a sandbox should be implemented in the US (Allen, 2018).

that innovative developments imply markets working better for both consumers and suppliers of financial services and products. The aim of Project Catalyst is to facilitate innovation in order to enable the development of both safe and beneficial products and services in the financial services sector. In this regard, the CFPB announced a threefold strategy, consisting of the establishment of communication channels with stakeholders,[26] the development of programs and policies which support consumer-friendly innovation and finally the engagement in pilot projects as well as research collaborations (Consumer Financial Protection Bureau, 2016b). As a result, the CFPB developed the "Policy To Encourage Trial Disclosure Programs" and "Policy on No-Action Letters". The rationale of the "Policy To Encourage Trial Disclosure Programs", which became effective in October 2013, is to improve the way consumers receive information (e.g. regarding costs, benefits and associated risks) which are necessary to decide whether or not to use certain financial products or services. This again should increase competition and transparency, imply improved consumer understanding and lead to better-informed decision-making. In this respect, the CFPB has the authority to waive, for a defined time frame, certain disclosure requirements for companies with innovative versions and ideas for disclosures (Consumer Financial Protection Bureau, 2016b; Consumer Financial Protection Bureau, 2013). Moreover, similar to the FCAs' approach, the CFPB has the authority to issue no-action letters ("Policy on No-Action Letters", issued February 2016). In such a letter, which (following a formal application of potential companies) can be issued by the CFPB, staffs state that there is no intention to recommend enforcement or supervisory action against the company. However, a no-action letter is, for instance, limited to a predetermined period and certain statutes or regulations as well as possibly limitations regarding the volume of transactions. Using this tool, the CFPBs' aim is to prevent the regulatory framework in hindering innovation and to reduce regulatory uncertainties, which ultimately should promote the development of consumer-friendly innovations (Consumer Financial Protection Bureau, 2016b; Consumer Financial Protection Bureau, 2016a). To date, this tool was used once in September 2017, issued to an online lending platform (Consumer Financial Protection Bureau, 2017; Bologna, 2017).

Additionally, the "Financial Services Innovation Act of 2016" was published in September 2016. This initiative implements several actions to be conducted by agencies, whereas "agencies" comprise many regulatory authorities, boards, commissions etc. Each agency shall regularly identify and publish existing regulations, which both apply or may apply to financial innovation and which the agency would consider to modify or waive. The act requires the

[26] e.g. entrepreneurs, innovative businesses, other regulators.

agencies to set up a Financial Services Innovation Office (FSIO) in order to promote and assist financial innovations. In special circumstances and if appropriate,[27] agencies shall, acting through its FSIO, waive existing regulations. The act enables firms that offer or intend to offer financial innovations to submit a petition to an agency. This may result in the agencies' FSIO entering an agreement with the requesting company, which implies modifications or waivers for regulations where the agency has authority. Within the time frame from receiving the petition until the determination, the respective authority may undertake no enforcement actions which are related to the financial innovations that are subjected to the petition ("Safe Harbor") (Mc Henry, 2016).

Finally, the U.S. Commodity Futures Trading Commission (CFTC) launched another FinTech initiative in May 2017, named LabCFTC. This initiative, which again is limited to the CFTCs' authorities and overseen markets, has a twofold purpose: Firstly, it aims at increasing regulatory certainty in order to encourage innovation, thus quality, resilience and competitiveness. Secondly, the CFTCs' objective is to identify and utilize new technologies. In order to accomplish this goals, the CFTC fosters a proactive engagement with the innovator community, academia, students and professionals, its participation in studies and research, the collaboration and cooperation among the FinTech industry as well as the CFTF market participants and the financial regulators both at home and overseas (U.S. Commodity Futures Trading Commission, 2017).

2.5 Proposal of a Regulatory Sandbox Concept for Germany

Despite the variety of successful[28] and promising sandbox approaches worldwide, to date no such solution to the trade-off between sound regulation and promotion of innovation (in the financial sector) in Germany exists. However, as the previous analysis indicates, current regulatory concepts differ in several specifications, thus, there neither seems to be a "one size fits all solution" nor a general assessment regarding benefits and downsides of the applied concepts is possible. Nevertheless, we can use the findings of our detailed analysis as a foundation to develop a set of recommendations for a regulatory sandbox concept specifically for the German market, which is in line with the regulatory framework[29] and objectives. However, the analysis also indicates that despite the discretion in licensing and other

[27] E.g. a rule being burdensome.
[28] In terms of usage and successful market entries of participating FinTechs.
[29] A possibly implemented regulatory sandbox needs to be in line with relevant national and international law and its scope is limited to the national supervisors' power and authority within the respective legislation.

supervisory requirements, most of the sandboxes remain strict on fundamental regulations relating to consumer protection and anti-money laundering. Thus, as often challenged by the BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016), the core mandates of financial regulation to ensure the efficiency and stability of the financial system and to create a level playing field between market participants, are not compromised during the period of a regulatory sandbox.

Meanwhile the German banking supervisor BaFin[30] realized the need for a certain degree of flexibility in the context of FinTech and has henceforth dedicated itself to their diverse concerns. Against the background of the BaFins' objective to create a contemporary supervision without compromising its core mandates[31] (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016; Bundesanstalt für Finanzdienstleistungsaufsicht, 2018a), the aim of this section is to develop a sandbox framework which is applicable in the German regulatory environment. Similarly to the scrutiny of the legal and regulatory framework, also the regulators capacity as well as the market conditions of a particular country must be considered when developing a regulatory sandbox (Jenik and Lauer, 2017). However, as shown in sections 2.3.2 to 2.3.5, both the global and national developments in the FinTech markets as well as Germany being identified as one of the major representative FinTech markets worldwide, clearly provide strong evidence of the need for action in this regard. Moreover, from a theoretical point view, particularly with regard to market entry barriers and its potential consequences as well as the principal-agent theory with its potential adverse selection and moral hazard issues, it seems favorable to address this topic.

To facilitate the implementation of a regulatory sandbox in practice, the following suggestions are divided into three phases and address the same criteria as used in section 2.4 to analyze the respective sandbox concepts:

Objectives and scope		
Application phase	Testing phase	Exit phase

Figure 8: Phases of the proposed regulatory sandbox framework

[30] According to § 6 sec. 1 KWG.
[31] In line with § 6 sec. 2 KWG.

The first phase concerns the FinTechs' prerequisites to apply for the sandbox. Generally, the sandbox should be applicable for both, start-ups and incumbents respectively licensed and unlicensed companies that intend to operate regulated financial services[32] under the BaFin. This all-embracing approach ensures a level playing field between market participants and thus cannot be confused with an economic promotion, which the BaFin has no mandate for (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016). The proposed services should be innovative in the way that they include new technology or utilize existing technologies in a novel or reinvented way. In addition, the written application must contain clear and concrete information, how the firms plan to operate during the testing phase, which include distinct definitions of the test scenarios, targeted customers, the expected exposure as well as a clear exit and transition strategy. Moreover, the applicants are supposed to have safeguards and risk management controls already in place, which meet the BaFins' requirements to appropriately protect consumers and the soundness of financial system during the sandbox period. Thus, risk identification and mitigation strategies depict important eligibility criteria to be permitted to participate in the sandbox. However, this screening process of the regulator, who represents the uniformed principal, is an adequate instrument to reduce ex ante private information (i.e. pre-contractual opportunism) held by the applicants, which represent the agent. Thus, potential adverse selection issues – driven by hidden information as part of the principal-agent problem – would yet be diminished (Akerlof, 1970; Ross, 1973; Rothschild and Stiglitz, 1976). Finally, there shall not be any application-deadlines as under the cohort-approach in the UK, however, the FinTechs must demonstrate their organizational preparedness to conduct the trials and to enter the market within an adequate time frame before applying.

Secondly, the implementation of the testing-phase shall then be conducted in close cooperation with the supervisor. As the BaFin intends to review each business model individually (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016), a case-by-case evaluation of adequate allowances and potential relaxations of specific regulatory requirements seems to be the most suitable approach in the German context. This facilitates both parties to jointly define clear boundary conditions such as the maximum number and type of clients as well as the maximum exposure and the time frame of the sandbox period. Similarly, an individual relaxation of certain regulations is eligible under this approach. Notably the authorization requirements according to § 33 KWG constitute a potential reference point in this respect, as amongst others the initial capital requirements of § 33 sec. 1 KWG may represent major hurdles especially to young

[32] According to § 1 sec. 1, 1a KWG.

firms. This alternative certainly requires the supervisor to thoroughly assess and balance those regulations that pose concrete issues or barriers to an individual FinTech and thus may be relaxed for a limited time, without putting the trust in the financial system at risk.

Furthermore, this principle-based sandbox approach enables the BaFin to react to each firm in an adaptive way, providing FinTechs with the flexibility they require in their respective stage of development. However, it must be clear that the core principles of consumer protection, anti-money laundering and countering the financing of terrorism policies (Bundesanstalt für Finanzdienstleistungsaufsicht, 2018a) will not be compromised at any time. The achievements of the already operating sandboxes suggest a time frame of participation of at least six month, during which the FinTechs have time to test their innovative products or services and to develop the capability to fully comply with the relevant regulatory requirements before exiting the sandbox. Finally, the trials shall be subject to close monitoring by the responsible supervisor. Therefore, the participants should be requested to provide periodic reports. These reports would represent an effective monitoring tool for the supervisor (i.e. the principal) to reduce the FinTechs' (i.e. the agent) freedom of action for post-contractual opportunistic behavior in terms of hidden action, which potentially may cause moral hazard issues (Hölmstrom, 1979). Since the ongoing supervision of institutions by the BaFin is executed in cooperation with the Deutsche Bundesbank,[33] those reports and resulting consultation may also be conducted by the latter.

Thirdly, the exit from the sandbox and the transition to a fully-fledged financial institution represents the final stage of the sandbox-participation, if a FinTech succeeds to fully comply to all relevant regulations and furthermore demonstrates a reliable technology, which can operate under the same supervision requirements as authorized institutions. Otherwise, a FinTech is not allowed to continue operations as the relaxation of regulatory requirements expire. Either way, the participants should be induced to provide a final report of its experiences and suggestions to facilitate a knowledge-exchange, giving the supervisor the chance to learn and continuously improve the approach.

These general suggestions for guidelines, if adequately applied, would not only preserve the trust in the financial system but also counteract the BaFins' concerns that sandboxes could potentially degrade consumer protections by creating a "supervision light" (Bundesanstalt für

[33] According to § 7 KWG.

Finanzdienstleistungsaufsicht, 2016). On the contrary, a sandbox developed on this basis does not contradict any of the supervisors' statutory duties and would moreover create a level playing field for market participants, which is clearly distinctive from a mere economic promotion of young start-ups. It would enable licensed as well as unlicensed start-ups and incumbents to test their innovative services in a controlled environment by the BaFin, thereby accelerating their time-to-market and access to capital. In summary, a German sandbox developed on this basis, could represent a sound solution to the above derived trade-off between encouraging innovation and ensuring compliance to regulations.

2.6 Conclusion

With this study, we aimed at developing a sandbox framework that is applicable in the German regulatory environment without compromising core regulatory objectives. Capital, liquidity and licensing requirements imposed by financial regulations pose a major hurdle for young FinTechs to enter the markets. Economic growth and customer welfare through innovation, increasing consumer choice and lower prices in the course of an entry of new FinTechs would yet be restricted. Through its ability to reduce time-to-market for FinTechs, a regulatory sandbox is a useful approach to overcome the regulatory barriers to entry and to foster competition in the financial markets while ensuring consumer protection and financial stability. Otherwise, young firms may be encouraged to circumvent those regulatory barriers by unauthorized and arbitrary operations, which in turn may cause new costs and sanctioning effort for regulators and supervisors as well as the emergence of shadow-banking markets (Ringe and Ruof, 2018). A further consequence may be the emigration of entrepreneurs to alternative and in this regard more dedicated economies. This again may, by affecting the innovativeness within the German financial services sector negatively, worsen its competitiveness and eventually impair the national economies' condition. The implementation of innovation hubs, however, does not represent a holistic approach to this topic and should not be used to justify an omission of an – from our point of view – indispensable and integral regulatory sandbox concept. Finally, it seems favorable to address this topic not only from a practical but also from a theoretical point view. This may be emphasized by taking into account the both empirically and theoretically discussed consequences of market entry barriers as well as with principal-agent problems. In this respect, we utilized the traditional principal-agency theory in the context of the relationship between the regulators and the FinTechs to demonstrate the capability of a sandbox approach to reduce typical principal-agent problems arising from adverse selection and moral hazard. The agents' (FinTechs) opportunistic behavior to pursue its personal interest

at the expense of the uninformed principals (regulators) may be countered by a comprehensive application process (i.e. screening) as well as a constant dialogue and regular reports (i.e. monitoring). During the sandbox period, the potentially unexperienced FinTechs obtain the opportunity to understand and thereupon meet the regulatory requirements, while the competent authorities can assess the inherent opportunities and risks of the innovation.

Building on a detailed analysis of various sandbox models worldwide, which were systematically identified as relevant, we proposed an own set of recommendations as a basis for an accessible and sustainable sandbox implementation. These recommendations have the potential to contribute to the solution of the trade-off between sound regulation and innovation support. In doing so, we also contribute to different strands of literature regarding the evolution and general understanding of FinTechs and its services, the recent discussions of an optimal design of sandbox concepts and – specifically for the German market – the existing regulatory frameworks and their approaches to FinTech-supervision. In this regard, this study represents to our best knowledge the first study on key international sandboxes as a basis to design guidelines for a regulatory sandbox concept specifically for the German market. Hence, since the responsible regulator itself recognized a "need for action" in this regard (Bundesanstalt für Finanzdienstleistungsaufsicht, 2016), we not only contributed to the identified research gap in literature but also to the practical solution of current challenges that both regulators and affected companies face. However, even though our derived implications focus on the Germany financial sector, the results may potentially be applicable in further jurisdictions with similar regulatory requirements. Additionally, our analysis of various sandbox models worldwide can be used as a basis for further research, which focuses on other than the German financial markets.

Nevertheless, it is important to mention that this paper neither can provide a detailed regulatory framework for the German FinTech market and nor did we aim at this. Rather, we encourage to interpret this study as a "call for action" regarding the identified "need for action" by providing systematically derived general guidelines as a basis for further discussions and the implementation of a regulatory sandbox concept in Germany. Further limitations concern divergent legal systems (i.e. case law/code law) as well as cultural differences between the considered countries, in which Germany represents a code law country with a high reliance on comprehensive codes and laws (Zogning, 2017; Durand and Tarca, 2005). It is important to highlight that so far no empirical evidence regarding the assumed contribution of regulatory

sandboxes to the trade-off between sound regulation and innovation support exists. Notwithstanding, based on conceptual and qualitative considerations we expect this causality to most likely exist.

Partly derived from these limitations, we identified needs for future research. Firstly, our analysis of various sandbox models worldwide can be used as a basis for further research, which focuses on other than the German financial markets. Secondly, subjected to accessible data, future research should empirically investigate the assumed interconnection of the existence of regulatory sandbox concepts and the resolutions of the identified trade-off. Additionally, it would be highly interesting to research on the question whether and how differing characteristics in national regulatory sandbox concepts imply differences in the efficiency and performance of those concepts, particularly in respect to the emergence and success of FinTechs. Since these questions are highly relevant for the sustainability and efficiency of financial industries and thus the sustainable and long-lasting competitiveness of national economies, we encourage both practitioners and researchers to further focus on these issues.

2.7 Appendix

Appendix A: Comparison of regulatory sandboxes within the scope of analysis

Criteria	UK	US	Australia	Singapore	Hong Kong		
					FSS	SFC Regulatory Sandbox	Insurtech Sandbox
General aspects							
Responsible Regulator	FCA	Several	ASIC	MAS	HKMA	SFC	IA
Starting time	Jun. 2016	Several	Dec. 2016	Nov. 2016	Sept. 2016	Sept. 2017	Sept. 2017
Stage of implementation	In operation	Several	In operation	In operation	In operation	In operation	In operation
Objective	The regulatory sandbox aims at delivering more effective competition in the interests of consumers by • the ability to test products and services in a controlled environment • reducing the time-to-market at potentially lower cost • supporting the identification of appropriate consumer protection safeguards • better access to finance The overall aim of "Project Innovate" is to foster competition and growth in the financial services sector by supporting both small and large business, which develop products and services that genuinely improve consumers' experience and outcomes.		The regulatory sandbox aims at assisting and supporting FinTechs to test their products and services in an environment with reduced regulatory requirements whilst safeguarding adequate consumer protection. Moreover, the concept aims at facilitating innovation, accelerating time-to-market and improving flexibility and access to capital.	The regulatory sandbox aims at assisting and supporting FinTechs to test their products and services in an environment with relaxed legal and regulatory requirements, however consumer protection and financial stability must not be deteriorated.	The regulatory sandbox enables financial institutions to conduct pilot trials to gather real-life data and user feedback in a controlled environment. Since there is no demand to fully comply with the regulatory requirements the time-to-market of new products and services as well as development costs should be reduced.	The regulatory sandbox helps to give regulatory certainty regarding risks that are relevant to the entities' regulated activities. It provides a confined regulatory environment before innovative products and services are offered on a larger scale.	The regulatory sandbox aims at facilitating pilot runs to collect sufficient data in order to demonstrate that certain Insurtech applications can broadly meet relevant supervisory requirements. Moreover, before launching a product or service on a large scale, the sandbox firms should obtain real market data and user feedback in a controlled environment.
Scope / Content	Firms in the sandbox may be provided with "sandbox tools" to conduct the test within the regulatory framework, e.g.	Policy to Encourage Trial Disclosure Programs: The rational is to improve the way consumers receive information, which are necessary to decide whether	The framework consists of three components: • Existing flexibility or exemptions provided by law	Relaxation of specific legal and regulatory requirements for operating MAS-regulated functions on a case-by-case basis. Legal and regulatory requirements	The regulatory sandbox allows banks and their partnering technology firms to conduct pilot trials without fully complying with the HKMA's supervisory requirements.	No relaxation of regulatory requirements, which are key to investor protection.	Flexibility in the supervisory requirements on a case-by-case basis.

	• restricted authorization • individual guidance • waivers • no enforcement action letters Sandbox firms are assigned a dedicated case officer who supports the design and implementation of the test. The FCA works closely with sandbox firms to ensure that sufficient safeguards are in place and to mitigate potential harm during and after the test period.	to use certain financial products or services. This again should increase competition and transparency, imply improved consumer understanding and lead to better-informed decision-making. In this respect, the CFPB has the authority to waive, for a defined period, certain disclosure requirements for companies with innovative versions and ideas for disclosures. Policy on No-Action Letters: The rational is to prevent the regulatory framework in hindering innovation and to reduce regulatory uncertainties, which ultimately should promote the development of consumer friendly innovations. Entities may formally submit a request for a No-Action Letter. In such a letter, the CFPB may state that there is no intention to recommend enforcement or supervisory action against the company. No-Action Letters may for instance be limited to a predetermined period and certain statutes or regulations as well as possibly limitations regarding the volume of transactions. IRS Data Verification Modernization Act of 2016: Initiative that aims to automate and speed up taxpayers' income verification process for legitimate business purposes. The verification process should be conducted entirely automated, electronic, online and close to real-time in order to prevent delays for FinTech companies and banks that	• FinTech licensing exemptions applicable to certain products or services • Individual licensing exemptions Only licensing requirements are waived, not regulations.	that may be relaxed consist e.g. • fund solvency and capital adequacy • license fees Requirements that must be maintained consist • consumer protection • prevention of money laundering and financing of terrorism • fit and proper criteria particularly on honesty and integrity	Relaxations will be discussed on a case-by-case basis with every individual sandbox firm.	Sandbox firms must comply with the applicable financial resources requirements.	

		rely on leveraging data and technology to make faster, informed decision for consumer and small business lending. Financial Services Innovation Act of 2016: This act requires agencies (e.g. regulatory authorities, boards, commissions) to • identify and publish a list of existing regulation that apply or may apply to financial innovation and that the agency would consider modifying or waiving • establish a FSIO in order to promote and assist financial innovations as well as eventually waive existing regulations The act further enables entities that offer or intend to offer financial innovations to submit a petition to an agency in order to reach individual agreements regarding modifications or waivers for certain regulations. LabCFTC: Initiative by the CFTC that aims at increasing regulatory certainty in order to encourage innovation and to identify and utilize new technologies.					
Eligibility to apply for participa-tion	Sandbox is open to • both start-ups and incumbents • authorized and unauthorized firms Applications must • explain proposition • meet the default standards (e.g. duration, number of		Exemption excludes license-holders (established financial institutions) and covers mostly early-stage financial institutions (start-ups).	The regulatory sandbox is applicable for trials of new financial services by both (unregulated) FinTech start-ups and large (regulated and licensed) financial institutions.	The regulatory sandbox only applies to authorized financial institutions (i.e. license holders) and their partnering technology firms, excluding start-ups and non-bank institutions.	The Sandbox is applicable to corporations licensed by the SFC and start-ups that intend to operate a regulated activity under the Securities and Futures Ordinance (SFO).	The regulatory sandbox only applies to insurers authorized by the IA.

	customers, customer selection and safeguards) • meet the eligibility criteria (firm in scope? Genuine innovation? Consumer benefit? Need for a sandbox? Ready for testing? Background research?)						
Targeted customers?	Sandbox firms are expected to source (potential) customers by themselves. The appropriate type of customers is expected.		Retail, wholesale and sophisticated clients. No sectorial restrictions.	Sandbox firms can choose the type of targeted customers. No limitations, specifications or sectorial restrictions. Agreed on a case-by-case basis.	Company staff members or focus group of selected customers. Agreed on a case-by-case basis.	SFC can impose licensing conditions, which limit the types of clients.	External customers, which can give live and real data or selected group of the insurers' staff. Clear definition of targeted users on a case-by-case basis.
Targeted products / services?			Products and services allowed to be tested: • Financial services (giving financial advice and dealing with certain products such as listed Australian securities, deposits and payment products; however, no issuing of financial products allowed) • Credit activities (limited to activities as intermediary or assistant and further limitations such as volume; however, no allowance to act as a credit provider)	Financial services that are not similar to already offered ones. Thus, financial services must include new or emerging technologies or use existing technologies in an innovative and different way.	All innovative FinTech products and services, e.g. mobile payment services, blockchain, robotics, augmented reality, biometric authentication.	All under the SFO regulated activities that utilize innovative technologies.	Innovative Insurtech applications.
Targeted region?				Sandbox firms must have intention and ability to deploy its financial services in Singapore. However, the broader scale deployment is not limited to Singapore.	Technology initiatives must be intended to be launched in Hong Kong.		
Transition plan for full development / actions following the sandbox test	The sandbox firms must submit a final report summarizing the outcomes of the test before transitioning out of the sandbox. The report also should summarize the		At the end of the testing period, the sandbox firms are not allowed to continue operations, unless • they granted a financial services or credit license	At the end of the sandbox period, the relaxation of the legal and regulatory requirements will expire and the sandbox firms must exit the sandbox. The sandbox firms may proceed to deploy	Termination arrangements must be pre-specified.	Sandbox firms can request a removal or variation of some or all of the imposed licensing conditions, once they have demonstrated a reliable technology.	The sandbox firms must have an exit strategy if the pilot run has to be terminated unsuccessfully.

	sandbox firms' findings and next steps.		• they entered into an arrangement to provide services on behalf of a financial services or credit licensee • the ASIC has given it individual relief extending its testing period	their financial services on a broader scale, if they can fully comply with the relevant legal and regulatory requirements.			
Limitations							
Entry criteria	Sandbox firms are expected to have a clear objective. Tests are expected to be conducted on a small scale. Sandbox firms are expected to have clear testing plans, including • timeline and key milestones • measures to evaluate the success of the sandbox test • testing parameters (e.g. duration, customers, transaction limit) • customer safeguards • risk assessment • exit strategy Eligibility criteria must be met, e.g. • Is the firm in scope? • Genuine innovation? • Consumer benefit? • Need for a sandbox? • Ready for testing? Further criteria: Sandbox firms are • are responsible for securing partners • required to have a significant UK presence • (usually) required to have a UK bank account		To rely on the licensing exemption, the sandbox firms must • have no more than 100 retail clients • have a total client exposure not exceeding AUD 5 million • comply with consumer protection requirements • have adequate compensation arrangements • have both internal and external dispute resolution procedures in place	Sandbox evaluation criteria: • Financial services include new technologies or use existing technologies in an innovative way • Financial services address a problem or brings benefits to consumers and / or the industry • Intention and ability to deploy the proposed financial services in Singapore on a broader scale (after exiting the sandbox) • Clearly defined test scenarios and expected outcomes • Clearly defined boundary conditions, protecting the interests of consumers • Significant risks must be assessed and mitigated • Clearly defined exit and transition strategy	• Clearly defined scope and phases (if any) of the pilot trial, timing and termination arrangements • Sufficient customer protection measures • Reasonable risk management controls • Readiness of the systems and processes for the trial	• SFC can impose requirement to install adequate compensation schemes for investors or to submit to periodic supervisory audits • Sandbox firms may face close monitoring and supervision by the SFC	Principles applicable for the Sandbox: • Well-defined boundary and conditions of the trial • Adequate risk management controls to meet of the relevant supervisory requirements • Adequate safeguards to ensure customer protection • Adequate resources • Development of an exit strategy

Exit criteria / Exit strategy for test failure				The sandbox will be discontinued when • the achievement of the intended purpose is unclear • the sandbox firm is not capable to fully comply with the relevant legal and regulatory requirements at the end of the sandbox period • a flaw has been discovered in the financial service, which cannot be resolved within the duration of the sandbox and the risks outweigh the benefits • MAS terminates the sandbox due to breaches of agreed sandbox conditions • the sandbox firm exits the sandbox		The SFC may revoke the license if the sandbox firms fail to meet regulatory requirements.	
Duration	The sandbox operates on a cohort basis, 2 cohorts per year, each test period 6 months. Long enough to enable statistically relevant data to be obtained from the test.		12 months, extension option for another 12 months.	Limited. Agreed on a case-by-case basis. Extension option available.	Limited. Agreed on a case-by-case basis.		Limited. Agreed on a case-by-case basis.
(Max.) number of customers	• FCA sets a strict limit to the size of the test (small scale testing) • Customer set should be big enough to obtain statistically relevant data Sandbox firms are requested to disclose information regarding the test, e.g. available compensation in the event of failure.		• Retail: maximum of 100 clients • Wholesale: unlimited Extension option for client limit available.	Limited. Agreed on a case-by-case basis.	Limited. Agreed on a case-by-case basis.		

Max. exposure			• The exposure of each retail client to deposit products, simple managed investment schemes, securities, government bonds and payment products in relation to which services are provided must not exceed AUD 10,000 • The amount of credit under a credit contract in relation to which services are provided must not exceed AUD 25,000 • The sum insured under a general insurance contract in relation to which services are provided must not exceed AUD 50,000 • The total maximum exposure of all clients taking part in the testing must not exceed AUD 5 million	Not specified. Sandbox firms have to state and justify quantifiable limits such as transaction thresholds or cash holding limits.		SFC can impose licensing conditions, which limit the maximum exposure of each client.	

2.8 Declaration of Co-authors and record of accomplishments

Title	The Predicament of FinTechs in the Environment of Traditional Banking Sector Regulation – An Analysis of Regulatory Sandboxes as a Possible Solution
Authors	Johannes M. Gerlach (Heinrich-Heine-University Duesseldorf) Daniel Rugilo (University of Cologne)
Conferences	Participation and presentation at the "5th Academic International Conference on Law, Economics and Finance", 3rd-5th December 2018, Cambridge, United Kingdom.
Publications	Contribution to the "Machine Lawyering Blog" of the Centre for Financial Regulation and Economic Development, The Chinese University of Hong Kong. Credit and Capital Markets, Vol. 52, Issue 3, 2019, pp. 323-373.

Contributions	**Daniel Rugilo**	**Johannes M. Gerlach**
Conceptualization Development of research question Methods specification	50%	50%
Execution Literature review and development of theoretical framework Data collection and preparation Data analysis Analysis and discussion of results Derivation of implications and conclusions	50%	50%
Manuscript preparation Initial draft Finalization	50%	50%
Overall contribution	**50%**	**50%**

Date, Daniel Rugilo

Date, Johannes M. Gerlach

3 Evidence on Usage Behavior and Future Adoption Intention of FinTechs and Digital Finance Solutions

3.1 Abstract

Financial Technology Companies are gaining popularity and becoming more relevant within financial services industries worldwide. This growth can be encouraged by the EY FinTech Adoption Index, which indicates a global average FinTech Adoption of 33.0% in 2017. With regard to Financial Technology Companies and Digital Finance Solutions, this figure emphasizes the importance of this study's objective to identify potential determinants of current use behavior and future usage intention. To both theoretically and empirically address this research question, we conducted a questionnaire-based survey with 381 participants from three German universities. Because our study bases on both the theory of reasoned action and the unified theory of acceptance and use of technology 2, we contribute not only to the general understanding of Financial Technology Companies and Digital Finance Solutions but also to the existing literature on behavioral intention and technology acceptance. Thus, we contribute to several strands of literature. However, based on this study's results, we defined certain fields of interest and derived corresponding strategic and managerial implications from the viewpoint of traditional financial institutions. Moreover, we contribute to the practical solution of the current challenges faced by traditional financial services providers. Finally, based on our analyses, we identify future research opportunities regarding these important issues.

Keywords: FinTech, Digital Finance Solutions, technology adoption, current use behavior, future usage intention, behavioral intention, consumer behavior, theory of reasoned action, unified theory of acceptance and use of technology 2

JEL Classification: G10, G20, G21, G22, G23, G24, M13, M31, O33

3.2 Introduction

Currently, FinTechs are gaining popularity and overall attention. Customers of financial services are changing expectations and increasing their usage of financial technologies. Further, a general shift in utility and usability can be observed. Based on the EY FinTech Adoption Index, the percentage of FinTech users increased significantly from 16.0% in 2015 to 33.0% in 2017 and may increase to a global average of 52.0% (Ernst & Young, 2017b). These developments emphasize the importance of identifying potential drivers of FinTech adoption. Furthermore, the development of strategic and managerial implications from the viewpoint of traditional financial institutions is inevitable. Moreover, traditional banks are currently having evolving discussions on how to address FinTechs as new competitors, either co-operative or competitive (Gomber et al., 2017). However, leaving FinTechs or digital movers unchecked could be dangerous for traditional financial institutions, because customer out-migration poses significant risks.

Consequently, this study's aim is to identify potential determinants of current use behavior and future usage intention. Moreover, gaining knowledge about whether and how these drivers affect decision-making is of great relevance. This raises the question of whether and how customers of traditional financial institutions are likely to shift to FinTechs as alternative service providers. Therefore, this paper investigates, with regard to FinTechs and Digital Finance Solutions, how customers behave currently and intend to behave in the future. In doing so, this paper contributes to several strands of literature. First, we contribute to the general understanding of FinTechs and Digital Finance Solutions. Second, we improve the understanding of the adoption, readiness and behavior of customers regarding the TRA and the UTAUT2 (Venkatesh et al., 2012; Ajzen and Fishbein, 1977). These theoretical frameworks produce a comprehensive set of variables that concern the circumstances and perceived benefits and risks that drive decision-making, usage intention and expectations. To achieve this paper's objective, we conducted a questionnaire-based study with 381 participants from three German universities.

To provide a systematic and clear understanding of the addressed topics, the remainder of this paper is structured as follows: First, in the next section, a literature review illustrates the theoretical foundation. The following section defines the collected dataset as well as the research methodology, i.e., represented by a questionnaire-based survey, a descriptive analysis and a logistic regression approach. Afterwards, the results section provides comprehensive

analyses and discussions. This is enhanced by the derivation of strategic and managerial implications and a proof of robustness. The final section offers concluding comments and highlights limitations as well as future research opportunities.

3.3 Literature review

First, we build our definitional foundations regarding FinTechs and Digital Finance Solutions, which represent the basis of our research approach and are associated with the dependent side of our empirical model design. According to previous research, we state that – so far – no unique definition of "FinTech" has been established (Dorfleitner et al., 2016; Ryu, 2018a; Schueffel, 2016; Gerlach and Rugilo, 2019; Zavolokina et al., 2016). However, albeit the lack of agreement, there is consensus that "FinTech" being a composition of the words "financial" or "finance" and "technology" (Arner et al., 2016; Dorfleitner et al., 2016; Gomber et al., 2017; Kim et al., 2016; Kuo Chuen and Teo, 2015; Ryu, 2018a; Zavolokina et al., 2016). Anyhow, regarding the question of how to define "FinTech", some authors propose a functional (i.e., product or service oriented) view, whereas others follow an institutional approach. For instance, Arner et al. (2016) refer to FinTech as technology-based financial solutions and speak about a new marriage of IT and financial services. Similarly, Kim et al. (2016); Kuo Chuen and Teo (2015) and Ryu (2018a) focus their understanding on the use of new technology that enables the development of innovative, disruptive and differentiated financial services or products. These services and products have the potential to disrupt existing industry structures and boundaries (Philippon, 2016). Contrariwise, other authors follow an institutional approach to defining "FinTech" and refer to FinTechs as companies or entities, both start-up or established, that develop and offer innovative financial services by the use of new technology. As a consequence, FinTechs usually represent some kind of innovator or disruptor (Dorfleitner et al., 2016; Gomber et al., 2017). According to Deloitte (2014); AGV Banken (2015) and Christensen et al. (2015), those entities threaten established competitors by developing revolutionary products and services with powerful displacement potentials. Because this paper addresses the adoption of FinTechs as new and – compared to traditional financial institutions – alternative service providers, it follows the institutional approach to defining FinTechs.

Based on offered products and services as well as the underlying technological concepts, there are different approaches to systemizing FinTechs. However, even though we can find numerous proposed systemization approaches (He et al., 2017; Maume, 2017; Philippon, 2016; Brummer and Gorfine, 2014; Dorfleitner et al., 2016; Bank for International Settlements, 2017), we must

state that all of them are similar. For the purpose of this study, the paper follows the comprehensive "Digital Finance Cube-concept" by Gomber et al. (2017). This systemizes FinTechs along the Digital Finance Business Functions, i.e., Digital Financing, Investments, Money, Payments, Insurances and Financial Advice. Moreover, a second dimension of the Digital Finance Cube distinguishes FinTechs based on the technological concepts used. Since this paper addresses the adoption of financial institutions as well as their products and services, the technological perspective is disregarded. However, Digital Finance Solutions are defined as products and services (independently of the supplier) that fall within the scope of the above-mentioned Digital Finance Business Functions. Thus, as the following table depicts, we derive six Digital Finance Solutions, which build the basis of our further research:

Digital Finance Solutions	Definition
Digital Financing Solutions (DFS)	Traditionally, banks act as suppliers for financial resources. Thus, corporates and individuals who are seeking financial resources contact banks. However, Digital Financing Solutions enable corporations and individuals to become independent from these traditional methods, since the necessary financing can be acquired by using the internet. For the purposes of this study, all digital types of financial resources are considered as Digital Financing Solutions. This implies, for instance, platforms that offer digitalized solutions in the area of crowdfunding, factoring, leasing or invoicing (Gomber et al., 2017).
Digital Investment Solutions (DIS)	Digital Investment Solutions embrace products and services that support both individuals and institutions in making investment decisions as well as, by the use of the respective devices and technologies, in arranging required investment transactions on their own. In the B2C context, this phenomenon includes mobile and social trading as well as online brokerage and online trading. Within the B2B area, high-frequency and algorithmic trading account for Digital Investment Solutions (Gomber et al., 2017).
Digital Money Solutions (DMS)	For the purpose of this study, Digital Money Solutions are considered as newly established digital, virtual or cryptocurrencies that exist only electronically and are used mainly on the internet. The best-known Digital Money Solution in this context is bitcoin, which was introduced in 2008 (Gomber et al., 2017; Nakamoto, 2008).
Digital Payment Solutions (DPS)	In contrast to Digital Money Solutions, Digital Payment Solutions refer to electronic payments that use traditional currencies such as EUR or USD (fiat currency). Moreover, Digital Payment Solutions imply mobile payment transactions (smartphone involved), P2P payments (e.g., PayPal) and e-wallets or digital wallets that are used to store money digitally (Gomber et al., 2017).
Digital Insurance Solutions (DInS)	Digital Insurance Solutions are digital products and services in the area of insurance. For instance, friendsurance.com provides a digital platform on which individuals can ally in order to reduce insurance costs at a constant level of protection (Gomber et al., 2017).
Digital Financial Advice Solutions (DFAS)	Digital Financial Advice Solutions embrace the provision of investment proposals, which are – in contrast to traditional financial advice – designed to work with no or minimal human intervention and are based on algorithms and a digital onboarding process that considers pre-defined parameters concerning investment goals, financial background and risk aversion. Presently, these so-called robo advisors focus on portfolio management services and utilize investment strategies, which base on established theories such as modern portfolio theory. A well-known supplier in Germany is Scalable Capital (Gomber et al., 2017).

Table 2: Definitional foundations of Digital Finance Solutions

In terms of this study, we aim to identify both past and current use behavior as well as future (continuous) usage intention (Ryu, 2018b; Lee, 2009; Cheng et al., 2006). Therefore, the actual and future usage intentions of both FinTechs and Digital Finance Solutions are associated with the dependent side of our empirical model design. In doing so, we investigate how experience as well as expectation about FinTechs and Digital Finance Solutions determine the decision to use or to continue the usage. Following Venkatesh et al. (2012); Brown and Venkatesh (2005) and Venkatesh et al. (2003), experience applies to all past and current users, while expectation addresses future consumers and those who intend to continue usage. In order to identify

potential drivers, a theoretical framework built on decision-making and acceptance has been reviewed.

Since decisions are often made on incomplete and imperfect information, potential users build expectations. Various approaches aim to model users' intention on current and future behavior (Venkatesh et al., 2002; Limayem et al., 2007; Pikkarainen et al., 2004). For this study, the theoretical framework of usage decisions in general is grounded on the TRA (Ajzen and Fishbein, 1977). Regarding the net valance framework, which is based on the TRA, users (of technology) face a certain degree of benefit and risk when making decisions (Ryu, 2018b; Peter and Tarpey Sr, 1975). Assuming that the continuous usage of a service, good or technology is based on negative and positive attributes, the net valence theory combines those attributes (Ajzen and Fishbein, 1977; Lewin, 1943a). However, perceived risks are represented through the variables of financial, legal, security and operational risks. Incentivization through perceived benefits is expressed by economic benefits, seamless transactions and convenience. By modeling a multi-dimensional benefit-risk framework in accordance with the technological components of usage and behavior, considerable studies have examined the benefit-risk framework for the adoption and usage process of financial IT services (Ryu, 2018b; Abramova and Böhme, 2016; Zhou et al., 2010; Lee, 2009; Liu et al., 2012). While Lee (2009) and Liu et al. (2012) proposed a single dimension for the perceived benefit side and a multi-dimensional construct for the perceived risk side, this study follows Ryu (2018b) and Abramova and Böhme (2016) by modeling both a multi-dimensional benefit and risk framework.

After making a decision, consumers need to accept a product or service to adopt and continue using it. Therefore, we extended the set of variables by technology acceptance drivers to model a future continuance intention. Regarding technology acceptance, there have been many developments in theories, evolving from the technology acceptance model (TAM) (Davis, 1989), technology acceptance model 2 (TAM2) (Venkatesh and Davis, 2000), to the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) and its modifications (Brown and Venkatesh, 2005; Venkatesh et al., 2012). However, this study is grounded on the theoretical framework of UTAUT2 (Venkatesh et al., 2012), as it represents the latest version and combines various contributions since then (Morosan and DeFranco, 2016; Raman and Don, 2013; Yang, 2013). Following UTAUT, originally modeled to explain employee technology acceptance, UTAUT2 focuses on the consumer use context (Venkatesh et al., 2012), which matches the aim of our study. In doing so, UTAUT2 addresses whether and

how behavioral intention is affected by performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value and habit.

Finally, this study combines both the classical acceptance research as mentioned in UTAUT2 and the net valence concept of TRA to identify a theoretical overlap and therefore possible drivers of current use behavior and future adoption intention. Although extending the mentioned theories to a financial context is not novel, our proposition is different from previous research, as we state that this approach – to the best of our knowledge – is the first study to model both the UTAUT2 variables and the net valence framework with regard to FinTechs and Digital Finance Solutions. Thus, based on the above-mentioned literature, we identified a comprehensive set of 15 potential determinants, which were clustered into 11 variables due to intersections. Moreover, these were enlarged by socio-demographic variables to consider potential effects on the previously mentioned constructs. The following table outlines a detailed explanation of these systematically derived variables.

Variable	Definition
Performance expectancy (PE)	The degree to which using a technology provides benefits to consumers in performing certain activities (Venkatesh et al., 2012).
Economic benefit (EB)	The consumers' cognitive trade-off regarding cost reductions and financial gains resulting from the usage of FinTechs or Digital Finance Solutions (Venkatesh et al., 2012; Dodds et al., 1991; Ryu, 2018b; Kuo Chuen and Teo, 2015; Mackenzie, 2015; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Convenience (C)	The degree of ease, portability, accessibility and flexibility associated with consumers' use of technology (e.g., in terms of time and location) (Venkatesh et al., 2012; Ryu, 2018b; Kuo Chuen and Teo, 2015; Sharma and Gutiérrez, 2010; Okazaki and Mendez, 2013; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Social influence (SI)	The extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology (Venkatesh et al., 2012).
Technical conditions (TC)	Consumers' perceptions of resources and support available to perform a behavior (e.g., organizational and technical infrastructure, speedy and simple processes) (Venkatesh et al., 2003; Brown and Venkatesh, 2005; Venkatesh et al., 2012; Ryu, 2018b; Chishti, 2016; Zavolokina et al., 2016; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Hedonic motivation (HM)	The fun or pleasure derived from using a technology (perceived enjoyment) (Brown and Venkatesh, 2005; Venkatesh et al., 2012).
Habit (H)	The extent to which an individual believes the behavior to be automatic, depending on the extent of interaction and familiarity that is developed with a target technology. Thus, habit is a perceptual construct, which reflects the result of prior experiences (Venkatesh et al., 2012; Limayem et al., 2007).
Financial risk (FR)	The potential financial losses resulting from the usage of FinTechs or Digital Finance Solutions (Ryu, 2018b; Forsythe et al., 2006; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Legal risk (LR)	The users' distrust and anxiety arising from unclear legal status and the lack of regulations (e.g., regarding suffered financial losses and security issues) resulting from the usage of FinTechs or Digital Finance Solutions (Ryu, 2018b; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Security risk (SR)	The potential losses arising from fraud or hacking resulting from the usage of FinTechs or Digital Finance Solutions (Ryu, 2018b; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Operational risk (OR)	The potential losses, distrust and dissatisfaction arising from failed or inadequate internal processes, employee behavior and systems resulting from the usage of FinTechs or Digital Finance Solutions (Ryu, 2018b; Barakat and Hussainey, 2013; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).
Socio-demographics	n/a

Table 3: Definitional foundations of potential determinants

3.4 Data and methodology

In order to investigate how users of financial services currently behave and intend to behave in the future as well as which factors determine their use behavior regarding FinTechs

(institutional level) and Digital Finance Solutions, we developed an English-language questionnaire. The questionnaire bases on the systematically derived comprehensive set of potential determinants that results from the above-described literature review. It contains four questions per construct, including one control question. All measures were – unless otherwise noted – evaluated with a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree) (Carifio and Perla, 2007; Jacob et al., 2013; Klopfer and Madden, 1980). The questionnaire was structured as follows: each participant received a three-page questionnaire. Thereof, one page featured questions related to the former and future use behavior and intention regarding FinTechs and one page related to one out of the six Digital Finance Solutions. Regardless, the questions related to FinTechs and Digital Finance Solutions were, except for slight adjustments to their wording, equivalent to each other. Finally, to gather data to control for individual differences and key characteristics, each participant received one page of socio-demographic and personal questions. Appendix B provides an overview of the set of variables as well as its related questionnaire items and literature.

However, prior to the final data collection, we performed a pre-test, which included 34 participants. Following this pre-test, the final data collection was conducted from November 26th to December 21st, 2018, in business-, economics- and banking-related lectures at three German universities. Thus, the target group used is of particular interest because we derive our implications from the traditional financial institutions' point of view, and the participants represent future high net worth individuals. As a result, we count 381 participants, which ultimately led, based on the above-described structure of the questionnaire as well as inevitable deletions, to a dataset of 300 evaluable observations. The following table shows the final dataset, subdivided by FinTechs and the six Digital Finance Solutions. Additionally, a detailed overview of the socio-demographics and key characteristics of the dataset is provided in Appendix C.

Variable	Numbers of observations	Inconsistencies		Evaluable observations / final dataset
FinTech (institutional level)	381	81	(26.3%)	300
DFS	65	17	(26.2%)	48
DIS	64	15	(23.4%)	49
DMS	61	19	(31.1%)	42
DPS	64	16	(25.0%)	48
DInS	62	20	(32.3%)	42
DFAS	65	18	(27.7%)	47

Table 4: Numbers of observations, deletion process and final dataset

Since we collected data regarding the former use behavior and future usage intention of FinTechs as well as six Digital Finance Solutions, we gathered data for 14 potential dependent variables. However, for the purpose of the empirical part of this paper, we focus on the future usage intention regarding FinTechs as alternative service providers to traditional financial institutions. This approach implies the application of one empirical model specification, which uses the binary constructed dependent variable "future usage intention (FinTechs)". In this respect, participants were asked whether they intend to use or continue to use FinTechs within the next years. To investigate which factors determine future usage intention, the comprehensive and systematically derived set of 11 potential determinants represents the independent side of the empirical model specification. Finally, we insert socio-demographics as well as key characteristics to control for unobserved effects and to limit and forestall endogeneity issues. Consequently, the following regression equation was estimated to identify determinants of the future usage intention of FinTechs:

$$Future\ usage\ intention\ (FinTechs) = \beta_0 + \beta_1(PE) + \beta_2(EB) + \beta_3(C) + \beta_4(SI) + \beta_5(TC) + \beta_6(HM) + \beta_7(H) + \beta_8(FR) + \beta_9(LR) + \beta_{10}(SR) + \beta_{11}(OR) + \beta_{12}(SD) + \varepsilon$$

3.5 Results and discussion

The following section of this paper first delivers insight into the descriptive statistics of the sets of dependent and independent variables. In contrast to the empirical analysis, the descriptive results are neither limited to FinTechs (institutional level) nor to one specific Digital Finance Solution, nor to the former use behavior or future usage intention. Subsequently, we introduce the key results of our logistic regression model from traditional financial institutions' point of view. In doing so, potential opportunities and threats that banks face – due to the customers' attitude regarding the eventual usage of FinTechs and Digital Finance Solutions – are taken into account. Moreover, the following discussion considers only positive and negative significant outliers because we aim to draw valid implications. Nevertheless, this approach does not postulate that average and inconspicuous results as well as – in this dataset – non-significant effects do not have any influence on strategic and managerial decision-making. Finally, this section concludes by conducting several robustness checks for the dataset and the regression approach.

3.5.1 Results

The descriptive results show that 54.3% of all respondents had – to date – never used FinTechs instead of or parallel to traditional financial institutions as service providers. However, the

results also show that more than 70.0% intended to do so in the future. Notwithstanding, there are great differences regarding the former use behavior and future usage intention between the respective Digital Finance Solutions. For instance, DFAS were used by less than 15.0% of all respondents. Moreover, DInS and DMS were used by less than 20.0% of all respondents. In contrast, DPS reached, with almost 90.0%, the greatest past adoption rate. Anyhow, regarding all dependent variables, the data show that the future usage intention outweighs the current use behavior. This indicates a positive attitude toward FinTechs as alternative service providers and toward the currently observable digitization process of the financial services industry. Nevertheless, there are huge differences in future usage intentions ranging from 38.1% for DMS to 97.9% for DPS. This finding, however, implies great differences regarding prospective customer needs and expectations. Finally, the following table summarizes the descriptive results for the 14 dependent variables:

Use behavior	**FinTechs** (Institutional level)	**DFS**	**DIS**	**DMS**	**DPS**	**DInS**	**DFAS**
Former use behavior							
Yes	137 (45.7%)	26 (54.2%)	15 (30.6%)	8 (19.0%)	43 (89.6%)	7 (16.7%)	7 (14.9%)
No	163 (54.3%)	22 (45.8%)	34 (69.4%)	34 (81.0%)	5 (10.4%)	35 (83.3%)	40 (85.1%)
Future usage intention							
Yes	215 (71.7%)	37 (77.1%)	31 (63.3%)	16 (38.1%)	47 (97.9%)	19 (45.2%)	20 (42.6%)
No	85 (28.3%)	11 (22.9%)	18 (36.7%)	26 (61.9%)	1 (2.1%)	23 (54.8%)	27 (57.4%)
Correlation (former use behavior / future usage intention)	0.55	0.59	0.41	0.62	0.43	0.49	0.49
N	300	48	49	42	48	42	47

Table 5: Descriptive results for the dependent variables

The great differences in descriptive results emphasize the importance of questioning the determining factors of past and future use behavior. In doing so, we identified the above-described comprehensive set of potential determinants. However, the following descriptive results regarding the potential determinants were obtained: First, the data show that for the institutional level and – apart from DPS – across all Digital Finance Solutions, the determinants FR, LR, SR and OR were rated, compared to the other variables, relatively low. This finding indicates a general uncertainty about how to evaluate these risk factors when conducting a decision behavior. Furthermore, at the institutional level, the respondents rated the independent variables PE, C and TC relatively high, which indicates that these determinants are quite important for individuals' use behavior and intention. For DFS, DIS, DInS and DFAS, we find the same variables, and EB was rated – compared to the other determinants – relatively high.

Finally, within DMS and DPS, both PE and TC were rated relatively high, whereas – again compared to other determinants within the respective Digital Finance Solutions – EB seems to be relatively important to DMS and C to DPS. Comparing the responses of the determinants not within but rather across the Digital Finance Solutions, we find PE, C, SI, TC, HM and H were rated highest for DPS. Moreover, EB was rated highest for DFS. However, there is almost no difference compared to its rating for DPS and DFAS. Finally, the following table reports the descriptive results of the independent set of variables:

Variable	FinTechs (Institutional level)	DFS	DIS	DMS	DPS	DInS	DFAS
PE							
Mean	4.42	4.35	3.89	3.48	5.09	3.74	3.78
Median	4.67	4.67	4.00	3.33	5.33	3.67	4.00
Std. deviation	1.07	1.29	1.26	1.36	1.07	1.06	1.17
EB							
Mean	3.90	4.17	3.90	3.53	4.10	3.78	4.13
Median	4.00	4.33	4.00	3.67	4.17	4.00	4.33
Std. deviation	0.96	0.91	1.04	1.20	1.17	1.19	1.06
C							
Mean	4.16	4.12	3.62	3.25	4.79	3.62	3.84
Median	4.33	4.00	4.00	3.17	5.00	3.67	4.00
Std. deviation	1.04	1.14	1.08	1.26	1.10	1.10	0.84
SI							
Mean	3.11	3.28	2.69	2.53	4.33	2.21	2.61
Median	3.33	3.33	2.67	2.00	4.42	2.00	2.67
Std. deviation	1.38	1.38	1.13	1.36	1.43	1.13	1.09
TC							
Mean	4.12	4.13	3.76	3.48	4.79	3.87	3.84
Median	4.00	4.33	3.67	3.67	5.00	3.83	4.00
Std. deviation	1.17	1.37	1.05	1.34	1.10	1.13	0.98
HM							
Mean	3.44	3.49	3.21	3.30	3.70	2.66	3.22
Median	3.42	3.50	3.00	3.33	3.67	2.83	3.33
Std. deviation	1.10	1.22	1.26	1.30	1.17	1.18	1.12
H							
Mean	3.66	3.64	3.14	2.74	4.53	2.99	2.94
Median	3.67	3.67	3.33	2.67	4.67	3.00	3.00
Std. deviation	1.13	1.22	1.05	1.41	0.95	1.11	1.21
FR							
Mean	3.00	2.88	2.84	2.79	3.57	3.04	2.80
Median	3.00	3.00	3.00	2.67	4.00	3.00	2.67
Std. deviation	1.25	1.21	1.20	1.31	1.44	1.25	1.15
LR							
Mean	3.23	3.23	3.03	2.86	3.51	3.21	3.12
Median	3.33	3.00	3.00	3.00	3.50	3.00	3.00
Std. deviation	1.17	1.14	1.18	1.41	1.41	1.30	1.06
SR							
Mean	3.08	3.13	3.02	2.76	3.17	3.19	2.99
Median	3.00	3.00	3.00	2.67	3.00	3.17	3.00
Std. deviation	1.34	1.29	1.21	1.26	1.41	1.26	1.30
OR							
Mean	3.11	3.23	2.85	2.81	3.30	3.07	2.97
Median	3.00	3.00	3.00	3.00	3.67	3.00	3.00
Std. deviation	1.17	1.28	1.05	1.15	1.39	1.25	1.11
N	300	48	49	42	48	42	47

Table 6: Descriptive results for the independent variables

Utilizing the comprehensive dataset, we built a logistic regression model specification that appropriately addresses this paper's research question concerning factors that potentially determine users' behavior regarding the adoption of FinTechs as alternative service providers.

In doing so, we included all 11 systemically derived potential determinants. However, for several methodological reasons, we did not include the full set of available socio-demographics and key characteristics. Due to the homogeneity of all respondents, we excluded age, field of study and target degree. Moreover, with regard to multi-collinearity issues, we excluded the respondents' digital experience, which is highly correlated with digitization knowledge. For the same reason, we needed to exclude the importance of personal interaction (provider and service). Finally, due to a lack of additional value regarding potential implications, we excluded the former banking and finance app usage, which, compared to online banking usage, has little difference in its descriptive results.

Based on the remaining set of variables, the logistic regression approach leads to the following results: PE, EB, C, SI, TC and H positively affect the future usage intention. Thus, increasing perceived PE, EB, C, SI, TC and H ceteris paribus implies an increasing probability of future FinTech usage. However, this effect is significant for PE, SI and TC at the 10.0% level. Contrariwise, the data show a negative ceteris paribus effect of HM on the probability of future FinTech usage. Yet, one must note that this effect remains insignificant. Furthermore, ceteris paribus, FR, LR and SR seem to positively influence the probability of future FinTech usage. In this respect, it is important to mention that due to the questions' wording, a lower perceived FR, LR and SR positively influence future usage decisions (Appendix B).

Anyhow, these effects are not significant at the 10.0% level. In contrast, the data show a significant and negative ceteris paribus effect of OR on the probability of future FinTech usage. Moreover, the higher the users' disposable income is and the lower the total liquid wealth is, the higher the probability of future FinTech usage, ceteris paribus. Finally, former online banking usage significantly increases the probability of future FinTech usage. Although some of the identified ceteris paribus effects are not significant at the 10.0% level, the McFadden R^2 of 0.393 indicates a satisfactory model design. Thus, the independent variables collectively explain the variance in the dependent variable quite well (McFadden, 1973; Veall and Zimmermann, 1996). However, the following table summarizes the R-Output of our logistic regression approach:

Variable	Estimate	Std. error	z value	Pr(>|z|)
(Intercept)	-9.470	1.805	-5.245	0.001***
PE	1.146	0.227	5.052	0.004***
EB	0.241	0.213	1.131	0.258
C	0.003	0.213	0.015	0.988
SI	0.268	0.151	1.771	0.077*
TC	0.353	0.192	1.845	0.065*
HM	-0.086	0.206	-0.419	0.675
H	0.267	0.204	1.311	0.190
FR	0.090	0.175	0.516	0.606
LR	0.231	0.194	1.190	0.234
SR	0.143	0.172	0.829	0.407
OR	-0.523	0.213	-2.459	0.014**
sd.genderfemale	0.386	1.072	0.360	0.718
sd.gendermale	0.100	1.089	0.092	0.927
sd.risk.attitude	-0.027	0.144	-0.191	0.848
sd.disposable.income	0.186	0.108	1.721	0.085*
sd.total.wealth.liquidity	-0.136	0.075	-1.803	0.071*
sd.online.bankingyes	1.397	0.506	2.760	0.006***
sd.digitization.knowledge	0.183	0.174	1.051	0.293

Null deviance:	357.64 on 299 degrees of freedom
Residual deviance:	217.14 on 281 degrees of freedom
AIC:	255.14
Number of Fisher scoring iterations:	6
McFadden R2:	0.393

Table 7: Logistic regression output

Due to the binary formulation of the dependent variable, we conducted a logistic regression approach. Thus, it is only able to interpret the direction of the independent variables' effects, but not their extent. To find the latter, we calculated the average marginal effects of all independent variables of the above model specification. As the following table shows, the results indicate, for instance, that if the independent variable PE increases marginally, the probability of future FinTech usage increases – on average, for all 300 observations – by 13.14 percentage points. Because the estimated coefficient of the determinant PE is highly significant, the average marginal effect is also highly significant. Moreover, the calculations indicate a highly significant average marginal effect of 16.00 percentage points for the independent variable of online banking. Thus, the likelihood of online banking customers to use FinTechs as alternative service providers increases by 16.00 percentage points compared to non-online banking customers. Additionally, the data show that a marginal increase of SI and TC raises the probability of future FinTech usage by 3.07 and 4.05 percentage points. Finally, these differences indicate the importance of the calculation of average marginal effects prior to the discussion and interpretation of the results. However, the following table summarizes the estimated coefficients as well as the calculated average marginal effects for all included independent and control variables:

Variable	Estimate	Average marginal effect
(Intercept)	-9.470	-1.085
PE	1.146	0.131
EB	0.241	0.028
C	0.003	0.000
SI	0.268	0.031
TC	0.353	0.040
HM	-0.086	-0.010
H	0.267	0.031
FR	0.090	0.010
LR	0.231	0.026
SR	0.143	0.016
OR	-0.523	-0.060
sd.genderfemale	0.386	0.044
sd.gendermale	0.100	0.012
sd.risk.attitude	-0.027	-0.003
sd.disposable.income	0.186	0.021
sd.total.wealth.liquidity	-0.136	-0.016
sd.online.bankingyes	1.397	0.160
sd.digitization.knowledge	0.183	0.021

Table 8: Average marginal effects of independent variables

3.5.2 Discussion

On the institutional level, the descriptive results show that more than 70.0% of the participants intend to make use of FinTechs in the future. This indicates that a customer shift from traditional service providers to FinTechs is possible. Moreover, this shift may interfere in the relationship between the principal banks and their customers, which has – particularly in Germany – a long tradition (the house bank principle). Furthermore, the comparison of the identified future usage intention of FinTechs with the already mentioned EY FinTech Adoption Index – which indicates an adoption rate of 35% in Germany in 2017 – points out a huge gap and thus great potential for customer out-migration for traditional financial institutions (Ernst & Young, 2017b). This finding further emphasizes the motivation and importance of research on future usage intentions as conducted in this study. Additionally, on the Digital Finance Solutions level, we identify – across all solutions apart from DMS and DPS – a gap of more than 20.0 percentage points between the current FinTech usage and its future intention. Since DPS is already used by 89.6% of all participants, the future usage intention could increase by only a maximum of 10.4 percentage points. These results again validate that traditional financial institutions need to be aware of potential customer out-migration in all areas of financial services. An extension of consciousness in this issue should therefore be of high priority for traditional service providers.

How current and potential customers rate the different drivers that might determine a usage decision and intention is of major interest. We investigated positive customer expectation drivers of former and future FinTech usage considerations. On the institutional level, the

participants rated PE, C and TC highest, which indicates that these determinants have a major impact on the future usage intention, perceived as positively inherent in FinTechs. Banks need to be aware of the degree to which using technology provides benefits. In addition, C, as an extrinsic factor, seems to determine the future usage intention positively in terms of technological flexibility in time and location. Moreover, the ease of use drives a decision. For banks, this phenomenon implies the need for improvements of customer applications as well as flexible time and location availability of products and services to avoid customer out-migration. TC, as a third factor of FinTech success, addresses the technological and organizational infrastructure of FinTechs. Customers intend to make use if they understand the process (Zhou et al., 2010) and have faith in the organizational resources to operate properly. Two important implications for traditional financial institutions follow these results: First, a certain base of confidence must be created. Second, technological knowledge and background must be imparted. Otherwise, customers' lack of trust in technology may ultimately cause potential out-migration. Furthermore, C (effort expectancy and convenience) and TC (facilitating conditions and seamless transaction) are clustered variables that again emphasize the idea of combining the TRA and UTAUT2 variables. Moreover, this finding underlines the importance of those variables for banks as a main driver of potential customer out-migration. In summary, on the institutional level, the three determinants of PE, C and TC outline potential losses for traditional financial institutions. Thus, it is inevitable to strengthen a positive perception of those three determinants in strategic and managerial decision-making.

Regarding the individual Digital Finance Solutions, the descriptive results also show that for DFS, DIS, DInS and DFAS, participants rated PE, C and TC relatively high. The resulting practical implications can be associated with those on the institutional level, as discussed before. Moreover, EB – clustered of price value and economic benefit – was rated relatively high, too. What stands out most when focusing on EB is the expected cost-performance ratio. With consideration of financing, investment, money, insurance and financial advice solutions, customers are focused on potential gains and savings potential. Since the potential gains are sometimes not controllable directly (e.g., exogenous shocks), the focus for banks should be on the conditions and cost structure to ensure that customers expect a satisfactory cost-performance ratio and thus are willing to demand the respective products or services. Furthermore, for DMS and DPS, we observe a relatively high rating for PE and TC. Hence, the previously derived implications regarding those determinants are also valid for DMS and DPS. Moreover, for DPS, the variable C turns out to be of great importance. This indicates that – according to the

importance of C on the institutional level – flexibility in time and location as well as general convenience drive customers' willingness to use DPS.

In addition, with regard to the risk variables (FR, LR, SR, OR), we identify outliers, too. In this regard, it is important to mention again that due to the questions' wording, lower-rated and thus perceived FR, LR, SR and OR imply a greater importance of those risk factors. On the institutional level as well as for DMS, we did not find any outliers within the participants' rating. This may be explained by a lack of both the providers' and customers' internal influence on DMS. For DFS, we observe a relatively lower rating for FR. This means that the risk of making a loss – due to mistakes by the customer itself or by a counterparty – is critical for future usage intention. In general, all fields of tailspin determine a usage consideration. For DIS, we also identified FR as a relatively important determinant. This follows the interpretation and implications previously drawn for DFS. Moreover, with regard to DIS, the participants' ratings of OR indicate that customers perceive a relatively high risk of uncontrollable internal processes. On the Digital Finance Solution level, this finding implies that traditional banks need to build up security and trust on the inside and project it to the outside because customers do not typically fear operational risks when using DIS.

Solely for DPS, SR is observed to have greater importance. This can be explained by the required security of transactions for both personal and financial data. Thus, customers fear hacking and fraud as well as personal uncertainty. This fear may not be a threat but rather an opportunity for traditional banks to strengthen DPS, because data security may be communicated and perceived as a competitive advantage of traditional financial institutions. When stating that security, especially transaction and data security, is an important factor for Digital Finance Solutions, we find that FR is rated relatively important for DFAS. As for the previously mentioned security risks, this finding may be due to the technical fear of misunderstanding algorithmic processes and the resulting fear of losing money. A lack of knowledge in the functioning of DFAS (e.g., robo advisory) and an ascribed missing rationality of the system may overweight a high interest and cause customers to refuse to use it. At this point, for traditional banks, the opportunity to create a hybrid solution is arising. Merging a digital solution with traditional banking security and the banks' employees' great expertise in this sensitive field could be a good way to attract and hold that group of customers.

As this survey attempts to explain behavioral intention as a dependent variable, the empirical results indicate several fields of interest for traditional banks, where they may suffer potential customer out-migration. The strong positive effect of PE implies that if a FinTech is able to improve its perceived performance, customers' future usage intention increases significantly. The expected benefit in daily usage improvement and time efficiency is of great importance for customers' usage intention. Thus, banks need to strengthen their appearance as beneficial and their competitive advantage in creating effectiveness and benefits in daily usability and acceptance. Moreover, SI is also identified as a significant positive driver. This implies great multiplier and network effects (Katz and Shapiro, 1994; Bertrand et al., 2000), because both the private and professional surroundings positively influence the future usage decision. In addition, group influence has a major impact on risk-taking behavior (Wallach et al., 1962). The intention to use digitized financial services, which are – due to their novelty – perceived to be more risky, increases within a certain group. To strengthen this aspect, traditional banks need to focus on the group behavior of customers. Communities and platforms as well as a transformation in private surroundings may be potential instruments to empower customer relationships and to prevent the loss of market share to FinTechs.

Furthermore, traditional banks' customer churn management should focus on technical aspects of function, time and location flexibility as well as process improvement. This is represented by a positive effect of TC on the future FinTech usage intention. According to the descriptive results on TC, for the institutional level as well as for the individual Digital Finance Solutions, this finding matches the implication of a change in technical conditions. If FinTechs succeed in creating efficient technical processes, customers intend to increase their usage. Finally, we find that OR negatively influences future usage intention, which means – due to the questions' wording – that a lower perceived OR leads to a decreasing future usage intention. Anyhow, this result is not interpretable intuitively and needs to be taken into account in more detail. A potential explanation may be that – so far – from the users' point of view, there is a lack of experience regarding OR in FinTechs. Consequently, this lack of experience may imply that users feel unable or unsecure to appropriately evaluate the OR associated with FinTechs.

Among the socio-demographic variables, online banking is the strongest factor, significantly affecting future usage intention positively. This indicates that customers who already use online banking tend to be more open-minded towards using FinTechs as alternative service providers. Primarily, their inhibition level is lower, which might also lower their perceived risk of using

FinTechs. This group of customers represents the most important one to observe for traditional financial institutions, as they may have a relatively high risk of potential out-migration. The behavioral intention of usage is affected not only by the way the technology is used or the money is spent but also by the source and amount of money possessed. Disposable income has a significant positive effect on the future usage intention of FinTechs. With an increasing regular disposable income, customers are more willing to take higher risks (Shaw, 1996; Kanbur, 1979). Apparently, this willingness includes increasing readiness regarding the usage of new technologies and alternative service providers. This relates to the simple effect of more possibilities with an increasing amount of money. Hence, the opportunity to use alternative financial services providers becomes more tangible. Therefore, the intention to use them would, depending on the expectations, increase. Moreover, former research indicates that less mature decision makers tend to take higher risks, while more mature customers tend to be more risk averse (MacCrimmon and Wehrung, 1990). As our sample focuses on students, this finding entails that students who begin increasing their disposable income tend to take higher risks when making financial decisions. Therefore, if FinTechs manage to create the previously mentioned network effects within customer groups of rising disposable income, traditional banks may encounter a higher loss potential. Thus, the latter should try to motivate and incentivize these customers by using hold and push strategies.

In contrast, the empirical results show that wealth has a vice versa negative effect on the future usage intention of FinTechs. This depicts that usage intention is decreasing with increasing wealth. This behavioral intention may be ascribed to a traditional attitude towards wealth. Students usually have a certain income, which does not yet provide great wealth. Thus, it usually takes a student longer to earn or save a certain amount of money than it does for middle-aged employees. Consequently, any wealth a student has – if having so – is likely to be provided by others (e.g., parents, grandparents). According to previous research, this implies a greater fear of loss compared to a monthly returning income (Slovic, 1964). This phenomenon may explain the identified negative effect of wealth on FinTech usage, which is perceived to be more risky. Hence, if the fear of losing a saved amount increases with rising wealth, the willingness to take risks decreases. To conclude, this group of customers represents a very important one for traditional financial institutions, since they may be less likely to out-migrate.

Ultimately, these studies' results indicate that customers are willing to and expect to use innovative and reinvented financial products and services, thus, Digital Finance Solutions. It is

important to once again state that there is a general acceptance and future usage intention of FinTechs as alternative service providers. Thus, from traditional financial institutions' point of view, integrating Digital Finance Solutions into their product portfolios is inevitable. Otherwise, banks are likely to experience great customer out-migration to FinTechs, because these servicers offer the expected and demanded innovative Digital Finance Solutions. To summarize the above-discussed results, the following table outlines the systematically derived strategic and managerial implications for traditional financial institutions.

Field of interest	Strategic and managerial implications…
FinTechs (institutional level)	…derived from the descriptive results: • Generally: Be aware of the great potential of customer out-migration and strengthen customers' positive perception of, especially, the determinants PE, C and TC • PE: Strengthen technology since customers expect them to improve performance and provide benefits • C: Improve customer applications and their time- and location-flexible availability • TC: Create a base of confidence and impart technological knowledge and background …derived from the empirical results: • PE: Strengthen technology since customers expect them to improve performance and provide benefits. Customers' intention to use FinTechs increases if they expect to be able to improve time efficiency and daily usage experience • TC: Create a base of confidence and impart technological knowledge and background. Focus on efficient processes as well as time- and location-flexible availability of products and services • SI: Make use of private and professional network effects. For instance, build up communities and platforms in order to empower customer relationships and to prevent the loss of market share to FinTechs • Online banking: Focus on technically affine customers since they have a higher probability of out-migrating to FinTechs as alternative service providers • Disposable income/total liquid wealth: Be aware of differing risk attitudes of customers, make use of customers' data analysis in order to implement target-group-specific marketing activities
Digital Financing Solutions (DFS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DFS • PE/C/TC: See FinTechs (institutional level) • EB: Focus on conditions as well as cost structure in order to ensure that customers expect a satisfactory cost-performance ratio • FR: Lower customers' fear of losing money due to mistakes and counterparties' failure
Digital Investment Solutions (DIS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DIS • PE/C/TC: See FinTechs (institutional level) • EB/FR: See DFS • OR: Improve customers' trust in internal security and processes
Digital Money Solutions (DMS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DMS • PE/TC: See FinTechs (institutional level) • EB: See DFS
Digital Payment Solutions (DPS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DPS • PE/C/TC: See FinTechs (institutional level) • SR: Focus on transactional security for both personal and financial data and communicate this as a competitive advantage
Digital Insurance Solutions (DInS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DInS • PE/C/TC: See FinTechs (institutional level) • EB: See DFS
Digital Financial Advice Solutions (DFAS)	…derived from the descriptive results: • Generally: Be aware of customers' high future usage intention of DFAS • PE/C/TC: See FinTechs (institutional level) • EB: See DFS • FR: See DFS + focus on hybrid solutions in order to merge the DFAS advantages with the banks' great expertise in this sensitive field

Table 9: Strategic and managerial implications

3.5.3 Robustness

To ensure the best possible data quality, we conducted several robustness checks regarding the dataset as well as the regression approach. As already mentioned, the questionnaire contains four questions per construct, including one control question with (partly) reversed wording. All measures – apart from the dichotomous dependent variables – were evaluated on a 6-point Likert scale. Thus, we were able to ensure the respondents' understanding of the questions by calculating the correlations of every three questions per construct with their corresponding control question. In doing so, we obtained – as expected – negative correlations. This finding indicates a great understanding of the questions by the participants and thus that this study's dataset is of high quality. Moreover, we double-checked our control questions by implementing a reverse wording for the OR's control question. In this case, we obtained a positive correlation, which reconfirms the high quality of the dataset. All correlation results are provided in Appendix D of this paper.

Furthermore, we checked our regression approach for multi-collinearity issues by examining the correlations between the independent variables as well as calculating the variance inflation factors (VIF). However, as mentioned earlier, we excluded several variables from the model specification (e.g., the respondents' digital experience) to prevent multi-collinearity. After doing so, the correlation coefficients and variance inflation factors indicate no further multi-collinearity issues. All calculated variance inflation factors are provided in Appendix E. Moreover, we analyzed the reliability by calculating Cronbach's alpha. Because all numeric variables have a Cronbach's alpha above 0.75, referred to Gliem and Gliem (2003) and Peterson (1994), the questionnaires' reliability is satisfactory. Furthermore, to check for autocorrelation and heteroscedasticity issues, we calculated resistant standard errors. This did not lead to any significant changes. Finally, even though we derived the set of independent variables systemically and clustered the potential determinants carefully, it is impossible to prevent all endogeneity issues for sure. Nonetheless, with regard to potential endogeneity issues, we do not expect certain coefficients to be overestimated or underestimated.

3.6 Concluding comments

This paper investigates the customers' current use behavior and future usage intention of FinTechs and Digital Finance Solutions. Its objective is to identify and evaluate potential adoption drivers and to develop strategic and managerial implications for traditional financial institutions. To both theoretically and empirically address this research question, a survey of

students at three German universities was conducted. This ultimately led to 300 evaluable observations. Consequently, in addition to the descriptive analysis, a logistic regression approach for "future usage intention (FinTechs)" was used to estimate the effect of 11 potential determinants on the behavioral intention.

Finally, the results of this study show that customers are willing and expect to use innovative and reinvented financial products and services, thus, Digital Finance Solutions. At the same time, the results indicate a huge gap between the customers' current use behavior and future usage intention not only with regard to the Digital Finance Solutions but also to FinTechs. Thus, we state that from the traditional financial institutions' point of view, integrating Digital Finance Solutions into their product portfolios is inevitable. Otherwise, banks are likely to experience great customer out-migration to FinTechs, since these servicers offer the expected and demanded innovative Digital Finance Solutions. Moreover, building on the diffusion of the benefit-risk framework of TRA and UTAUT2, we identified several potential determinants of customers' use behavior regarding both FinTechs and Digital Finance Solutions. However, these findings enabled us to define certain fields of interest and to derive corresponding strategic and managerial implications for traditional financial institutions. To attract customers, build up competitive advantages and thus prevent customer out-migration, the implications particularly but not exclusively focus on determinants such as PE, EB, C, SI and TC. Furthermore, this study contributes to several strands of literature. We contribute not only to the general understanding of FinTechs and Digital Finance Solutions but also to the existing literature on behavioral intention and technology acceptance in clustering TRA and UTATUT2 variables. However, one should outline that traditional financial institutions still hold competitive advantages, such as a high level of acceptance, good market positions and financial resources as well as a strong customer base. Nevertheless, the current digitization tendencies with corresponding changes in both competitive and market landscapes seem to be of a disruptive nature and of great relevance. Managers should not only be aware of the resulting challenges but – in order to remain competitive – also implement strategic and managerial measures in a timely manner.

Notwithstanding, it is important to outline that – due to the sample's structure as well as its geographic scope – one should be careful in generalizing the results and implications to more heterogeneous customer groups. However, because we derive our implications from the traditional financial institutions' point of view, the underlying sample is of particular interest

because these participants represent future high net worth individuals. Moreover, even though the set of potential determinants was derived systematically and carefully, it is impossible to completely avoid the lack of further important variables. This may ultimately cause endogeneity issues. However, we do not expect endogeneity issues in this study. Furthermore, the results and implications are limited to the conducted methodological approach. Thus, even though several robustness checks were conducted, remaining methodological issues may affect both the results and implications of these studies.

Partly derived from the limitations, we identify requirements for future research. First, future research approaches should address the above-stated limitations to verify this study's results and implications. This implies, for instance, addressing the research question with a more heterogeneous national or even international sample as well as with alternative methodological approaches. Moreover, this paper's research questions should be concretized regarding the individual Digital Finance Solutions. This would qualify research to identify and evaluate differences. In addition, this would deliver additional value in terms of the derivation of specific practical implications. Furthermore, since we clustered variables from different strands of literature, the set of potential determinants can be further reviewed. In particular, the great relevance of the clustered variables postulates that further research should consider the individual sample and the isolated Digital Finance Solutions.

3.7 Appendix

Appendix B: Variables, questionnaire items and related literature

Variable/construct	Items	References
Overall Usage/ Behavioral Intention	Did you ever make use of FinTechs? Do you intend to use (continue the usage of) FinTechs within the next years?	Cheng et al. (2006); Lee (2009); Venkatesh et al. (2012); Ryu (2018b)
PE	The use of FinTechs (might) improve(s) my daily usage of financial services. The usage of FinTechs is (might be) less time intense. Using FinTechs is (might be) more efficient. I see no advantages in using FinTechs. (control)	Venkatesh et al. (2012); Featherman and Pavlou (2003); Lee (2009)
EB	The usage of FinTechs is (might be) less cost intense. The usage of FinTechs (might) offer(s) savings potentials. I do (might) expect financial gains from the usage of FinTechs. I see no benefit in using FinTechs. (control)	Yiu et al. (2007); Lee (2009); Ryu (2018b)
C	FinTech interaction is (might be) clear, understandable and easy. The usage of FinTechs is (might be) easy for me. The usage of FinTechs is (might be) possible at any time very quickly and easily. The use of FinTechs is not clear and understandable. (control)	Venkatesh et al. (2012); Ryu (2018b)
SI	People who influence my behavior use FinTechs. In my private surrounding, I know many people who use FinTechs. In my professional surrounding, I know many people who use FinTechs. I do not know people in my private/professional surrounding who use or may use FinTechs. (control)	Self-worded
TC	I have the resources and technological infrastructure to use FinTechs. The whole process of using FinTechs is (might be) simple for me. I have the technological knowledge to use FinTechs. I do not have the technological knowledge and the resources to use FinTechs. (control)	Venkatesh et al. (2012); Brown and Venkatesh (2005)
HM	It is (might be) fun and entertaining to use FinTechs. Using FinTechs is (might be) enjoyable. It (might) give(s) me pleasure to use FinTechs. I do (might) not enjoy using FinTechs. (control)	Venkatesh et al. (2012)
H	The use of FinTechs is (might become) a habit for me. The use of FinTechs is (might be) natural to me. I will (would) try to use FinTechs in my daily usage of any financial solutions. I will (would) never get used to FinTechs within my daily life. (control)	Venkatesh et al. (2012)
FR	I am (might) not (be) worried to lose money due to a counterparty failing when using FinTechs. I am (might) not (be) worried about a financial risk due to mistakes I could make. I am (might) not (be) worried to lose money due to transaction errors. I do (might) fear financial risks when using FinTechs. (control)	Abramova and Böhme (2016); Lee (2009); Featherman and Pavlou (2003)
LR	I am (might) not (be) worried about the legal status and restrictions of FinTechs. I am (might) not (be) worried about the uncertainty of regulation. I am (might) not (be) worried about a restriction of use of FinTechs. I do (might) fear legal risks when using FinTechs. (control)	Ryu (2018b); Abramova and Böhme (2016)
SR	I am (might) not (be) worried about security when using FinTechs. I am (might) not (be) worried about data security when using FinTechs. I am (might) not (be) worried about financial information security when using FinTechs. I do (might) fear security risks when using FinTechs. (control)	Ryu (2018b)
OR	I am (might) not (be) worried about potential losses due to internal processes out of my field of control. I am (might) not (be) worried about losses due to technological vulnerabilities of FinTechs. I am (might) not (be) worried about the compensation of potential losses or information leakages. I do (might) not fear any operational risks when using FinTechs. (control)	Abramova and Böhme (2016), Self-worded
Construct	6-point Likert scales, unless otherwise noted, with 1 = strongly disagree and 6 = strongly agree.	Jacob et al. (2013); Carifio and Perla (2007); Klopfer and Madden (1980)

Appendix C: Socio-demographics and key characteristics of the final dataset

Variable	Absolute frequency		Relative frequency (%)
Gender	Male:	155	51.7
	Female:	137	45.7
	Diverse:	8	2.7
	Total:	*300*	*100.0*
Age	Under 20:	36	12.0
	20-22	147	49.0
	23-25:	81	27.0
	26 and older:	36	12.0
	Total:	*300*	*100.0*
Field of study	Banking and Finance:	11	3.7
	Business Administration:	151	50.3
	Business Chemistry:	23	7.7
	Economics:	100	33.3
	Finance and Actuarial Mathematics:	10	3.3
	Mathematics:	4	1.3
	Others:	1	0.3
	Total:	*300*	*100.0*
Target degree	Bachelor:	211	70.3
	Master:	89	29.7
	Total:	*300*	*100.0*
Disposable income	<250:	53	17.7
	250-500:	82	27.3
	501-750:	59	19.7
	751-1,000:	55	18.3
	1,001-1,250:	25	8.3
	1,251-1,500:	6	2.0
	1,501-1,750:	2	0.7
	1,751-2,000:	4	1.3
	2,001-2,250:	3	1.0
	>2,250:	11	3.7
	Total:	*300*	*100.0*
Total wealth (liquidity)	<1,000:	58	19.3
	1,001-2,500:	54	18.0
	2,501-5,000:	46	15.3
	5,001-7,500:	38	12.7
	7,501-10,000:	30	10.0
	10,001-15,000:	21	7.0
	15,001-20,000:	14	4.7
	20,001-30,000:	12	4.0
	30,001-50,000:	14	4.7
	>50,000:	13	4.3
	Total:	*300*	*100.0*
Online banking usage	Yes:	265	88.3
	No:	35	11.7
	I don't know:	0	0.0
	Total:	*300*	*100.0*
Banking / Finance app usage	Yes:	204	68.0
	No:	95	31.7
	I don't know:	1	0.3
	Total:	*300*	*100.0*
Risk attitude	Mean:		3.21
	Median:		3.00
Digital experience	Mean:		4.65
	Median:		5.00
Digitization knowledge	Mean:		4.41
	Median:		5.00
Importance of personal interaction (provider)	Mean:		3.72
	Median:		4.00
Importance of personal interaction (services)	Mean:		3.84
	Median:		4.00

Appendix D: Correlations of questionnaire items with their corresponding control questions

Questionnaire item	Correlation
PE, PE.control	-0.448
EB, EB.control	-0.311
C, C.control	-0.423
SI, SI.control	-0.563
TC, TC.control	-0.607
HM, HM.control	-0.335
H, H.control	-0.398
FR, FR.control	-0.255
LR, LR.control	-0.107
SR, SR.control	-0.313
OR, OR.control	0.431

Appendix E: Calculated variance inflation factors

Variable	GVIF	Df	GVIF^(1/(2*DF))
PE	1.273	1	1.128
EB	1.228	1	1.108
C	1.448	1	1.203
SI	1.210	1	1.100
TC	1.389	1	1.179
HM	1.463	1	1.210
H	1.387	1	1.178
FR	1.469	1	1.212
LR	1.465	1	1.210
SR	1.597	1	1.264
OR	1.937	1	1.392
sd.gender	1.544	2	1.115
sd.risk.attitude	1.234	1	1.111
sd.disposable.income	1.256	1	1.121
sd.total.wealth.liquidity	1.270	1	1.127
sd.online.banking	1.131	1	1.063
sd.digitization.knowledge	1.159	1	1.076

3.8 Declaration of Co-authors and record of accomplishments

Title	Evidence on Usage Behavior and Future Adoption Intention of FinTechs and Digital Finance Solutions
Authors	Johannes M. Gerlach (Heinrich-Heine-University Duesseldorf) Julia K. T. Lutz (Heinrich-Heine-University Duesseldorf)
Conferences	Participation and presentation at the research seminar "Financial Markets and Financial Management", 15th May 2019, Duesseldorf, Germany. Participation and presentation at "The 27th Global Conference on Business and Finance", 28th-31st May 2019, San José, Costa Rica. Achievement of the "Best in Session Award" and "Outstanding Research Award". Acceptance at the "International Finance and Banking Society (IFABS) 2019", Angers, France. Acceptance at "The Third Israel Behavioral Finance Conference", Tel Aviv, Israel. Acceptance at "The 6th Vietnam International Conference in Finance", Danang, Vietnam. Acceptance at "The 2nd UWA conference on Blockchain, Cryptocurrencies and FinTech", Perth, Australia. Acceptance at the "2019 Vietnam Symposium in Banking and Finance", Hanoi, Vietnam.
Publications	The International Journal of Business and Finance Research, Vol. 13, No. 2, 2019, pp. 83-105.

Contributions	**Julia K. T. Lutz**	**Johannes M. Gerlach**
Conceptualization Development of research question Methods specification	50%	50%
Execution Literature review and development of theoretical framework Data collection and preparation Data analysis Analysis and discussion of results Derivation of implications and conclusions	50%	50%
Manuscript preparation Initial draft Finalization	50%	50%
Overall contribution	**50%**	**50%**

Date, Julia K. T. Lutz

Date, Johannes M. Gerlach

4 Digital Financial Advice Solutions – Evidence on Factors Affecting the Future Usage Intention and the Moderating Effect of Experience

4.1 Abstract

Recently, Digital Financial Advice Solutions (i.e., "Robo Advice" or "Robo Advisory") are emerging rapidly within the financial services sectors, which can be outlined by the respective Assets und Managements' CAGR of 255.9% from 2016 to 2018 in Germany (Kaya, 2019). However, these developments imply both opportunities and threats for traditional financial institutions: On the one hand, potential customer out-migrations, the loss of cross-selling potentials and potential yields as well as challenged competitiveness pose significant risks. On the other hand, if traditional banks manage to implement appropriate measures timely, the recent developments also offer great market potentials. Thus, it is inevitable to identify, understand and discuss factors that drive the customers' future usage intention of Digital Financial Advice Solutions. As a result, we derive, from the traditional financial institutions' point of view, strategic and managerial implications on how to deal with the currently emerging trends of Digital Financial Advice Solutions. For this purpose, we conducted a questionnaire-based online survey, which ultimately led to 600 evaluable observations. Finally, according to the two strands of literature this study bases on, i.e., the net valence framework and unified theory of acceptance and use of technology 2, we built a structural model that incorporates a comprehensive set of variables. In doing so, we contribute to not only the general understanding of Digital Financial Advice Solutions and two different strands of literature but also to the solution of issues that are of great relevance for practitioners, too. Subsequently, this study concludes by the derivation of future research requirements regarding these, both theoretically and practically, important matters.

Keywords: Digital Financial Advice Solutions, Robo Advisory, Robo Advice, digitization of traditional wealth management services, technology adoption, future usage intention, behavioral intention, net valence framework, unified theory of acceptance and use of technology 2

JEL Classification: G10, G20, G21, G23, M10, M13, M31, O30

4.2 Introduction

Recently, traditional financial services sectors worldwide face tremendous challenges, i.e., the easy monetary policies by important central banks, regulatory tightening, increasing digitization tendencies, proceeding globalization and, especially in Germany, demographic changes (McKinsey, 2016; Statistisches Bundesamt, 2015). Among them, the current digitization tendencies pose a main challenge for traditional financial institutions. In this regard, not only the digitization of financial products and services but also continuing market entries of FinTechs that already offer the full range of financial products and services, represent significant challenges for traditional financial institutions (Arner et al., 2016; Dorfleitner et al., 2016). Several numbers outline these developments: For instance, the global EY FinTech Adoption Index indicates that the global FinTech adoption rate increased from 16.0% in 2015 to already 33.0% in 2017 and is expected to increase further (Ernst & Young, 2017b). More specifically, the emergence of DFAS, also known as "Robo Advice" or "Robo Advisory" (characterized by user-friendly and automated processes, attractive pricing models and solid performances), pose significant challenges for the providers of traditional wealth management services (Kaya, 2017). This can be highlighted by means of the strong growth of the Assets under Management in Germany from EUR 0.3 billion in 2016 to EUR 3.8 billion in 2018 (CAGR: 255.9%) (Kaya, 2019). However, the comparison with the total Assets under Management in Germany, around EUR 3,000 billion in 2018 (BVI, 2019), emphasizes the great market potential of DFAS. Finally, this implies both opportunities and threats for traditional financial institutions: Changing market landscapes and customer expectations, potential customer out-migrations and thus the loss of cross-selling potentials and potential yields as well as challenged competitiveness represent significant risks. In contrast, if traditional financial institutions manage to address the current market developments and implement appropriate strategic and managerial measures timely, the recent developments may also offer great market potentials and thus opportunities. Consequently, from the viewpoint of traditional financial institutions, it is indispensable to identify and understand the factors that drive the customers' future usage intention of DFAS. Otherwise, traditional banks will neither be able to implement appropriate strategic and managerial measures to prevent risks of the current developments, nor to utilize the associated opportunities.

Hence, the following study investigates the effects of potential determinants on the future usage intention of DFAS. In doing so, this study aims at addressing the formulated research questions, i.e., (1) how do perceived benefit and risk influence the future usage intention of DFAS? (2)

Which factors determine perceived benefit and risk? (3) Does experience have a moderating effect on how perceived benefit and risk affect the future usage intention of DFAS? Correspondingly, we derived and formulated a set of hypotheses. Furthermore, based on our analysis, we aim to derive strategic and managerial implications on how to deal with the emerging trend of DFAS, from the viewpoint of traditional financial institutions. In order to both theoretically and empirically address these objectives, we conducted a questionnaire-based online survey, which ultimately led to 600 evaluable observations. Finally, based on our systematic review of two strands of literature, we built a structural model that incorporates a comprehensive set of variables.

With this study, we contribute not only to the academic literature but also to practical issues that are of great relevance: First, we identified a significant research gap on the adoption or acceptance of DFAS, which represents the dependent side of our subsequent empirical model design. Second, since this study combines two different strands of literature, we, compared to former studies, identify and incorporate a more comprehensive set of variables. This ultimately enriches our analysis, results and discussions as well as the derived implications. Consequently, with this study, we do not only contribute to the general understanding of FinTechs and DFAS but also to the existing literature on both decision-making and the acceptance or adoption of technologies. Finally, with regard to the recent developments in the financial services industries both nationally and internationally, gaining insights into the hereinafter-addressed issues is of great relevance for practitioners, too.

In order to address this study's research questions, we structured the remainder of this study systematically: Firstly, section 4.3 builds the theoretical foundation. Thus, it provides essential definitions, related literature and the resulting set of variables. Subsequently, section 4.4 illustrates the data and methodology as well as this study's research questions and corresponding hypotheses. Afterwards, section 4.5 provides a comprehensive overview of both descriptive and empirical results as well as the corresponding discussion and implications. Moreover, it conducts several checks of robustness. After all, section 4.6 offers concluding remarks, outlines inherent limitations and finally identifies future research requirements.

4.3 Theoretical foundation and literature review

The following section builds the theoretical background of this study. In order to address this study's topics and research questions, it is first necessary to build our definitional foundations

of FinTechs and DFAS. Afterwards, our comprehensive literature review derives both the identified research gap and the resulting set of variables utilized to address this study's research questions and hypotheses.

4.3.1 Digital Financial Advice Solutions

Since DFAS fall within the scope of products and services offered by both FinTechs and traditional financial institutions, it is reasonable to introductory point out that, according to former research, until now no unique understanding of the term "FinTech" could be established. Yet, there is a broad consensus that the term "FinTech" is a composition of the words "Finance" or "Financial" and "Technology". Anyhow, for the purpose of this study, we follow an institutional oriented approach in defining "FinTech". Thus, we understand a FinTech as a company or entity, no matter if start-up or established, that develops and offers innovative financial products or services, by utilizing new technologies. These, however, are of revolutionary and disruptive nature (Arner et al., 2016; Dorfleitner et al., 2016; Gerlach and Lutz, 2019; Gomber et al., 2017; Kim et al., 2016; Kuo Chuen and Teo, 2015; Ryu, 2018b; Schueffel, 2016; Zavolokina et al., 2016; Gerlach and Rugilo, 2019).

In this respect, there exist various but in each case similar systemization approaches for FinTechs (Bank for International Settlements, 2017; Brummer and Gorfine, 2014; Dorfleitner et al., 2016; He et al., 2017; Maume, 2017; Philippon, 2016). However, in this study, we follow Gomber et al. (2017), who use the comprehensive "Digital Finance Cube-concept" to systemize FinTechs. In this case, the two dimensions "Digital Finance Technologies and Technological Concepts" (e.g. Block Chains, NFC, P2P Technologies, Big Data Analytics) and "Digital Finance Business Functions" (Digital Financing, Investments, Money, Payments, Insurances and Financial Advice) are used for the purpose of systemization. Building on this, we define DFAS as products and services, independently of the supplier, that fall within the scope of the mentioned Digital Finance Business Function "Digital Financial Advice":

> Digital Financial Advice Solutions (DFAS) embrace the provision of investment proposals, which are – in contrast to traditional financial advice – designed to work with no or minimal human intervention and are based on algorithms and a digital onboarding process that considers pre-defined parameters concerning investment goals, financial background and risk aversion. Presently, these so-called robo advisors focus on portfolio

management services and utilize investment strategies, which base on established theories such as modern portfolio theory (Gerlach and Lutz, 2019; Gomber et al., 2017).

In this regard, it is important to highlight that we use the term DFAS synonymously to in numerous studies commonly used terms like “Robo Advice” or “Robo Advisory” (Coombs and Redman, 2018; Fulk et al., 2018; Jung et al., 2018a; Jung et al., 2018b; Lee et al., 2018; Woodyard and Grable, 2018). However, within the German context, Scalable Capital, quirion or cominvest represent well-known suppliers of DFAS, whereas Betterment or Wealthfront are commonly known robo advisors in the US (Gerlach and Lutz, 2019). Finally, since this study focuses on the adoption respective future usage intention of DFAS and thus robo advisory services, DFAS is associated with the dependent side of this study’s empirical approach. Beyond that, it is once again worthwhile to point out that both FinTechs and traditional financial institutions as well as new entrants and established companies represent potential providers of DFAS.

4.3.2 Literature review and resulting set of variables

Since this study addresses the customers’ future usage intention of DFAS, it is needful to build a theoretical framework on both decision-making and acceptance. Regarding decision-making processes, we state that individuals face incomplete and imperfect information, which imply the presence of uncertainties. Hence, risks are incorporated factors in decision-making (Kim et al., 2008; Ryu, 2018b). On the other hand, decision-making processes are not only associated with risk factors but also to potential positive outcomes, thus benefits (Kim et al., 2008; Ryu, 2018b; Wilkie and Pessemier, 1973). Consequently, the combination of both perceived benefit and risk factors result in the net valence framework, which bases on the TRA. “Net valence”, in this context, is defined as the arithmetic difference between the expected positive return (i.e., perceived benefit) and the expected negative return (i.e., perceived risk) of a decision and its outcome (Ajzen and Fishbein, 1977; Peter and Tarpey Sr, 1975; Ryu, 2018a; Ryu, 2018b).

Additionally, since DFAS represent technology-based products and services of revolutionary and disruptive nature, it is not sufficient to focus on the decision-making related literature, exclusively. Rather, it is inevitable to take the acceptance or adoption of technology related literature into account, too. In this regard, the variables perceived usefulness and perceived ease of use were the first ones to be incorporated in the TAM and its extension TAM2 (Davis, 1986; Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 2000). Evolving from this, further

extensions, contributions and particularly combinations of former theories on the acceptance of technologies resulted in the UTAUT2 (Brown and Venkatesh, 2005; Venkatesh et al., 2003; Venkatesh et al., 2012). To date, UTAUT2 represents the latest and most comprehensive theory on the acceptance of technologies (Venkatesh et al., 2012).

According to former research, we find that empirical approaches focus mostly on either the decision-making related literature or the acceptance of technology related literature to model the (future) usage intention of individuals. Moreover, with regard to the dependent side, we find that former research focuses on other than DFAS and thus robo advisory services. For instance, Meyliana et al. (2019) utilize TAM, combined with perceived risk and trust, to model the adoption of FinTech services in general. However, the authors find that perceived usefulness and ease of use as well as the attitude regarding the usage positively affect the intention to use FinTech services. Furthermore, there is several literature that addresses the adoption of internet, online or mobile banking. In doing so, Cheng et al. (2006); Pikkarainen et al. (2004); Yiu et al. (2007) focus on TAM and its modifications. Whereas Lee (2009) combines both TAM and the Theory of Planned Behavior, Featherman and Pavlou (2003) utilize both TAM and perceived risk but leave perceived benefit out of considerations. In addition, Casaló et al. (2007) focus exclusively on privacy and security, usability, reputation and trust as determining variables, whereas Zhou et al. (2010) take into account UTAUT, solely. Finally, even though Jugurnath et al. (2018) conduct a comprehensive discussion on both the decision-making and acceptance of technology related literature and thus potential determining factors, they empirically only focus on a set of socio-demographic variables on the independent side. Additionally, Abramova and Böhme (2016) combine both TAM and perceived benefit and risk but focus on the usage of Bitcoin on the dependent side. Besides, former research addresses the adoption of mobile payment by utilizing a modified TAM (Kim et al., 2016), UTAUT2 (Havidz et al., 2018; Morosan and DeFranco, 2016) or perceived benefit and risk framework (Liu et al., 2012; Ryu, 2018a; Ryu, 2018b), whereat Ryu (2018a); Ryu (2018b) takes P2P lending and crowdfunding as dependent variable into account, too.

Beyond that, with regard to the usage and adoption of DFAS, former research addresses the question about who uses robo advisory services (Fulk et al., 2018; Woodyard and Grable, 2018). Moreover, Hohenberger et al. (2019) address the adoption of DFAS but focus on financial experience, joy, anxiety and self-enhancement, exclusively. Furthermore, Lee et al. (2018) conduct a simulation based approach and identify price and trustworthiness as crucial factors

for the choice of DFAS. Finally, whereas Jung et al. (2018b) concentrate on the design process of robo advisory services Rühr et al. (2019) address a trade-off between perceived automation and user control as determining factors for the usage intention. As a result, we state, that to date there is little research that focuses on the adoption of robo advisory services, which indicates a significant research gap (Jung et al., 2018a).

As already mentioned, for the purpose of this study it is not sufficient to focus on either the decision-making related literature or the acceptance or adoption of technology related literature, solely. Rather, we propose to combine these two strands of literature and thus build a comprehensive set of determining variables to model the future usage intention of DFAS. With regard to the above literature review and the outlined former research approaches, to the best of our knowledge, this is the first study that combines these two relevant strands of literature in order to model the future usage intention of DFAS and therefore this study's research questions and hypotheses. In doing so, our derived set of variables incorporates both decision-making related and technology adoption related determinants.

In more detail, with regard to the review of the decision-making related literature, this study's set of independent variables bases on the net valence framework and correspondingly the perceived benefit and risk factors. Thus, we incorporate economic benefit, seamless transaction and convenience as well as financial, legal, security and operational risk as determining variables (Ryu, 2018a; Ryu, 2018b). On the other hand, with regard to the acceptance or adoption of technology related literature, this study's set of independent variables bases on UTAUT2, as this is the latest and most comprehensive theory on the acceptance of technologies. Consequently, we incorporate performance and effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, experience and socio-demographics as determining variables (Venkatesh et al., 2012). At this point, it is once again reasonable to point out that the future usage intention of DFAS is associated with the dependent side of our empirical approach, whereas the comprehensive and systematically derived set of variables of the review of the two strands of literature refers to the independent or determining side of our empirical model design. Finally, the following table summarizes the full set of independent or determining variables and their definitions, at which economic benefit (price value and economic benefit), convenience (effort expectancy and convenience) and technical conditions (facilitating conditions and seamless transaction) represent clustered variables from both strands of literature:

Variable	Definition and related literature	Baseline theory
Performance expectancy (PE)	The degree to which using a technology provides benefits to consumers in performing certain activities (Venkatesh et al., 2012).	UTAUT2
Economic benefit (EB)	The consumers' cognitive trade-off regarding cost reductions and financial gains that result from the usage of technology (Venkatesh et al., 2012; Dodds et al., 1991; Ryu, 2018b; Kuo Chuen and Teo, 2015; Mackenzie, 2015; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	UTAUT2 Net valence concept / perceived benefit and risk framework
Convenience (C)	The degree of ease, portability, accessibility and flexibility associated with consumers' use of technology (e.g., in terms of time and location) (Venkatesh et al., 2012; Ryu, 2018b; Kuo Chuen and Teo, 2015; Sharma and Gutiérrez, 2010; Okazaki and Mendez, 2013; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	UTAUT2 Net valence concept / perceived benefit and risk framework
Social influence (SI)	The extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology (Venkatesh et al., 2012).	UTAUT2
Technical conditions (TC)	Consumers' perceptions of resources and support available to perform a behavior (e.g., organizational and technical infrastructure, speedy and simple processes) (Venkatesh et al., 2003; Brown and Venkatesh, 2005; Venkatesh et al., 2012; Ryu, 2018b; Chishti, 2016; Zavolokina et al., 2016; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	UTAUT2 Net valence concept / perceived benefit and risk framework
Hedonic motivation (HM)	The fun or pleasure derived from using a technology (perceived enjoyment) (Brown and Venkatesh, 2005; Venkatesh et al., 2012).	UTAUT2
Habit (H)	The extent to which an individual believes the behavior to be automatic, depending on the extent of interaction and familiarity that is developed with a target technology. Thus, habit is a perceptual construct, which reflects the result of prior experiences (Venkatesh et al., 2012; Limayem et al., 2007).	UTAUT2
Financial risk (FR)	The potential financial losses resulting from the usage of Digital Financial Advice Solutions (Ryu, 2018b; Forsythe et al., 2006; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	Net valence concept / perceived benefit and risk framework
Legal risk (LR)	The users' distrust and anxiety arising from unclear legal status and the lack of regulations (e.g., regarding suffered financial losses and security issues) resulting from the usage of Digital Financial Advice Solutions (Ryu, 2018b; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	Net valence concept / perceived benefit and risk framework
Security risk (SR)	The potential losses arising from fraud or hacking resulting from the usage of Digital Financial Advice Solutions (Ryu, 2018b; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	Net valence concept / perceived benefit and risk framework
Operational risk (OR)	The potential losses, distrust and dissatisfaction arising from failed or inadequate internal processes, employee behavior and systems resulting from the usage of Digital Financial Advice Solutions (Ryu, 2018b; Barakat and Hussainey, 2013; Lewin, 1943a; Bilkey, 1953; Bilkey, 1955; Peter and Tarpey Sr, 1975).	Net valence concept / perceived benefit and risk framework
Perceived benefit	The users' belief or perception that the use of Digital Financial Advice Solutions implies advantages, thus may potentially result in positive outcomes (Kim et al., 2008; Peter and Tarpey Sr, 1975; Ryu, 2018b; Benlian and Hess, 2011).	Net valence concept / perceived benefit and risk framework
Perceived risk	The users' belief or perception that the use of Digital Financial Advice Solutions implies uncertainties, thus may potentially result in negative outcomes (Kim et al., 2008; Peter and Tarpey Sr, 1975; Ryu, 2018b; Benlian and Hess, 2011).	Net valence concept / perceived benefit and risk framework
Experience	Modeled by the former usage experience of Digital Financial Advice Solutions (Venkatesh et al., 2012).	UTAUT2
Investments diversity	Modeled by the number of asset classes where participants are currently invested in.	n/a
Digitization knowledge	Modeled by the participants' individual self-assessment.	n/a
Socio-demographics and key characteristics	n/a	n/a

Table 10: Determining variables, definitions and related theories

4.4 Data, methodology and hypotheses

In order to address this study's aim of research, we conducted a questionnaire-based online survey. The questionnaire bases on our systematic literature review and thus the comprehensive set of variables. It contains two questions per determinant as well as a set of socio-demographic and key characteristic related questions. Unless otherwise noted, all measures were evaluated with a 6-point Likert scale that ranges from 1 (strongly disagree) to 6 (strongly agree) (Carifio and Perla, 2007; Jacob et al., 2013; Klopfer and Madden, 1980). However, Appendix F presents

the systematically derived questionnaire, its items as well as the related literature. The final data collection was performed from May 3rd until June 28th, 2019. Prior to this, we conducted a pre-test lasting from April 15th to April 28th, 2019. The pre-test included 19 participants and resulted in adjustments of the questionnaires' structure and wording. Anyhow, the final data collection resulted in 733 observations of which, due to inconsistencies and inevitable deletions, 600 were evaluable. Therefore, 600 observations represent this study's final dataset.

With regard to the theoretical background and literature review provided in section 4.3, we derived both this study's underlying research questions as well as the corresponding set of hypotheses. At this point, it is reasonable to once again clearly state the research questions of this study: (1) How do perceived benefit and risk influence the future usage intention of DFAS? (2) Which factors determine perceived benefit and risk? (3) Does experience have a moderating effect on how perceived benefit and risk affect the future usage intention of DFAS? Correspondingly, in order to address these research questions appropriately, we derived a comprehensive set of hypotheses.

Originally, Peter and Tarpey Sr (1975) find, with regard to brand preferences, that both perceived benefit and risk as well as the already mentioned net valence affects decision-making significantly. Correspondingly, within the context of the adoption of software-as-a-service, Benlian and Hess (2011) research on the opportunities and risks that are associated with the adoption decision. In this regard, the authors find that perceived opportunities affect the behavioral intention to increase the future adoption of software-as-a-service positively, whereas perceived risk affects it negatively. These effects are significant in both cases. Moreover, analyzing purchasing decisions on the internet, former research delivers evidence that perceived benefit affects purchasing intentions positively and perceived risk negatively (Kim et al., 2008). Within a more financial context, Abramova and Böhme (2016) research on key determinants that influence the decision to use Bitcoin as an online payment instrument. In this regard, perceived benefit and risk are confirmed to affect the usage behavior positively respectively negatively. Finally, with regard to a more specified continuance intention of digitized financial services, i.e. mobile payment, P2P lending and crowdfunding solutions, former research both hypothesizes and confirmes a positive effect of perceived benefit and a negative effect of perceived risk on the continuance intention (Ryu, 2018b). Correspondingly, within the context of the future usage intention of DFAS we derive the following two hypotheses:

H1: Perceived benefit affects the future usage intention of DFAS positively
H2: Perceived risk affects the future usage intention of DFAS negatively

Considering the variable PE, Venkatesh et al. (2003) identify it, within their formulation of UTAUT, to be the strongest predictor of the intention to use technology and to affect it positively. This effect, however, is confirmed by the development of the extension of UTAUT to UTAUT2. Moreover, within the formulation of UTAUT2, the variable HM is also found to affect the behavioral intention to use technology positively (Venkatesh et al., 2012). As this study combines two strands of literature, we incorporate the variables PE and HM in the net valence framework and thus hypothesize a positive effect on perceived benefit. Concerning our structural model design and H1, this hypotheses are corresponding with the former research conducted by Venkatesh et al. (2003) and (Venkatesh et al., 2012):

H1.1: Performance expectancy affects perceived benefit positively
H1.4: Hedonic motivation affects perceived benefit positively

With regard to the clustered variable EB, Dodds et al. (1991) confirm a negative relationship between prices and the willingness to buy certain electronic goods. Later on, Venkatesh et al. (2012) deliver evidence on a positive effect of the price value, which is positive if the benefits of the usage of a technology are greater than the financial efforts for its usage, on the behavioral intention to use a technology. Moreover, in the context of the net valence framework Ryu (2018b) hypothesizes and confirms a positive effect of economic benefits, characterized by cost reductions and financial gains, on perceived benefit. Additionally, the herein incorporated variable C represents another clustered variable from both strands of literature. With regard to UTAUT and UTAUT2, Venkatesh et al. (2003) and Venkatesh et al. (2012) find a positive relationship between the effort expectancy and thus the degree of ease of use and the behavioral intention to use a technology. Correspondingly, within the net valence framework, convenience is confirmed to influence perceived benefit positively (Ryu, 2018b). As with the variables PE and HM, we hypothesize a positive effect of EB and C on perceived benefit, as this, with regard to H1, is corresponding with both of the incorporated strands of literature:

H1.2: Economic benefit affects perceived benefit positively
H1.3: Convenience affects perceived benefit positively

Furthermore, within the context of the continuance intention regarding mobile payment, P2P lending and crowdfunding solutions, Ryu (2018b) delivers evidence on the hypotheses that the risk related variables FR, LR, SR and OR affect perceived risk positively. Moreover, within the context of the decision to use Bitcoin as an online payment solution or not and with regard to the variables FR, LR and OR, these effects are confirmed to influence perceived risk positively. Consequently, we hypothesize, within our context of the future usage intention of DFAS, that FR, LR, SR and OR affect perceived risk positively as well. Thus, concerning H2 and our structural model design, we assume a negative relationship with the future usage intention of DFAS:

H2.1: Financial risk affects perceived risk positively
H2.2: Legal risk affects perceived risk positively
H2.3: Security risk affects perceived risk positively
H2.4: Operational risk affects perceived risk positively

Moreover, the systemically derived comprehensive set of variables suggests significant effects of the variables SI, TC (clustered) and H. In this regard, Venkatesh et al. (2012) find, within the formulation of UTAUT2, that SI and H affect the behavioral intention to use a technology positively. Moreover, the authors find a positive relationship between the variable facilitating conditions, which is incorporated in our clustered variable TC, and the behavioral intention. The latter effect, however, is corresponding with the positive effect of the variable seamless transaction (also incorporated in our clustered variable TC) on the continuance intention regarding mobile payment, P2P lending and crowdfunding solutions (Ryu, 2018b). Consequently, we hypothesize a positive effect of the variables SI, the clustered TC and H on the future usage intention of DFAS. However, with regard to H1, the hypothesized effect of TC is corresponding with both strands of literature:

H3: Social influence affects the future usage intention of DFAS positively
H4: Technical condition affects the future usage intention of DFAS positively
H5: Habit affects the future usage intention of DFAS positively

Finally, we assume that the variable experience, modeled by the former usage experience of DFAS, moderates both the effect of perceived benefit and risk on the future usage intention of DFAS. This consideration, however, results from both the formulation of UTAUT and

UTAUT2. Therein, the authors hypothesize and test several moderating effects of experience on variables such as effort expectancy (incorporated in our clustered variable C), SI and facilitating conditions (incorporated in our clustered variable TC) as well as on HM and H (Venkatesh et al., 2003; Venkatesh et al., 2012). Moreover, another variable, i.e. trust, plays a substantial role within the second incorporated strand of literature, i.e. the perceived benefit and risk context (Kim et al., 2008). Additionally, particularly within the context of interactions and transactions on the internet and thus within a digital environment, past experiences are confirmed to positively affect the formation of trust (Chen et al., 2010). Consequently, this moreover motivates to check for a moderating effect of experience on perceived benefit and risk:

H6.1: Experience moderates perceived benefit, such that the positive effect of perceived benefit on the future usage intention of DFAS increases

H6.2: Experience moderates perceived risk, such that the negative effect of perceived risk on the future usage intention of DFAS decreases

Variable	Hypotheses	Related literature
Perceived benefit	H1: Perceived benefit affects the future usage intention of DFAS positively	Benlian and Hess (2011); Kim et al. (2008); Peter and Tarpey Sr (1975); Ryu (2018b); Abramova and Böhme (2016)
Perceived risk	H2: Perceived risk affects the future usage intention of DFAS negatively	
Performance expectancy (PE)	H1.1: PE affects perceived benefit positively	Venkatesh et al. (2003); Venkatesh et al. (2012)
Economic benefit (EB)	H1.2: EB affects perceived benefit positively	Dodds et al. (1991); Ryu (2018b); Venkatesh et al. (2003); Venkatesh et al. (2012)
Convenience (C)	H1.3: C affects perceived benefit positively	
Hedonic motivation (HM)	H1.4: HM affects perceived benefit positively	Venkatesh et al. (2012)
Financial risk (FR)	H2.1: FR affects perceived risk positively	Abramova and Böhme (2016); Ryu (2018b)
Legal risk (LR)	H2.2: LR affects perceived risk positively	
Security risk (SR)	H2.3: SR affects perceived risk positively	Ryu (2018b)
Operational risk (OR)	H2.4: OR affects perceived risk positively	Abramova and Böhme (2016); Ryu (2018b)
Social influence (SI)	H3: SI affects the future usage intention of DFAS positively	Venkatesh et al. (2012)
Technical conditions (TC)	H4: TC affects the future usage intention of DFAS positively	Ryu (2018b); Venkatesh et al. (2012)
Habit (H)	H5: H affects the future usage intention of DFAS positively	Venkatesh et al. (2012)
Investments diversity	n/a	n/a
Digitization knowledge	n/a	n/a
Experience	H6.1: Experience moderates perceived benefit, such that the positive effect of perceived benefit on the future usage intention of DFAS increases H6.2: Experience moderates perceived risk, such that the negative effect of perceived risk on the future usage intention of DFAS decreases	Venkatesh et al. (2003); Venkatesh et al. (2012); Kim et al. (2008); Chen et al. (2010)
Socio-demographics and key characteristics	n/a	n/a

Table 11: Variables and related hypotheses

Consequently, in order to test the comprehensive set of hypotheses and ultimately answer the underlying research questions, we formulated, based on the combination of both Ryu (2018b) and Venkatesh et al. (2012), the following structural model that is associated with both of this study's underlying strands of literature. However, in order to address this study's research approach, a partial least squares (PLS)-based structural equation model (SEM) was utilized. Given that this study represents an initial attempt to advance a theoretical model that determines both benefit and risk factors influencing the future usage intention of DFAS, PLS was chosen. This is due to its appropriateness for exploratory science and that PLS is recommended for predictive research models (Chin, 1998; Fornell and Bookstein, 1982; Ryu, 2018b). In doing so, we used the R-package lavaan for the evaluating and analyzing purposes.

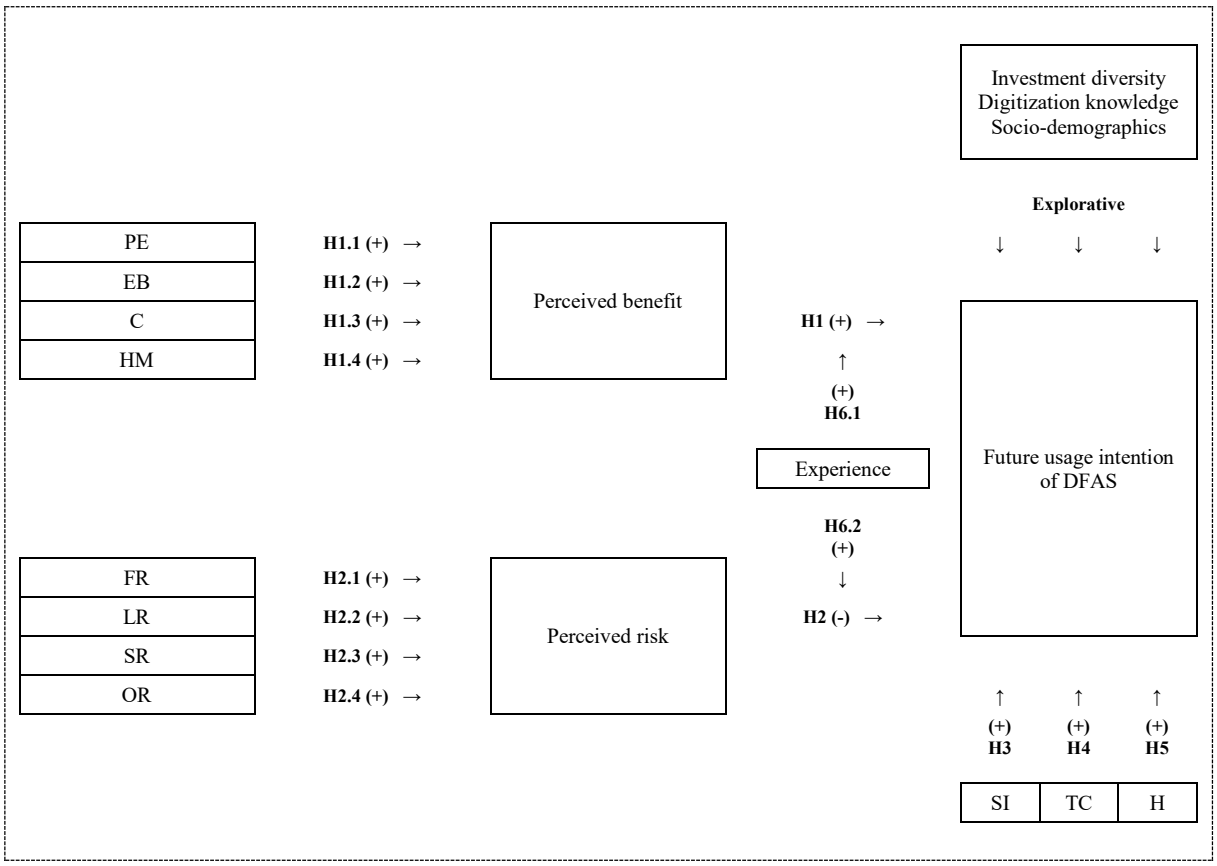


Figure 9: Structural model design

4.5 Results and discussion

In the following section, we firstly provide the descriptive and empirical results of this study. Subsequently, we conduct a comprehensive discussion that aims to derive strategic and managerial implications. At this point, it is once again important to highlight that we conduct the discussion from the viewpoint of traditional financial institutions. Hence, associated implications are valid for traditional financial institutions. Finally, in order to verify our

analysis, results and derived strategic and managerial suggestions, we perform several robustness checks regarding the dataset and the statistical approach.

4.5.1 Results

Firstly, with regard to the descriptive results of this study, one needs to mention that 26 (4.3%) out of the 600 participants used DFAS before. However, that 205 (34.2%) and thus more than one-third of the participants indicated a future usage intention, emphasizes, from both a theoretical and practical perspective, the importance and great relevance of this study's underlying research questions and hypotheses. Moreover, it is of great interest that only 74 (12.3%) participants would use DFAS to substitute traditional wealth management services. Instead, 332 (55.3%) participants would use DFAS as a complementary service, whereas the remaining 194 (32.3%) participants were uncertain regarding this question. Furthermore, 357 (59.5%) participants indicated that they would favor a traditional financial institution as a potential provider of DFAS. In contrast, only 60 (10.0%) participants would prefer to demand DFAS from a new entrant as a potential servicer. Additionally, compared to traditional wealth management services, 179 (29.8%) participants assessed DFAS to be more risky whereas 250 (41.7%) did not. The remaining 171 (28.5%) participants indicated to be unconfident regarding this question. Finally, the following table illustrates the socio-demographics and key characteristics of all participants:

Variable	Absolute frequency		Relative frequency (%)
Gender	Male:	242	40.3
	Female:	354	59.0
	Diverse:	4	0.7
	Total (rounded):	*600*	*100.0*
Age	18-22:	85	14.2
	23-30:	363	60.5
	31-40:	72	12.0
	41-50:	25	4.2
	51-60:	37	6.2
	61 and older:	18	3.0
	Total (rounded):	*600*	*100.0*
Education	Certificate of Secondary Education:	2	0.3
	General Certificate of Secondary Education:	13	2.2
	A levels:	200	33.3
	Bachelor:	245	40.8
	Master / Diploma:	127	21.2
	Doctoral level:	13	2.2
	Total (rounded):	*600*	*100.0*
Disposable income (EUR)	<2,000:	396	66.0
	2,001-3,500:	128	21.3
	3,501-5,500:	45	7.5
	5,501-8,500:	16	2.7
	>8,501:	15	2.5
	Total (rounded):	*600*	*100.0*
Total wealth (excl. real estates, EUR)	<5,000:	201	33.5
	5,001-20,000:	209	34.8
	20,001-60,000:	94	15.7
	60,001-100,000:	26	4.3
	100,001-200,000:	32	5.3
	200,001-500,000:	19	3.2
	500,001-1,000,000:	10	1.7
	>1,000,000:	9	1.5
	Total (rounded):	*600*	*100.0*
Number of participants invested in…			
…shares		199	33.2
…bonds		66	11.0
…funds (incl. ETFs)		202	33.7
…commodities		36	6.0
…cryptocurrencies		41	6.8
…others		24	4.0
Former usage of professional investment advisory services	Yes:	242	40.3
	No:	358	59.7
	Total (rounded):	*600*	*100.0*
Former dissatisfaction with investment decisions	Yes:	198	33.0
	No:	402	67.0
	Total (rounded):	*600*	*100.0*
Online banking usage	Yes:	556	92.7
	No:	44	7.3
	Total (rounded):	*600*	*100.0*
Mobile banking usage	Yes:	404	67.3
	No:	196	32.7
	Total (rounded):	*600*	*100.0*
Preference to pay digitally	Yes:	444	74.0
	No:	156	26.0
	Total (rounded):	*600*	*100.0*
Satisfaction with financial situation	Mean:	4.10	
	Median:	4.00	
Risk attitude	Mean:	3.12	
	Median:	3.00	
Digitization knowledge	Mean:	4.51	
	Median:	5.00	
Importance to interact personally with the provider of financial products and services	Mean:	3.66	
	Median:	4.00	
Importance to be able to demand the full range of financial products and services from the same provider	Mean:	3.84	
	Median:	4.00	

Table 12: Socio-demographics and key characteristics of the final dataset

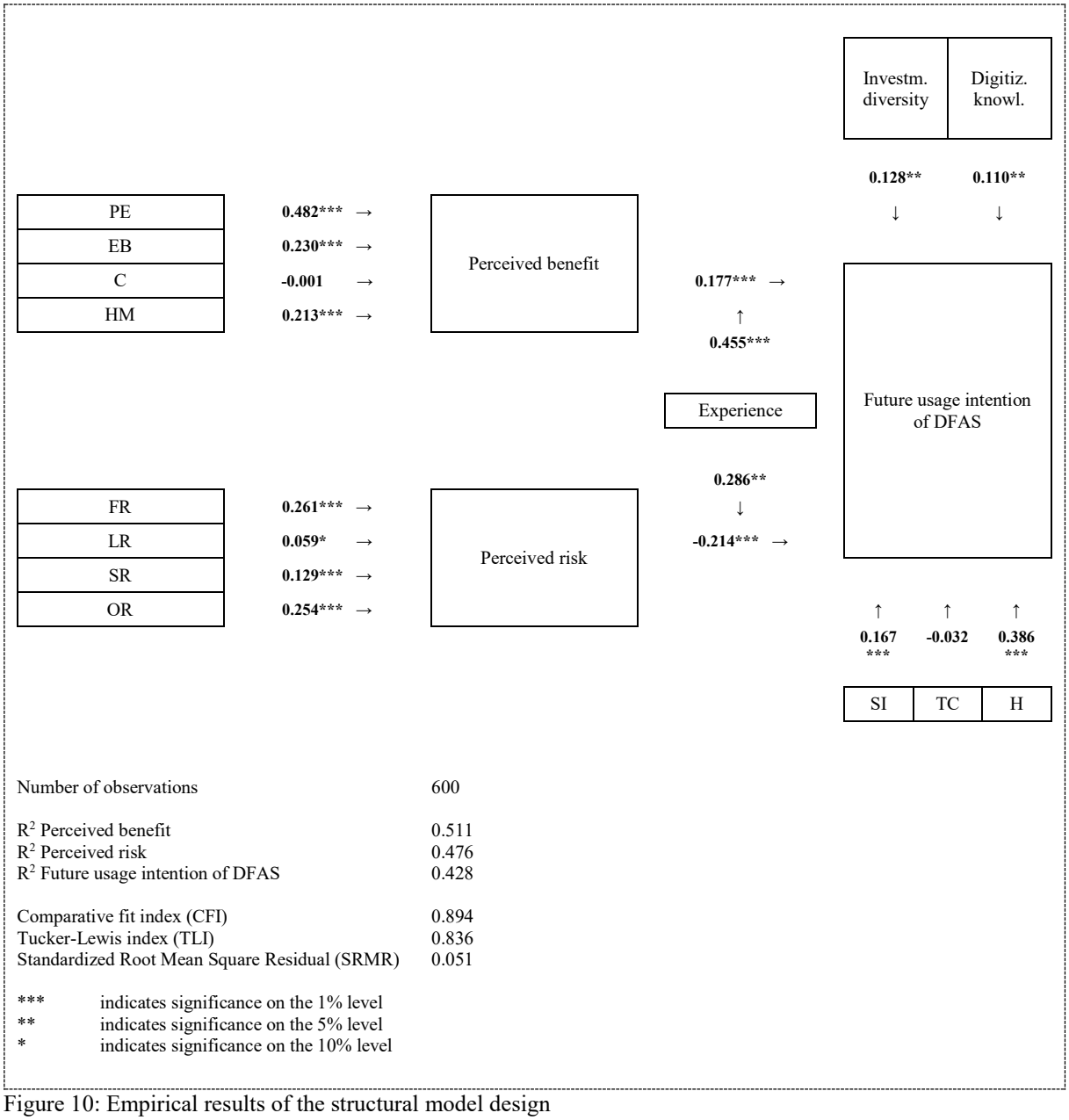
Secondly, with regard to the empirical results of this study, it is reasonable to clearly distinguish between the different paths of the structural model: Concerning the variable perceived benefit, we find the determinants PE, EB and HM affecting it positively. Thus, an increasing perceived PE, EB and HM ceteris paribus imply an increasing perceived benefit. In addition, the estimates show that this effect is likely to be the greatest for PE and almost equal for EB and HM. Furthermore, the effects are significant on the 1.0% level. The R^2 of 0.511 indicates that the determinants PE, EB, C and HM commonly explain 51.1% of the variance of the variable perceived benefit. With regard to the hypotheses, we thus verify H1.1, H1.2 and H1.4, whereas H1.3 needs to be rejected.

Concerning the variable perceived risk, we find the explanatory variables FR, LR, SR and OR affecting it positively. Hence, if the perceived FR, LR, SR or OR ceteris paribus increase, the perceived risk increases as well. However, the estimated coefficients indicate that these effects are the strongest for FR and OR, followed by SR and LR. Moreover, apart from LR, these effects are significant on the 1.0% level. Anyhow, with regard to LR, the effect remains to be significant on the 10.0% level. Finally, the R^2 of 0.476 shows that the four determinants altogether account for 47.6% of the variance of the variable perceived risk. Consequently, based on this study's dataset we are able to verify the hypotheses H2.1, H2.2, H2.3 and H2.4.

Finally, we find that perceived benefit, SI, H, investment diversity and digitization knowledge have a ceteris paribus positive effect on the future usage intention of DFAS. In contrast, perceived risk ceteris paribus affects the future usage intention of DFAS negatively. These effects are significant on the 1.0% level for perceived benefit, perceived risk, SI and H and on the 5.0% level for investment diversity and digitization knowledge. Moreover, the estimations indicate a moderating effect of experience, which is modeled by the former DFAS usage, for both perceived benefit and perceived risk. Thus, the ceteris paribus positive effect of perceived benefit on the future usage intention increases, if DFAS was used before. Accordingly, the ceteris paribus negative effect of perceived risk on the future usage intention decreases with a former usage experience of DFAS. These moderating effects are significant on the 1.0% level for the interaction of the variable perceived benefit and experience and on the 5.0% level for the interaction of the variable perceived risk and experience. Finally, with regard to the R^2 we state that perceived benefit and risk, SI, TC, H, investment diversity and digitization knowledge as well as both interactions commonly explain 42.8% of the future usage intentions' variance. Hence, concerning these results, we confirm hypotheses H1, H2, H3 and H5 and falsify H4.

Furthermore, we verify the hypothesized moderating effects of experience on the future usage intention of DFAS (H6.1 and H6.2).

As a result, with regard to this study's research questions we state that (1) perceived benefit (risk) influences the future usage intention of DFAS positively (negatively). Moreover, (2) PE, EB and HM affect perceived benefit positively whereas FR, LR, SR and OR increase the perceived risk. Finally, (3) experience moderates both perceived benefit and risk positively:



Number of observations	600
R^2 Perceived benefit	0.511
R^2 Perceived risk	0.476
R^2 Future usage intention of DFAS	0.428
Comparative fit index (CFI)	0.894
Tucker-Lewis index (TLI)	0.836
Standardized Root Mean Square Residual (SRMR)	0.051

*** indicates significance on the 1% level
** indicates significance on the 5% level
* indicates significance on the 10% level

Figure 10: Empirical results of the structural model design

4.5.2 Discussion

Based on the above-described results, we systematically derive a comprehensive set of strategic and managerial implications. This, however, is conducted from the viewpoint of traditional financial institutions. First, with regard to the descriptive results, the huge gap between the current usage of DFAS (4.3%) and the indicated future usage intention (34.2%) outlines a shift of the customers' expectations. Additionally, due to the recent developments within the financial services industries worldwide, we expect the future usage intention to increase further in the future. Consequently, for traditional financial institutions, it is inevitable to not only be aware of the changing customer expectations but also to enlarge their portfolio of offered products and services by DFAS in order to meet the customers' demand. Otherwise, traditional financial institutions are likely to experience great customer out-migrations, which implicate the loss of cross-selling potentials, too. Notwithstanding, the banks' managements must also take into account that 65.8% of the customers still did not indicate any DFAS usage intention. Even though we expect this share to decrease significantly in the future, it outlines that there are still great potential yields resulting from the traditional wealth management services. Thus, for now it seems inalienable to conduct a double-tracked strategy, i.e., to implement both traditional wealth management services and DFAS in their product portfolio. Otherwise, if focusing on one approach exclusively, banks risk to experience great customer out-migrations and, as a consequence, the loss of potential yields. This implication is underlined by the result that only 12.3% of the participants would use DFAS to substitute traditional wealth management services, whereas 55.3% would use it as a complementary service.

Second, with regard to the empirical results, it is important that traditional financial institutions are aware of both the positive effect of perceived benefit and the negative effect of perceived risk on the future usage intention of DFAS. Therefore, in order to increase the chance of successful product launches and to prevent the risk of customer out-migrations, characteristics as well as conditions of newly designed and offered DFAS should address factors that inherently affect the customers' perceived benefit and risk. In doing so, it is to highlight that the extent of the negative effect of perceived risk is greater than the positive effect of perceived benefit. Hence, it may be appropriate to prioritize the identified risk factors. This may be in line with the sensitiveness and great meaning of "trust" within the area of financial products and services in general and wealth management services in particular (Ennew and Sekhon, 2007; Llewellyn, 2005; Sunikka et al., 2010).

Addressing perceived benefit, we firstly conclude that PE is of great relevance. When using a technology, customers greatly value effectiveness and efficiency in order to improve their performance. Thus, it is indispensable to focus on outstanding technology that provides effective and efficient processes to improve the customers' daily usage experience. Secondly, EB and thus the experienced cost-performance ratio is of relevance, too. Hence, customers have a certain awareness for the pricing of DFAS and incorporate this within their usage decision. This is in line with former studies that address the pricing and price awareness with regard to financial products and services (Estelami, 2005; Nejad and Estelami, 2012). In this respect, it is inevitable to monitor the market developments on both the cost and performance side of competitors continuously and to offer an attractive pricing model. Consequently, if the own pricing model is not as favorable as compared to competitors, it is of great importance to offensively communicate an added value of the offered DFAS: What characteristics differentiate the own from the competitors' DFAS and why is it worth a higher price? Moreover, when implementing DFAS, traditional financial institutions should consider cost drivers in order to provide competitive cost-performance ratios (e.g. using passively managed rather than actively managed funds). Finally, HM, thus enjoyment and entertainment, positively affects perceived benefit and ultimately the future usage intention of DFAS, too. This implicates that DFAS applications should not only focus on effectiveness and efficiency but also could comprise gamification approaches. This would be in line with former research that investigates the relationship between the implementation of gamification elements and sales success (Grobelny et al., 2018; Lucassen and Jansen, 2014; Rodrigues et al., 2016). Anyhow, with regard to the extent of the effects, banks should prioritize PE and approximately weigh EB and HM equally.

Among the factors that affect perceived risk, FR and OR should be prioritized. With regard to FR, the results once again outline the sensitivity of financial and wealth management services and the customers' fear of losing money and thus the great meaning of trust (Ennew and Sekhon, 2007; Llewellyn, 2005; Sunikka et al., 2010). However, since a general averseness to anything related to "financial investment" is often a result of nescience (Cao et al., 2011; Llewellyn, 2005), traditional financial institutions should implement and offer web based services (i.e., webinars, online academies). These should target to improve the customers' financial literacy in order to lower nescience and perceived risk and ultimately increase the future usage intention of DFAS. Moreover, particularly addressing the advantages of passively managed funds and regular investments (i.e., cost-average-effect) should be valuable, since these represent inherent

characteristics of DFAS. Additionally, these suggested web based services may be designed in a way that positively addresses the above-mentioned implications of HM, simultaneously. Considering OR and SR, banks should communicate their great expertise, established internal processes, compliance structures and guidelines as quite advantageous compared to new entrants. Consequently, the resulting risk of losing money due to failed or inadequate processes, employee behavior or even fraud or hacking should be communicated as significantly lower. Thus, from the viewpoint of traditional financial institutions, it is of great importance that customers perceive a significantly lower OR and SR compared to new entrants or other competitors. Finally, regarding LR, banks should market oneself as subjected to regulatory guidance and hence much safer than new entrants. Therefore, compared to new entrants, customers are not as exposed to regulatory uncertainties or even opportunistic arbitrage by the supplier.

Furthermore, the positive effect of SI on the future usage intention of DFAS indicates that traditional financial institutions should not disregard the customers' private and professional surrounding. If customers observe people in their private and professional surrounding using DFAS, the customers' usage intention themselves increase as well. Hence, from the viewpoint of banks, it is important to bring both users and non-user together and enhance their communication about DFAS related topics to ultimately benefit from multiplier and network effects. A proper way of doing so should be the implementation of platforms, communities and the usage of social networks. This may also positively influence HM and address the aimed improvement of financial literacy (FR). Finally, this should empower the relationships both among the customers and with the supplier and thus lower the risk of customer out-migrations.

Moreover, in order to benefit from the positive effect of H on the future usage intention of DFAS, it is of great relevance to implement a simple and intuitive software application for DFAS. This should facilitate customers to get used to it and integrate it into their daily usage of financial products and services. In doing so, banks should rather think about the extension of already implemented and adopted software applications (e.g. existing mobile banking apps) than the development of completely new ones for DFAS. This should improve the customers' future usage intention of DFAS, since customers are already used to the application (H) and it should be easier to work out the functioning of extensions than completely new software applications.

With regard to the moderating effect of experience, herein modeled as the former usage behavior, it is of great importance to understand that a former usage increases the positive effect of perceived benefit on the one hand and counteracts the negative effect of perceived risk on the other hand. These effects point out that – once DFAS were used – customers are aware of the additional value it delivers. Thus, achieving the customers' first usage is of particular importance. Therefore, traditional financial institutions should incentivize the first usage and limit entry barriers for customers. Appropriate measures in this respect could be the provision of any financial benefits as for instance reduced fees or vouchers for a certain period of time or the first usage. Afterwards, the utilization of experienced customers should be particularly favorable with regard to the usage of multiplier and network effects (SI) and the aimed improved financial literacy (FR). Hence, traditional financial institutions should in particular target and incentivize these customers to interact on the proposed platforms and communities.

Besides, in order to implement target group specific marketing activities banks should be aware of the positive effect of the customers' current investment diversity, which can also be interpreted as a certain kind of experience. In this respect, the digitization knowledge of the customer is of relevance, too. Hence, banks should particularly address and incentivize both financially literate and tech-savvy customers to make use of DFAS. Additionally, banks should aim particularly these customers to act as multipliers on the proposed platforms and communities (SI and FR).

Finally, we once again outline that, as the results show, traditional financial institutions should offer both traditional wealth management services and DFAS. Moreover, within DFAS, banks should implement both pure and hybrid solutions, since the data show that many customers still rate the importance of a personal interaction with the provider relatively high. With regard to the perceived risk factors, the implementation of a hybrid solution should particularly address doubtful and reluctant customers that misunderstand and fear technical and algorithmic processes. The provision of a human counterpart should then incentivize the first usage and limit entry barriers. The pure DFAS, however, should deliver a particular well pricing model whereas the hybrid solution should be marketed as particularly favorable, which is due to both the opportunity of a personal interaction and the combination of the advantages of DFAS with human expertise and experience. Additionally, we finally suggest that banks should implement an own or white label solution of DFAS and not partner with another entity officially. This is because the results show that customers favor and tend to demand the full range of financial

products and services from one single provider. In addition, a great majority (59.5%) would prefer to use a traditional financial institution rather than a new entrant (10.0%) as a provider of DFAS.

Lastly, we state that traditional banks still hold competitive advantages as for instance a strong customer base, great levels of acceptance and good market positions as well as expertise, experience, trustworthiness and financial resources. Nevertheless, customers are willing and expect to use digitized financial products and services. Thus, for banks, it is inevitable to continuously examine and eventually enlarge their product portfolio in order to meet the customers' demand, prevent the experience of great customer out-migrations and remain competitive.

4.5.3 Robustness

In order to ensure the best possible data quality, conduct a valuable discussion and finally identify valid implications, we conducted several robustness checks regarding both the dataset and the statistical approach. Firstly, as already mentioned, we performed a pre-test prior to the final data collection. Therein, we implemented several feedback areas throughout the pre-test. Therefore, we were not only able to ensure the understanding of the questionnaire by the participants but also to gather comprehensive feedback. Consequently, the pre-test resulted in adjustments of the questionnaires' structure and wording. Moreover, based on the resulting dataset of 733 observations, we conducted a deletion process. Therein, we identified and excluded observations both with inconsistencies and if participants spent less than 300 seconds to fulfill the questionnaire, resulting in 600 observations. Besides, we assessed the reliability of the questionnaire by computing the Cronbach's alphas. Since all numeric variables reach a Cronbach's alpha above 0.85, we state the questionnaires' reliability to be quite satisfactory (Gliem and Gliem, 2003; Peterson, 1994). The calculated Cronbach's alphas are presented in Appendix G.

Additionally, we assessed our structural model concerning statistical issues. Firstly, we checked for heteroscedasticity and autocorrelation issues by calculating resistant standard errors. However, this did not imply any significant changes. Furthermore, we checked our statistical approach for multi-collinearity issues. This was conducted by calculating both the correlations and variance inflation factors of the full set of variables. As a result, we did not identify any multi-collinearity issues to be inherent in our structural model. The corresponding computations

are provided in Appendix H of this study. Besides, with regard to several fit indices, e.g. the comparative fit index (0.894), Tucker-Lewis index (0.836) or standardized root mean square residual (0.051), the fit of the estimated and specified structural model is acceptable (Hu and Bentler, 1999; Steinmetz, 2015). Nonetheless, it is impossible to prevent endogeneity issues and thus potential overestimations or underestimations of coefficients for sure. However, since we derived the full set of variables carefully and systematically by conducting an intense literature review, we do not expect any endogeneity issues.

4.6 Conclusion

With this study, we investigate determinants of the future usage intention of DFAS. In doing so, the inherent objectives are to address the formulated research questions and hypotheses as well as to derive, from the traditional financial institutions' point of view, strategic and managerial implications on how to deal with the currently emerging trend of DFAS. In order to both theoretically and empirically address these issues, we conducted a questionnaire-based online survey. This led to 600 evaluable observations, representing this study's final dataset. Consequently, based on the methodological approaches of the two relevant strands of literature, we built a structural model that implies the systematically derived comprehensive set of variables.

As a result, we state a huge gap between the current use of DFAS and the future usage intention. This outlines a shift of the customers' expectations and needs to be taken into account by the management of traditional banks. Nevertheless, only a small share of customers intends to substitute traditional wealth management services by DFAS. Moreover, there are still customers remaining that, so far, do not indicate a future usage intention. With regard to the empirical results we find, as hypothesized, that perceived benefit affects the future usage intention of DFAS positively, whereas perceived risk influences it negatively. In addition, PE, EB and HM have a positive effect on perceived benefit and thus on the future usage intention of DFAS. Furthermore, FR, LR, SR and OR have a positive impact on perceived risk and thus affect the future usage intention of DFAS negatively. Additionally, experience moderates both the effect of perceived benefit and perceived risk in a way that enhances the effect of perceived benefit and counteracts the effect of perceived risk on the future usage intention of DFAS. Finally, we find that SI, H, investment diversity and digitization knowledge influences the future usage intention positively, too. Consequently, the results implicate that, for now, it is indispensable to conduct a double-tracked strategy, i.e., to offer both traditional wealth management services

and DFAS. In addition, we derived our proposition to implement both a pure and hybrid alternative of DFAS, which should be an own or white label product, in order to attract different kinds of customers. Moreover, with regard to the identified effects and interactions, the implemented solution needs to be designed appropriately, which we discuss in detail in this study. Anyhow, we also outline that traditional financial institutions still hold competitive advantages, for instance a strong customer base, great levels of acceptance and good market positions as well as expertise, experience, trustworthiness and financial resources. Notwithstanding, since the customers' demand is shifting to digitized financial products and services, it is inevitable to continuously examine and eventually enlarge their product portfolio in order to prevent great customer out-migrations and the loss of potential yields as well as to finally remain competitive.

With this study, we contribute to both academic literature and practical issues in several ways: Firstly, through our literature review, we identified the significant research gap on the adoption of DFAS. Since the future usage intention of DFAS represents the dependent side of our empirical approach, this study addresses the identified research gap, which is of great relevance in practice, too. Secondly, this study combines two strands of literature. This results, compared to former studies, in a more comprehensive set of variables with valuable implications. In doing so, we do not only contribute to the general understanding of FinTechs and DFAS but also to the existing literature on decision-making as well as the acceptance or adoption of technologies. Consequently, we contribute to the existing literature by identifying and addressing a significant research gap and by utilizing two different strands of literature. After all, as already mentioned, concerning the recent developments in the financial services industries worldwide, the herein addressed issues and corresponding implications are of great relevance for practitioners, too.

Nevertheless, it is important to outline that this study's analysis, results, implications and propositions are limited to the structure of the underlying sample, i.e., particularly the geographic focus on Germany. Thus, one needs to be careful if the derived implications should be generalized to differing groups of customers. Additionally, albeit we derived the incorporated set of variables systematically and carefully, it is impractical to assure that no further relevant determinants exist, which is emphasized by the reached R^2s of 0.428 to 0.511. This, however, may ultimately cause endogeneity issues, even though we do not expect this. Moreover, we conducted a structural model estimation to address this study's research questions and hypotheses. Hence, the results and implications are limited to the specific

methodological approach. Therefore, any potential methodological issues would be inherent to the discussion and implications. Finally, it is once again necessary to point out that we conducted the discussion and derived the implications from the viewpoint of traditional financial institutions.

Partly derived from these limitations, we identify several requirements for future research. Firstly, since almost all traditional financial institutions conduct business on an international and not national level, it is of great interest to address this study's research questions and hypotheses with a broader and not exclusively German sample. Secondly, independently from the underlying sample, it would be valuable to verify this study's results and implications by using alternative methodological approaches. Thirdly, a further review of related literature that ultimately may allow the identification of further relevant variables, would deliver additional value, too. Finally, we state that not only traditional wealth management services but also other financial products and services are exposed to digitization tendencies and thus the development of innovative "Digital Finance Business Functions" (Gomber et al., 2017) that are of revolutionary and disruptive nature. Consequently, future research should also investigate and discuss implications for other services sectors than traditional wealth management respective DFAS.

4.7 Appendix

Appendix F: Questionnaire items, variables and literature

Variable/Construct	Items	Reference
DFAS former usage/experience DFAS future usage intention	Did you ever make use of DFAS? I intent to use (continue the usage of) DFAS in the future. How would you intent to use DFAS? Would it make a difference to you if an established financial institution or new entrant / start-up offers DFAS? If applicable: Which provider would you prefer? Do you perceive DFAS to be more risky than traditional wealth management services?	Cheng et al. (2006); Lee (2009); Venkatesh et al. (2012); Ryu (2018b)
PE	The usage of DFAS brings improvements. Using DFAS is more efficient.	Venkatesh et al. (2012); Featherman and Pavlou (2003); Lee (2009)
EB	The usage of DFAS is less cost intense. I do expect financial gains from the usage of DFAS.	Yiu et al. (2007); Lee (2009); Ryu (2018b)
C	Using DFAS is clear, understandable and easy. The usage of DFAS is possible at any time and everywhere.	Venkatesh et al. (2012); Ryu (2018b)
SI	In my private surrounding, I know people who use DFAS. In my professional surrounding, I know people who use DFAS.	Self-worded
TC	I have the technological infrastructure to use DFAS (e.g. smartphone, laptop with access to internet). I have sufficient technological knowledge and skills to use DFAS.	Venkatesh et al. (2012); Brown and Venkatesh (2005)
HM	Using DFAS is enjoyable. The use of DFAS is entertaining.	Venkatesh et al. (2012)
H	I might get used to the usage of DFAS. I can imagine to implement DFAS in my regular usage of financial products and services.	Venkatesh et al. (2012)
FR	I am afraid to lose money when using DFAS. I am worried to be exposed to financial risks when using DFAS.	Abramova and Böhme (2016); Lee (2009); Featherman and Pavlou (2003)
LR	I am worried about potential regulatory uncertainties and leakages when using DFAS. I am concerned about legal uncertainties when using DFAS.	Ryu (2018b); Abramova and Böhme (2016)
SR	I am worried about the security of my personal data when using DFAS. When using DFAS I am concerned about the security of my sensitive financial data.	Ryu (2018b)
OR	I am concerned that internal process issues (of the supplier) may cause financial losses when using DFAS. When using DFAS I am afraid to suffer from losses due to mistakes by the supplier or its employees.	Abramova and Böhme (2016); Barakat and Hussainey (2013)
Perceived benefit	I see many advantages in using DFAS. By using DFAS I can achieve a higher benefit.	Ryu (2018b); Kim et al. (2008); Benlian and Hess (2011)
Perceived risk	I see many disadvantages in using DFAS. By using DFAS I am exposed to many risks.	Ryu (2018b); Kim et al. (2008); Benlian and Hess (2011)
Construct	6-point Likert scales, unless otherwise noted, with 1 = strongly disagree and 6 = strongly agree.	Jacob et al. (2013); Carifio and Perla (2007); Klopfer and Madden (1980)

Socio-demographic and key characteristic related questions

What is your gender?	□ female □ male □ diverse
Which is your year of birth?	_____
What is your nationality?	_____
Which city are you living in?	_____
What is your marital status? □ Single □ Married □ Divorced □ Widowed □ Others: _____	
What is your highest educational achievement? □ Certificate of Secondary Education □ Secondary School Certificate □ A levels □ Bachelor's degree □ Master's degree / Diploma □ Doctor's degree □ Others: _____	
What describes your current occupational situation best? □ Student □ Housewife / Househusband □ Civil servant (without managerial responsibility) □ Civil servant (with managerial responsibility) □ Employed (without managerial responsibility) □ Employed (with managerial responsibility) □ Self-employed □ Jobless □ Retired □ Others: _____	
How would you rate your monthly disposable income (in EUR)? □ < 1,250 □ 1,251-2,000 □ 2,001-2,500 □ 2,501-3,000 □ 3,001-3,500 □ 3,501-4,000 □ 4,001-4,500 □ 4,501-5,000 □ 5,001-5,500 □ 5,501-6,000 □ 6,001-6,500 □ 6,501-7,000 □ 7,001-7,500 □ 7,501-8,000 □ 8,001-8,500 □ 8,501-9,000 □ 9,001-9,500 □ 9,501-10,000 □ > 10,000	
On average, which percentage of your disposable income are you saving?	_____%
How would you rate your total wealth (real estates excluded, in EUR)? □ < 1,000 □ 1,001-5,000 □ 5,001-10,000 □ 10,001-20,000 □ 20,001-40,000 □ 40,001-60,000 □ 60,001-100,000 □ 100,001-150,000 □ 150,001-200,000 □ 200,001-250,000 □ 250,001-300,000 □ 300,001-400,000 □ 400,001-500,000 □ 500,001-600,000 □ 600,001-700,000 □ 700,001-800,000 □ 800,001-900,000 □ 900,001-1,000,000 □ >1,000,000	
Are you currently invested in… □ Stocks? □ Bonds? □ Investment funds (incl. ETFs)? □ Commodities? □ Cryptocurrencies? □ Others: _____ If applicable: Current value of these investments (in EUR): _____ (approximately)	
Did you ever receive professional investment advice?	□ yes □ no
Have you ever been dissatisfied with an investment decision?	□ yes □ no
In general, how satisfied are you with your financial situation?	very dissatisfied □ □ □ □ □ □ very satisfied
In general, how would you describe your own risk attitude?	risk-averse □ □ □ □ □ □ risk-seeking
Are you using an online banking account?	□ yes □ no
Are you using mobile banking apps?	□ yes □ no
In general, do you prefer digital payment solutions to cash-payments?	□ yes □ no
In general, how would you rate your own knowledge and experience about digitization?	none □ □ □ □ □ □ advanced
In general, how important is personal interaction for you when using financial products and services?	not important □ □ □ □ □ □ very important
In general, how important is it to you that a single financial services provider offers the full range of financial products and services you demand?	not important □ □ □ □ □ □ very important
Any comments and/or suggestions?	

Appendix G: Reliability analysis: Cronbach's alphas of numeric variables

Calculated Cronbach's alphas of numeric variables

lower	alpha	upper	95% confidence boundaries
0.85	0.87	0.88	

	raw_alpha	std.alpha
DFAS future usage intention	0.85	0.85
Perceived benefit	0.85	0.85
Perceived risk	0.85	0.85
PE	0.86	0.85
EB	0.86	0.86
C	0.86	0.85
SI	0.87	0.86
TC	0.87	0.86
HM	0.86	0.86
H	0.85	0.85
FR	0.86	0.85
LR	0.86	0.86
SR	0.86	0.86
OR	0.86	0.86
Investments diversity	0.87	0.87
Digitization knowledge	0.87	0.86
Experience	0.87	0.87

Appendix H: Multi-collinearity analysis: Correlations and variance inflation factors

Calculated correlations

	Perceived benefit	Perceived risk	PE	EB	C	SI	TC	HM	H	FR	LR	SR	OR	Investments diversity	Digitization knowledge	Experience
Perceived benefit	1.00															
Perceived risk	-0.54	1.00														
PE	0.65	-0.44	1.00													
EB	0.55	-0.34	0.60	1.00												
C	0.40	-0.34	0.48	0.46	1.00											
SI	0.17	-0.17	0.14	0.01	0.19	1.00										
TC	0.15	-0.20	0.24	0.20	0.40	0.09	1.00									
HM	0.47	-0.32	0.36	0.32	0.38	0.26	0.24	1.00								
H	0.65	-0.53	0.57	0.50	0.46	0.21	0.32	0.58	1.00							
FR	-0.36	0.58	-0.34	-0.19	-0.27	-0.24	-0.19	-0.25	-0.39	1.00						
LR	-0.20	0.50	-0.18	-0.09	-0.20	-0.20	-0.17	-0.15	-0.24	0.51	1.00					
SR	-0.26	0.52	-0.27	-0.15	-0.25	-0.15	-0.18	-0.19	-0.31	0.46	0.58	1.00				
OR	-0.30	0.59	-0.27	-0.12	-0.21	-0.11	-0.16	-0.19	-0.33	0.52	0.60	0.59	1.00			
Investments diversity	-0.01	-0.10	0.11	0.10	0.21	0.21	0.19	0.10	0.13	-0.20	-0.16	-0.18	-0.10	1.00		
Digitization knowledge	0.12	-0.12	0.21	0.21	0.30	0.10	0.38	0.20	0.27	-0.13	-0.11	-0.19	-0.07	0.13	1.00	
Experience	0.06	-0.07	0.05	0.04	0.13	0.34	0.11	0.19	0.13	-0.08	-0.10	-0.09	-0.03	0.16	0.09	1.00

Variance inflation factors

	VIF
Perceived benefit	2.05
Perceived risk	1.66
PE	1.74
EB	1.67
C	1.46
SI	1.21
TC	1.28
HM	1.24
H	2.13
FR	1.52
LR	1.89
SR	1.78
OR	1.93
Investments diversity	1.14
Digitization knowledge	1.22

4.8 Declaration of Co-authors and record of accomplishments

Title	Digital Financial Advice Solutions – Evidence on Factors Affecting the Future Usage Intention and the Moderating Effect of Experience
Authors	Johannes M. Gerlach (Heinrich-Heine-University Duesseldorf) Julia K. T. Lutz (Heinrich-Heine-University Duesseldorf)
Conferences	Acceptance at "The 28th Global Conference on Business and Finance", Honolulu, Hawaii, United States. Acceptance at the "Changing Landscape of Securities Markets", Maharashtra near Navi Mumbai, India. Acceptance at the "2020 UAB Personal Finance Symposium", Birmingham, Alabama, United States. Acceptance and planned participation and presentation at the "1st International Conference on Economics and FinTech", 21st-23rd April 2020, Athens, Greece.
Publications	Submissions are planned as soon as conference participation and presentation has taken place.

Contributions	**Julia K. T. Lutz**	**Johannes M. Gerlach**
Conceptualization Development of research question Methods specification	50%	50%
Execution		
Literature review and development of theoretical framework	0%	100%
Data collection and preparation	50%	50%
Data analysis	0%	100%
Analysis and discussion of results	0%	100%
Derivation of implications and conclusions	0%	100%
Manuscript preparation Initial draft Finalization	0%	100%
Overall contribution	**10%**	**90%**

Date, Julia K. T. Lutz

Date, Johannes M. Gerlach

5 User Perception of Digital Money Solutions – Impact of the Complementary Usage to Fiat Currencies on Prospective Use Behavior

5.1 Abstract

Since the monetary world and its currencies are changing in the age of digitization, so do customers. With various possibilities to pay and store value, users have many opportunities when it comes to Money Solutions. This study aims to question the drivers of prospective usage behavior in the field of Digital Money Solutions by modelling a benefit and risk framework for technology acceptance. Thus, we investigate the determinants driving the future usage intention of Digital Money Solutions. It is based on the unified theory of acceptance and use of technology and on the framework of benefit and risk. Furthermore, we categorize users of the technology of Digital Money Solutions into groups to find out whether the parallel usage of fiat currencies and cryptocurrencies has an impact on the future usage intention. With the aim to find evidence on the drivers of usage behavior of digital money users we conduct a structural model. We aim to find evidence on the competitive advantages of digital money and fiat currency, parallel in circulation. Thus, we find that the perception of benefit has a significant positive influence on the future usage intention of Digital Money Solutions, yet even stronger for the complimentary usage to fiat currencies. Thus, we contribute to the existing literature of behavioral intention and coexistence theory and deduce a future research agenda.

Keywords: Cryptocurrency, usage intention, theory of reasoned action, unified theory of acceptance and use of technology 2, perceived benefit, perceived risk, parallel currencies, structural equation modelling

JEL Classification: E42, G23, M13

5.2 Introduction

Cryptocurrencies are in vogue. In some parts of the world they are a sign of protest against monetary policy and authority, elsewhere, they are a popular speculation asset. Amid huge media interest cryptocurrencies have attracted significant amounts of popular attention (Frisby, 2014; Vigna and Casey, 2015). From an economic perspective, the sums of money involved are substantial. As history has shown, man has the capacity to find alternatives for the official legal tender whenever needed (Rogojanu and Badea, 2014). With over 5,000 cryptocurrencies and a market capitalization of more than USD 230,000,000,000 (CoinMarketCap, 2020), it seems like various ways of currency and money alternatives have been found so far. A cryptocurrency is a digital currency stored on an open and decentralized electronic payment system. Especially Bitcoin intends to challenge the current monetary and payment system that finds itself in a legitimacy crisis in the aftermath of the financial market turmoil of 2008 (Weber, 2016). Since there is no unique definition of the topics of cryptocurrency, digital currency and virtual currency as the literature tends to be fragmented by disciplines, for the purpose of this study, we try to investigate for a broader sense of Digital Money Solutions (DMS). We therefore follow (Gomber et al., 2017), where Digital Money Solutions include all privately issued digital, virtual or cryptographic currencies, existing only electronically.

Cryptocurrencies, respectively Bitcoin, as a digital asset have been extensively discussed from the viewpoints of engineering and security design (Iwamura et al., 2014; Schilling and Uhlig, 2019). However, there are only few economic analyses from the perspective of currency usage in general and the intention of the users in particular. As former research showed, Digital Money Solutions, i.e. Cryptocurrencies, are not disrupting the current monetary system (Baek and Elbeck, 2015; Beer and Weber, 2014; Glaser et al., 2014; Osterrieder and Lorenz, 2017; Yermack, 2013). Rather what is of attention in the scholarly world is a parallel currency solution for a worldwide currency system. In principle, virtual currencies have the potential to become parallel currencies to national, having the attempt to be widely accepted and employed as a payment vehicle (Sauer, 2016).

Digital Money Solutions have a lot of benefits like low entry barriers, high returns and fast and dynamic development. Nevertheless, users also face risks regarding legal and security issues, fearing financial losses. Therefore, it is necessary to investigate determinants of the usage decision of digital currencies. More precisely what drives the future usage intention to use a digital currency when there is already a central bank issued currency circulating? Therefore, we

investigate for the drivers to use Digital Money Solutions complementary to currently circulating monetary solutions, i.e. fiat currencies. We also investigate their differences in experience and risk-taking behavior. We try to get insight into its ability to compete with fiat currency in the long run and to improve the usage of money solutions overall, independently from its digital character. According to the Chicago Fed Letter 2013, a currency that has value only because of the belief that it will have value may have no value at all (Velde, 2013). How does this differ from expectations that a currency is used, the higher customers' perception of benefits and the lower the risks? Following this question, our study investigates the following research questions:

- RQ1: What drives the future usage intention of Digital Money Solutions?
- RQ2: What are barriers in the future usage adoption of Digital Money Solutions?
- RQ3: What drives the intention to use cryptocurrencies complementary to fiat currencies in the future?

To systematically investigate and answer the above-mentioned research questions, we build on different theoretical constructs. Trust has often been posited as one of the essential elements of economic exchange (Kumar et al., 2012). Since DMS is differing from fiat currencies in many ways, for the users' acceptance behavior, the technology component will be the most important. When considering technological innovation, it is not only trust that drives the adoption and usage of applications. Users perceive different benefits and risks they associate with a technology. There is little academic research examining the factors influencing the adoption of Digital Money Solutions. Most of the research is on FinTechs in general as well as on e-commerce or e-money. To fill this research gap, this study documents the key determinants and inhibitors of the Digital Money Solutions' usage. Drawing upon the technology acceptance model (TAM), we integrate the unified theory of acceptance and use of technology 2 (UTAUT2) and the benefit-risk framework of the theory of reasoned action (TRA) to form a multi-dimensional construct of perceived benefit (PeB) and perceived risk (PeR). As this is not the first study to investigate the usage and adoption behavior of digital money users, our emphasis is different from previous research as we merge both the variables of the UTAUT2 and the benefit-risk framework of the net valence theory. To the best of our knowledge, no investigation of the drivers of complementary currency usage in the digital context has been conducted before. With this study, we do not only contribute to current literature on the disruption and changing currency landscape but also to the general literature on technology acceptance and adoption, especially for the solution of digital money. We also contribute to the

literature on usage type differences as well as on the complementary and coexisting character of currencies and money solutions (Duarte and Schnabl, 2019; Schnabl, 2018). Implications concerning the competitive landscape of the currencies for issuers and users are drawn from the results.

In order to address the previously mentioned research questions, the remainder of this study is composed as follows: Firstly, section 5.3 embraces the theoretical background as well as a brief literature review. Secondly, the assessed research model and the developed hypotheses follow in section 5.4. Subsequently, section 5.5 introduces the dataset and methodology. Afterwards, section 5.6 analyzes and synthesizes the main results of the research, whilst section 5.7 discusses and gives practical and theoretical implications as well as requirements for future research. Finally, section 5.8 concludes.

5.3 Theoretical background and literature review

5.3.1 Digital Money Solutions and cryptocurrencies

Digital Money Solutions (DMS) as part of the Digital Finance Business Functions (Gomber et al., 2017) are considered as newly established digital, virtual or cryptographic currencies. They only exist electronically with no physical counterpart. It is assumed to fulfil all typical functions of money, except for its physical existence. Such solutions serve as a medium of exchange, a unit of account and store of value (Dodgson et al., 2015). According to the European Central Bank (2015), they are not regulated, distributed and controlled by their creators. In this study, we focus the topic of DMS on the part of privately issued cryptocurrencies as virtual currencies, using cryptography to validate, denominated in legal tender, ensuring that value can be transferred. In the following, the terminologies of cryptocurrencies and DMS are used interchangeably for a better understanding. Throughout this study, we use it as a currency, independently from fiat currencies, but convertible to it. Moreover, we postulate an independence from bank accounts, intermediaries and transactional detours. Since there have been Digital Money Solutions before, that all have been connected with central institutions for money supply, limited to certain communities (Glaser et al., 2014), we investigate for decentralized currencies with certain popularity and a large user base. The most popular DMS is Bitcoin, which was introduced in 2008 (Gomber et al., 2017; Nakamoto, 2008). Consequently, this is also the most researched currency within the field of cryptocurrencies.

Considering the exchange and valuation character of cryptocurrencies, parallel circulating currencies have to be considered. In doing so, a definition and distinction to fiat currencies is necessary. Fiat currencies are defined as any legal tender, issued and designated by a central authority of that people are willing to accept in exchange for goods and services as it is backed by regulation (European Central Bank, 2015). Issued centralized by a monopolist (typically the central bank), fiat currencies follow the objective of price stability. The most common form of fiat currency is, therefore, the sovereign states government level as regulated legal tender (in means of payment). As a currency can also be exchanged for other currencies, according to (Østbye, 2017) the issuer must support a competing currency. If more than one currency exists alongside, they theoretically compete and potentially coexist. Coexistence in this context means that different kinds of money have their very own demand and therefore do not disrupt each other (Aiyagari et al., 1996; Bryant, 2005). Although the link between cryptocurrencies and fiat currencies is not novel, this study differs as we try to investigate for drivers of parallel usage adoption and therefore the future usage intention to use both fiat and cryptocurrencies simultaneously.

The development in Digital Money Solutions research is fragmented by the constructs of assets and currencies. As we investigate from a customer adoption perspective, in this study cryptocurrencies are considered from a currency perspective. Thus, we assume the money functions to be fulfilled.

5.3.2 UTAUT2 and perceived benefit and risk framework

When considering the adoption and usage of cryptocurrencies, we can make use of a theoretical framework that has been investigated before in the context of technology usage and adoption. In terms of this study, we aim to investigate not only the former usage but also and mainly the prospective usage behavior, which can be described as a continuance intention to use a certain technology, i.e. Digital Money Solutions (Cheng et al., 2006; Lee, 2009; Ryu, 2018b). Therefore, the future usage intention of Digital Money Solutions is associated with the dependent side of our empirical model design. Thus, we investigate how experience and expectation about cryptocurrencies, i.e. DMS, determine the decision to continue the usage. Following Brown and Venkatesh (2005); Venkatesh et al. (2003); Venkatesh et al. (2002); Venkatesh et al. (2012) experience applies to all past and current users, while expectation addresses future consumers and those who intend to continue the usage. Since decisions are often made on incomplete and imperfect information, potential currency users build

expectations. Various approaches aim to model users' intention on current and future behavior (Limayem and Cheung, 2011; Pikkarainen et al., 2004; Venkatesh et al., 2002) The theoretical framework of usage decisions, in general, is grounded on the theory of reasoned action (TRA) according to Ajzen and Fishbein (1977) in this study. Assuming that the continuous usage of a service, good or technology is based on negative and positive attributes, the net valence theory combines those attributes. Regarding the net valance framework as composed in the TRA, (technology) users face a certain degree of risk as a result of uncertainty when making decisions (Peter and Tarpey Sr, 1975; Ryu, 2018b). Contrary to the risk factors, perceived benefits also provide users with an incentive for usage decisions (Wilkie and Pessemier, 1973). However, perceived risks are represented through the variables of financial, legal, security and operational risks. Perceived benefits are expressed by economic benefits, seamless transactions and convenience. Combining the perceived benefits and risks, Peter and Tarpey Sr (1975) provided a net valence framework assuming that consumers will perceive products or services with positive and negative attributes and make decisions to maximize net valence, based on the negative and positive attributes of a decision. Accordingly, the positive beliefs of DMS usage will increase the perceived benefits, whereas the negative beliefs will result in perceived risks. The net valence theory is also consistent with theories by Lewin (1943b) and Bilkey (1953). By modelling a multi-dimensional benefit-risk framework following the technological components of usage and behavior, considerable studies have examined the benefit-risk framework for the adoption and usage process of financial IT services, as shown in the following table.

Making a decision is followed by accepting a product or service to adopt and continue using it. Therefore, we extended the set of variables by technology acceptance drivers to model a future continuance intention. Evolving from the technology acceptance model (TAM) (Davis, 1989) and TAM2 (Venkatesh and Davis, 2000) to the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) and its modifications (Brown and Venkatesh, 2005; Venkatesh et al., 2012), there is a lot of research regarding technology acceptance. However, this study is designed on the theoretical framework of UTAUT2 (Venkatesh et al., 2012), as this theory represents the latest and most comprehensive version and integrates various contributions since then (Morosan and DeFranco, 2016; Raman and Don, 2013; Slade et al., 2015). Originally modelled to explain employee technology acceptance, UTAUT2 focuses on the consumer use context (Venkatesh et al., 2012), which matches our aim of research. It addresses, whether and how behavioral intention is affected by performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation,

price value and habit. However, the following table illustrates the summary of the review of studies that concern both the TRA and UTAUT2 concerning digital payment and money solutions.

Abramova and Böhme (2016) explored the drivers and inhibitors of Bitcoin use. They suggested a benefit-risk framework integrated with a technology acceptance model to explain the use of Bitcoin. Three components of perceived benefits and four components of perceived risks were included in their study. While Lee (2009) and Liu et al. (2012) proposed a single dimension for the perceived benefit side and a multi-dimensional construct for the perceived risk side, this study follows Ryu (2018b) and Abramova and Böhme (2016) by modelling both a multi-dimensional benefit and risk framework. While in an earlier stage, most of the research focused on internet banking (Kim et al., 2008; Lee, 2009; Yiu et al., 2007; Zhou et al., 2010), current research investigates e-money (Khatimah and Halim, 2014), Bitcoin (Abramova and Böhme, 2016; Folkinshteyn and Lennon, 2016) and FinTechs in general (Ryu, 2018b). The closest we found on the topic of DMS was the study of Tobbin and Kuwornu (2011) on the components of risk and trust for money transfer technologies of digital money.

Authors	Research context	Content	Baseline theory	Overlapping variables
Yiu et al. (2007)	Internet banking	Adoption intention in Hong Kong	TAM, personal innovativeness in IT	PeR, ease of use, usefulness
Kim et al. (2008)	E-commerce	Trust-based consumer decision-making, purchase behavior	TRA, net valence framework	PeB, PeR, LR, SR
Lee (2009)	Internet banking	Factors that help to adopt (private) internet banking in Taiwan	TAM, planned behavior	PeB, PeR, FR, SR
Zhou et al. (2010)	Online banking	Mobile banking adoption	UTAUT, task technology fit	PeB, PE, SI, facilitating conditions, ease of use, usefulness
Benlian and Hess (2011)	Software	Adoption of software-as-a- service for IT executives	TRA, net valence framework	PeR, PeB, EB, FR, SR
Tobbin and Kuwornu (2011)	Mobile money transfer technologies	Trust in payment solutions of mobile money	TAM, diffusion of innovation	PeR, ease of use
Ariff et al. (2013)	Internet banking	Ease of use, usefulness, behavioral intention	TAM2	Usefulness, ease of use, behavioral intention
Khatimah and Halim (2014)	E-money	Current usage behavior of e-money in Indonesia	UTAUT	PE, effort expectancy, SI, facilitating conditions, usage behavior
Abramova and Böhme (2016)	Bitcoin	Current usage behavior of Bitcoin	TAM, TRA	FR, LR, OR, ease of use, PeB, PeR, usage behavior
Folkinshteyn and Lennon (2016)	Bitcoin transaction	Technology acceptance of Bitcoin transactions as currency and the blockchain, review	TAM	PeR, ease of use, usefulness, intention
Ryu (2018b)	FinTech usage	Early vs. late adopters, continuance usage	TRA, net valence framework	EB, C, seamless transaction, LR, SR, OR, FR, PeB, PeR, user type

Table 13: Literature review of the theoretical framework

Within this study, we combine both the net valence framework of the TRA and the UTAUT2. Therefore, we identify a theoretical overlap and investigate possible drivers of future usage and adoption intention of cryptocurrencies, i.e. DMS. Extending the mentioned theories of technology acceptance to a financial context is not novel. Nevertheless, our attempt is different from previous research, as we state that this study – to the best of our knowledge – is the first to model the variables of both theories in the context Digital Money Solutions.

5.3.3 Parallel usage of DMS

For FinTechs in general, individual differences have been generally expected to be related to the use of FinTechs, because interests in individual differences result in different perceptions of benefits and risks (Ryu, 2018b). Understanding the distinction between the different users can also be projected to the usage intention of Digital Money Solutions. The adoption and usage of Digital Money Solutions do not only depend on the benefit and risk variables mentioned before, but also on the alternatives and intention of usage type. The characteristics of the users result in a variety of adoption possibilities. One of it is the parallel, simultaneous usage of solutions, rather than making decisions. If several Digital Money Solutions exist alongside, they compete and maybe coexist in the long run. This means, that every solution has its very own demand (Bryant, 2005). This, as a result of imperfect information, is possible for noninterest-bearing money and interest-bearing default-free securities as also for private notes and fiat money (Aiyagari et al., 1996). While currency substitution means the use of a foreign currency instead of the domestic one, a complementary, non-national currency, therefore, serves as a supplement or complement to national currencies (Baliño et al., 1999; Costanza et al., 2003). Furthermore, a parallel currency is qualified as an additional source of money creation with its own independent monetary implications (Vaubel, 1990). Escobar-Rodríguez and Romero-Alonso (2014) and Ryu (2018b) indicated that parallel adopters are more willing to adopt and use new technologies in the long run. They also have a more positive attitude towards innovation than non-users. Vice versa, they might perceive a higher level of risk when deciding against a parallel usage.

What is of major interest in this context is how the drivers of usage intention of DMS differ depending on the usage type. Is there a difference in perceived benefit and risk, whether a customer intends to use DMS parallel to fiat currencies or instead of or not at all? User difference results in a variety of needs to be investigated. Resulting expectations for adopting and using different money solutions and therefore digital and non-digital ones at a time gives

theoretical and practical implications for scholars as well as practitioners. In this study, parallel and non-parallel users will be considered, whereas the non-parallel users consist of both non-users and digital money only users.

5.4 Research model and hypotheses

Based on the theoretical grounding and literature review provided in the previous section, we developed a research model with a corresponding set of hypotheses. Therefore, this study proposes a framework of perceived benefit and risk, enriched by factors of behavioral intention to investigate the future usage intention of Digital Money Solutions. With the aim to investigate the drivers of the complementary usage intention of cryptocurrencies parallel to fiat currencies in the future and the question of barriers in the future usage adoption of cryptocurrencies, a hypothesis was constructed for each path of influence. The following figure illustrates the overall research model with the corresponding hypotheses.

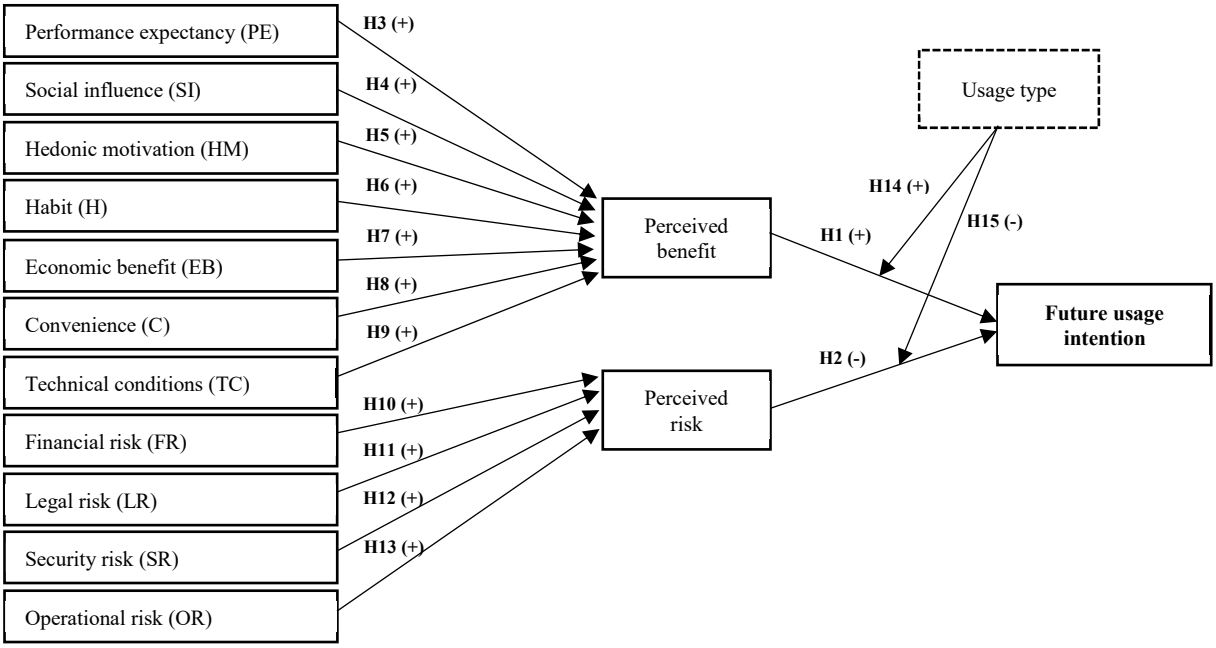


Figure 11: Overall research model

Perceived benefit is determined by the users' belief that the use of DMS creates advantages and may result in a positive outcome (Kim et al., 2008; Ryu, 2018b). As previous research showed a direct effect (Abramova and Böhme, 2016; Kim et al., 2008; Yiu et al., 2007), this study postulates perceived benefit as a direct determinant of the users' future usage intention. The direct effect is supposed to be positive on the usage intention (Benlian and Hess, 2011; Lee, 2009; Yiu et al., 2007). Since Abramova and Böhme (2016) revealed evidence on the positive

effect of perceived benefit on the usage of Bitcoin, we indicate a positive direct effect on the future usage of DMS within this study.

Perceived risk, representing the other side of the framework, is modelled as the users' perception that the use of DMS may create negative results, implied by uncertainties (Kim et al., 2008; Ryu, 2018b). This is mostly related, but not limited to issues of security (Cheng et al., 2006). Analogously to the positive influence of benefit, perceived risk is more likely to have a negative effect on the users' future usage intention as it represents a fundamental barrier. This is supported by studies by Abramova and Böhme (2016); Ryu (2018b); Yiu et al. (2007) and Peter and Tarpey Sr (1975).

Based on the proposed framework and the underpinned empirical evidence, we hypothesize a significant influence of perceived benefit and perceived risk on the users' future usage intention of Digital Money Solutions. The users' perception of benefit has a positive influence on the future usage intention. Alongside, the users' perception of risk may affect the future usage intention negatively. Consequently, the following hypotheses are developed:

H1: Perceived benefit influences the future usage intention of DMS positively.
H2: Perceived risk influences the future usage intention of DMS negatively.

5.4.1 Benefit variables

Besides the direct effects of perceived benefit and risk, the previously mentioned literature reveals a set of indirect effects on a multi-dimensional approach to test the users' future usage intention. As the users' motivation to use Digital Money Solutions in the future can be extrinsic as well as intrinsic according to the cognitive evaluation theory (Davis, 1989; Davis et al., 1992), we identified a comprehensive set of 15 potential determinants. Those were clustered into 11 variables due to intersections in the theoretical models. Enlarged by socio-demographic variables we consider potential effects on the previously mentioned constructs. For the evidence on perceived benefit, we derived 7 variables: Performance expectancy (PE), social influence (SI), hedonic motivation (HM), habit (H), economic benefit (EB), convenience (C) and technical conditions (TC). The following represent the intrinsic side of the benefit variables.

Performance expectancy derives from the UTAUT2 and is defined as the degree to which using a technology, i.e. Digital Money Solutions, provides benefits for users. Those improvements

and/or efficiencies are achieved by performing certain activities (Lee, 2009; Venkatesh et al., 2012). As one of the four main constructs of UTAUT2, PE is supposed to influence the perceived benefit positively (Brown and Venkatesh, 2005; Venkatesh et al., 2003). Following this approach, social influence, as the extent to which users perceive their private and professional surrounding believe they should use a technology, drives the future usage intention. Social influence is supposed to influence behavioral intention positively and therefore the future usage intention of DMS, too (Bilkey, 1955; Venkatesh et al., 2012). Furthermore, hedonic motivation is defined as the fun or pleasure that derives from using a technology. This perceived enjoyment refers to issues like if the usage of e.g. a cryptocurrency is enjoyable or entertaining (Brown and Venkatesh, 2005; Venkatesh et al., 2012). Therefore, HM is supposed to drive the perceived benefit of using DMS positively (Ryu, 2018b). Finally, habit is the extent to which individuals believe their behavior to be automatic. This depends on the extent of interaction and familiarity that is associated and developed with a technology (Venkatesh et al., 2012). It is a perceptual concept, which reflects the result of prior experience and is therefore expected to influence the future usage intention positively (Limayem and Cheung, 2011). Consequently, this study proposes the following hypotheses for intrinsic benefits:

H3: Performance expectancy is positively associated with perceived benefits.
H4: Social influence is positively associated with perceived benefits.
H5: Hedonic motivation is positively associated with perceived benefits.
H6: Habit is positively associated with perceived benefits.

For the digital solution of money, we tried to cluster or exclude several variables in order to better specify the model for the purpose of this study. Due to the combination of the two theoretical frameworks, i.e. UTAUT2 and the benefit-risk framework of the net valance theory, we finally clustered six variables into 3 due to redundancies, which also represent the extrinsic side of the benefit variables.

The variable economic benefit represents the clustering of the variables price value (UTAUT2) and economic benefit (TRA). As price value is defined as the cost and pricing structure (Venkatesh et al., 2012), we modelled it with economic benefit as the users' cognitive trade-off regarding the cost reductions and financial gains when using a technology (Bilkey, 1953; Lewin, 1943b; Mackenzie, 2015; Peter and Tarpey Sr, 1975; Ryu, 2018b). If a user perceives a high economic benefit, the future usage intention increases, which makes is positively related

to perceived benefit. Moreover, the variable convenience refers to the ease, portability, accessibility and flexibility that is associated with the usage of DMS. This might be in terms of either time or location (Bilkey, 1953; Lewin, 1943b; Peter and Tarpey Sr, 1975; Venkatesh et al., 2012). Convenience was clustered with the variable effort expectancy (UTAUT2) as assessed time and effort in forming views about the overall effort associated with the acceptance and use of technologies, e.g. DMS (Venkatesh et al., 2012). Therefore, convenience is supposed to be positively related to the perceived benefit of cryptocurrencies. Lastly, technical conditions built another extrinsic variable, clustered of facilitating conditions (UTAUT2) and seamless transaction (TRA). The users' perceptions of resources and support that are available to perform a behavior are of major importance and interest. These, however, may imply organizational and technical infrastructures of DMS, but also speedy and simple processes (Bilkey, 1953; Brown and Venkatesh, 2005; Peter and Tarpey Sr, 1975; Ryu, 2018b; Venkatesh et al., 2003; Venkatesh et al., 2012). TC might also affect perceived benefit positively. As a result, the following hypotheses have been developed:

H7: Economic benefit is positively associated with perceived benefits.
H8: Convenience is positively associated with perceived benefits.
H9: Technical condition is positively associated with perceived benefits.

5.4.2 Risk variables

However, benefits are always assorted with risks, on the other hand. Perceived risks are defined as the fear of facing losses due to legal, financial, security related or operational issues. User's intent to make use of DMS based on the reputation of the specific solution. This may include financial losses, privacy issues, the regulation and operational skills of the offering institution and the systematic risk of a solution itself. Since UTAUT2 only focusses on the benefit variables, the following risk variables all relate to the perceived benefit and risk framework of the net valence concept.

Legal risk (LR) refers to an uncertain legal status as a potential consequence of a lack of regulation. Users are afraid to suffer from financial losses or security issues, due to unclear regulation and missing laws (Ryu, 2018b). This might result in distrust and anxiety and therefore increase the perceived risk. Additionally, financial risk (FR) represents potential financial losses, which may result from the usage of DMS (Benlian and Hess, 2011; Peter and Tarpey Sr, 1975; Ryu, 2018b). It is mainly about the fear of losing money and potential fraud

due to the systematic risk of Digital Money Solutions (Abramova and Böhme, 2016; Featherman and Pavlou, 2003). Analogously, security risk (SR) is the potential loss arising from fraud or hacking resulting from the usage of Digital Money Solutions (Bilkey, 1953; Lewin, 1943b; Peter and Tarpey Sr, 1975; Ryu, 2018b). This may be associated with personal data as well as sensitive financial information. Finally, operational risk (OR) is the potential loss due to distrust and dissatisfaction, arising from failed or inadequate internal processes, employee behavior and systems resulting from the usage of Digital Money Solutions (Bilkey, 1953; Lewin, 1943b; Peter and Tarpey Sr, 1975; Ryu, 2018b). Users are concerned about losses due to internal process issues, e.g. of the issuer of a cryptocurrency or due to mistakes by the issuers, suppliers or their employees (Abramova and Böhme, 2016; Barakat and Hussainey, 2013). For Digital Money Solutions they can be defined in losing money, financial data sensitivity, regulatory uncertainty and internal process issues. All risk items are supposed to affect the perceived risk positively, whilst the perceived risk affects the future usage intention negatively. Based on this theoretical framework, we propose the following hypotheses:

H10: Legal Risk is positively associated with perceived risk.
H11: Financial Risk is positively associated with perceived risk.
H12: Security Risk is positively associated with perceived risk.
H13: Operational Risk is positively associated with perceived risk.

5.4.3 Moderating effect of usage type

Future usage intention is not only dependent on the technical conditions of the innovation itself, but also from the users' characteristics and intentions. Experience as well as the risk taking behavior of using something parallel, instead of or not at all might have an impact on the intention to use it in the future. For the specific solution of digital money, this addresses the disruptive character of new technologies. If more than one solution exists alongside, users have two different opportunities to participate. They can either use only one of the offered solutions or more than one parallel to each other. This would postulate the currencies to coexist, which means that different kinds of money, digital and fiat, have their very own demand and therefore do not drive each other out but circulating parallel (Bryant, 2005). In accordance with Aiyagari et al. (1996), this is a result of imperfect information and possible for private notes and fiat money. The behavioral intention to use only one or more than one money solution complementary is also dependent on perceived benefit and risk. Therefore, we follow the research question whether users of e.g. cryptocurrencies intend to use DMS instead of fiat

currencies or parallel to it. Thus, we try to gain evidence on the drivers of the parallel usage intention.

According to Fernández-Villaverde and Sanches (2018) and Fernández-Villaverde and Sanches (2016), cryptocurrencies will improve the use of money, parallel to fiat currency. This implies that the effects of convenience and therefore the positive effect of perceived benefit on the future usage intention of DMS are higher than for non-parallel users. This goes along with theories of dollarization in emerging and highly inflationary countries. A higher benefit for parallel circulating currencies in use is proposed. Therefore, the effect on the future usage intention should be higher for parallel users (Carrick, 2016; Hong et al., 2018; Lee, 2009; Nelson, 2018). DMS users might project their knowledge and intention of currency trading and competition with regard to Digital Money Solutions. The incentive to hold both cryptocurrencies and fiat currencies would increase the effect of perceived benefit on the future usage intention of DMS.

Following the approach of Rahman (2018), the socially efficient allocation of money with a deflationary policy is, due to the profit-maximizing incentives of issuers and suppliers of digital currencies (e.g. miners), at risk. Garratt and Wallace (2018) follow this by introducing a crowding-out effect of currencies. Independently from the type of currency, this would preclude a parallel usage. Users might prefer the fiat currency for regulatory and security reasons, where the effect tends to be higher than for operational and financial risk. As this is a reason against a parallel usage, the perceived risk might have a stronger negative effect on the future usage intention for non-parallel users of money solutions.

Therefore, we tested for moderating effects in conducting a multi-group analysis of parallel and non-parallel users of DMS and fiat currencies. We also investigate their differences in experience and risk-taking behavior. We try to get insight into the ability of DMS to compete with fiat currencies in the long run and to improve the overall usage of money solutions, independent from their digital character. Otherwise, we would postulate DMS to be an asset instead of a currency. As a result, the following hypotheses have been developed:

H14: The positive effect of perceived benefit on future usage intention is higher for users who are willing to use DMS parallel to traditional money solutions.
H15: The negative effect of perceived risk on future usage intention is higher for users who are not willing to use DMS parallel to traditional money solutions (independent from exclusion).

5.5 Data and methodology

Following a positivistic research approach, we conducted a questionnaire-based online survey. Grounded on the previous literature review and the derived set of dependent and independent variables, we developed 2 items per construct, enriched by a set of socio-demographic variables and key characteristics. All measures were evaluated on a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree), unless otherwise noted. We refined from using a 5- or 7-point Likert scale for a higher data quality (Carifio and Perla, 2007; Klopfer and Madden, 1980). Appendix I illustrates all relevant questionnaire items and the related literature. First, a pre-test with 19 participants was conducted from April 15th to April 28th, 2019. As a result, adjustments in the wording and structure of some questionnaire items followed. Afterwards, the final data collection was conducted from May 3rd to June 28th, 2019. A total of 733 responses were received. After carefully eliminating 133 outliers, due to inconsistencies and inevitable responses, we derived a final dataset of 600 observations (81.9% acceptance). All participants received a short definition and explanation on the topic of privately issued Digital Money Solutions, provided with the example of cryptocurrencies. The data collection process was performed online, mainly in Germany, Austria and Switzerland. Thus, we derived a heterogeneous dataset, particularly in gender, age and education. The following table summarizes the descriptive statistics of the dataset.

Measure Item	Absolute	Relative (%)	Measure Item	Absolute	Relative (%)
Gender			**DMS usage type**		
Female	354	59.0	Parallel to fiat currency	390	65.0
Male	242	40.3	Instead of fiat currency	9	1.50
Diverse	4	0.7	No usage	201	33.5
Age			**Investments (no. Investors)**		
18-22	85	14.2	Shares	199	33.2
23-30	363	60.5	Bonds	66	11.0
31-40	72	12.0	Funds (incl. ETF's)	202	33.7
41-50	25	4.2	Commodities	36	6.0
51-60	37	6.2	Cryptocurrencies	41	6.8
61 and older	18	3.0	Others	24	4.0
Education			**Digital payment preference**		
CSE	2	0.3	Yes	444	74.0
GCSE	13	2.2	No	156	26.0
A levels	200	33.3			
Bachelor	245	40.8	**Usage Medium**		
Master	127	21.2	Asset	220	36.7
Doctoral level	13	2.2	Currency	170	28.3
			Uncertain	210	35.0
Disposable Income (€)			**Online Banking Usage**		
<2,000	396	66.0	Yes	556	92.7
2,001-3,500	128	21.3	No	44	7.3
3,501-5,500	45	7.5			
5,501-8,500	16	2.7	**Mobile Banking Usage**		
>8,500	15	2.5	Yes	404	67.3
			No	196	32.7
Risk attitude			**Experience**		
Mean	3.12		Former Usage of DMS	71	11.8
Median	3.00		No Former Usage of DMS	529	88.2
Digitization Knowledge			**Provider Preference**		
Mean	4.51		Central Bank	315	52.5
Median	5.00		New entrant/start-up	83	13.8
			Uncertain	202	33.7
CC Risk Assessment					
Higher than fiat	461	76.8			
Equal or lower	54	9.0			
Uncertain	85	14.2			

Table 14: Characteristics of the final dataset

First, it is to mention, that 71 of 600 participants (11.8%) have experience with the former usage of Digital Money Solutions, whilst 164 (27.3%), more than twice as many, intend to use it in the future. The digital payment preference of 74.0% is relatively high, since only 28.8% intend to use DMS as currency instead of as asset (36.7%). The high uncertainty about the medium of usage (35%) indicates insecurity about the general usage of DMS. While 398 (66.3%) of the surveyed indicate a provider preference, 315 (52.5%) would prefer a central bank as issuer of Digital Money Solutions instead of a private issuer. Moreover, in comparison to that, 390 (65.0%) indicate to use privately issued DMS and central bank issued fiat currency parallel. In contrast to that, only 9 (1.5%) can imagine to use DMS instead of fiat currency, whilst the remaining (201 participants) refuse to use DMS at all. Furthermore, 461 participants (76.8%) assess the risk of Digital Money Solutions to be higher than the risk of fiat currencies. Finally, a relatively high self-assessed digitization knowledge (mean = 4.51) goes along with a high rate of online banking usage of 92.7% (556) and mobile banking usage of 67.3% (404).

In order to address the study's research questions, a structural equation model (SEM) based on partial least squares (PLS) was chosen to examine the effects of the comprehensive set of potential determinants on the future usage intention of DMS. To develop our SEM, we followed the four step approach according to Mulaik and Millsap (2000). After modelling an unrestricted model to define the latent variables, we developed the measurement model and built the SEM on that. For the measurement of the sampling adequacy we tested the KMO-Index as used for factor analytic data metrics (Kaiser and Rice, 1974). With a KMO of 0.879, above the suggested threshold limit of 0.60 (Tabachnick and Fidell, 2013), we demonstrate that our data is appropriate for a further factor analysis. To validate this, the Bartlett test for sphericity reveals a χ^2 of 593.76 on 78 degrees of freedom ($p < 0{,}001$) and is therefore highly significant.

5.6 Analysis and results

As previously explained, we used the PLS-SEM method to examine the integrated model of future usage intention towards Digital Money Solutions and their hypotheses. Given that the model is built to advance the theoretical models of perceived benefit and risk factors on a usage intention, we utilize a PLS-SEM method, as PLS is recommended for predictive research models (Chin, 1998; Hair Jr et al., 2016; Presthus and O'Malley, 2017; Ringle et al., 2012; Wetzels et al., 2009). Following Gefen et al. (2000), we used a two-staged analytical process. First, the measurement model was employed to determine how the observed items were loaded on the constructs in this study's model. Afterwards, we assessed a structural model, which allows testing the hypotheses and examining the relationships among the constructs. However, for evaluating and analyzing purposes and addressing the statistical approach, we utilized the *R*-package *lavaan*.

5.6.1 Measurement model

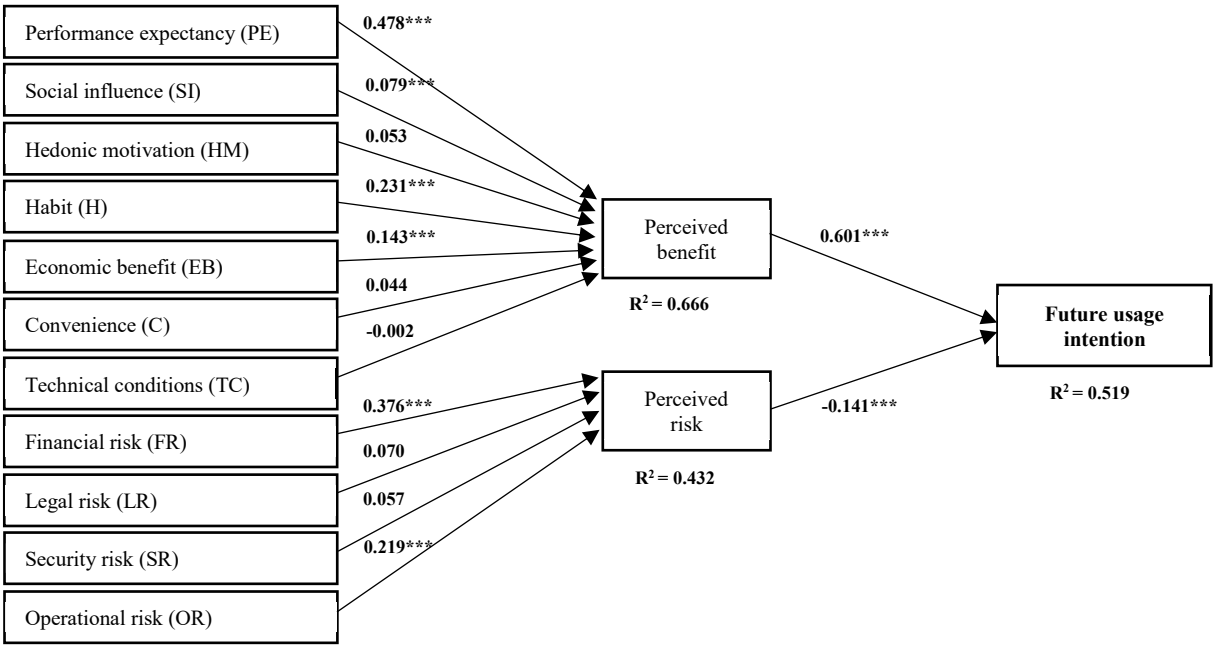
For estimating our hierarchical latent variables, we first of all applied the repeated indicator approach to measure the second-order constructs (Becker et al., 2012; Wetzels et al., 2009). Perceived benefit was measured by PE, EB, SI, C, TC, H and HM, while perceived risk was evaluated by the observable variables of LR, FR, SR and OR. For the purpose of robustness, we firstly checked for heteroscedasticity and autocorrelation by calculating resistant standard errors. Those did not reveal any significant changes. Furthermore, to test for endogeneity issues, we conducted a Durbin-Wu-Hausmann test for the need of instrumental variables. Both for the perceived benefit and the perceived risk, we receive insignificant (high) values ($p>0.05$), which supports the null hypotheses.

Furthermore, according to Ryu (2018b) and Abramova and Böhme (2016), content, convergent and discriminant validity were assessed to validate the measurement model. Content validity, however, is ensured by the consistency between the measurement items and the integration of two strands of literature without developing new measures (despite the clustered variables). Thus, the pre-test gave evidence on the content validity. To verify and confirm convergent validity, the questionnaires' reliability was tested by calculating Cronbach's alpha. With an overall alpha above 0.8, the test confirmed a satisfactory reliability of the questionnaire design (Bland and Altman, 1997; Peterson, 1994; Santos, 1999). Appendix J presents the calculated Cronbach's alphas for all numeric variables. The average variance extracted (AVE) and the composite reliability also show convergent validity of the data. The composite validity and AVE values for our measures were higher than 0.3 and therefore support the measurement model (Fornell and Larcker, 1981; Thompson et al., 1995). Subsequently, to control for discriminant validity, we calculated the square roots of the AVEs. Since every square root was greater than the correlation with the other constructs, this again supports our overall measurement model. All evaluations are illustrated in appendix J.

Moreover, multi-collinearity issues have been tested by calculating the correlations and variance inflation factors (VIF) for all incorporated variables. We did not identify any multi-collinearity issue within the dataset as all variables show VIF below the threshold of ≤ 3.3 for SEMs (Kock and Lynn, 2012; O'Brien, 2007). The results are illustrated in the appendices J and K. Nonetheless, for the overall average fit of the integrated model, we tested for the comparative fit index (CFI = 0.9), root mean square error (RMSEA = 0.046) and Tucker-Lewis index (TLI = 0.87). All measures have been acceptable according to Bentler (1990); Hu and Bentler (1999) and Steiger (1990).

5.6.2 Structural model

Grounded on the validity of the measurement model, all developed hypotheses were tested by evaluating the path coefficients and R^2 with PLS. Overall, the model explains 51.9% of the variance of future usage intention of Digital Money Solutions. The path coefficients of the model are illustrated in the following figure.



*p<0.10; **p<0.05; ***p<0.01

Figure 12: Path coefficients for the overall model

The presented integrated model, illustrated in the above figure, shows that PeB hast a significant positive effect on the future usage intention of DMS ($\beta = 0.601$, $p < 0.01$). This supports H1. Analogously to that, we find a significant negative effect of PeR on future usage intention ($\beta = -0.141$, $p < 0.01$). Thus, H2 is also supported. Consequently, perceived benefit has a positive effect on the intention of a respondent to use Digital Money Solutions in the future, whilst perceived risk affects it negatively. Also, the effect of perceived benefit is greater than the one of perceived risk. This supports the overall future usage intention of DMS, which is at 27.3%, as mentioned before.

For the benefit variables we find positive effect for PE ($\beta = 0.478$), SI ($\beta = 0.079$), H ($\beta = 0.231$), and EB ($\beta = 0.143$), all significant on a 0.01 level. This supports H3, H4, H6 and H7. However, among these, the path coefficient of PE was greatest, followed by H. The causal relationship for EB and SI on PeB was relatively weaker. While the effect of hedonic motivation and convenience is not significant, the effect of technical conditions is not only insignificant but also negative. Thus, H5, H8 and H9 need to be rejected. The R^2 of 0.666 indicates that PE, SI, HM, H, EB, C and TC commonly explain 66.6% of the variance of perceived benefit.

The results for the risk variables show a positive, significant effect of financial risk ($\beta = 0.376$, $p < 0.01$) and operational risk ($\beta = 0.219$, $p < 0.01$) on perceived risk. The higher loading on FR indicates that FR has a stronger impact on perceived risk. For security and legal

risk, the effect on PeR seems to be insignificant. However, all risk variables commonly explain 43.2% ($R^2 = 0.432$) of the variance of the variable perceived risk. Therefore, H10 and H13 are supported, whilst H11 and H12 need to be rejected.

5.6.3 Moderating effect of usage type

To test for the moderating effect of usage type, we conducted a multi-group analysis of the intention to use DMS parallel to fiat currencies or not. In doing so, we split the sample into two groups: parallel users (n = 390) and non-parallel users (n = 210). For the non-parallel users we clustered the "instead of" users (n = 9) and those who refuse from using DMS at all (n = 201). The parametric approach to statistically verify significant differences between the path coefficients reveals a distinction in the effect of perceived benefit on the future usage intention. Furthermore, all other fit statistics of the multi-group analysis (e.g. CFI, RMSEA, AIC, BIC) work in favor of the integrated model for those groups. The results of the difference test as well as the fit measures are provided in the appendixes L and M.

For a short descriptive analysis of the groups, the average age of parallel users is 28, while the non-parallel users tend to be older with an average of 33 years. Following this, the parallel users rated their own digitization knowledge higher (mean = 4.7) compared to the non-parallel users (mean = 4.3). While the value for the future usage intention of the parallel users has a mean of 2.84, the non-parallel user seem to be more likely to tend to refuse from using DMS at all (mean = 1.7). Moreover, with regard to the empirical results, the following table shows the multi-group analysis and the corresponding path coefficients for the two groups of potential parallel and non-parallel users of Digital Money Solutions.

The group of parallel users indicates a stronger path coefficient of the perceived benefit ($\beta = 0.622, p < 0.01$) than the group of non-parallel users ($\beta = 0.362, p < 0.01$). Thus, the effect of perceived benefit is affecting the parallel users stronger than the non-parallel users. As both are significant, the benefit variables commonly explain 64.7% of the variance of perceived benefit for the parallel users, whilst for the non-parallel users the benefit variables commonly explain 59.7% of the variance of perceived benefit. Thus, H14 is supported. The importance of the single benefit factors varies relatively weak depending on the usage type. For parallel users PE ($\beta = 0.511, p < 0.01$) has the strongest effect on the perceived benefit, followed by H ($\beta = 0.270, p < 0.01$) and EB ($\beta = 0.127, p < 0.01$). For the non-parallel users, also PE

($\beta = 0.402, p < 0.01$) has the strongest effect, followed by EB ($\beta = 0.174, p < 0.01$) and SI ($\beta = 0.126, p < 0.01$).

	Parallel users		**Non-parallel users**	
Variable	Path coefficient (β)	R2	Path coefficient (β)	R2
PeB	0.622***	0.647	0.362***	0.597
PeR	-0.199***	0.426	-0.063	0.419
PE	0.511***		0.402***	
SI	0.046*		0.126***	
HM	0.045		0.113*	
H	0.270***		0.079	
EB	0.127**		0.174***	
C	-0.001		0.103	
TC	-0.023		0.001	
FR	0.397***		0.335***	
LR	0.106*		0.035**	
SR	0.022		0.110*	
OR	0.206***		0.202**	

This table shows the path coefficients of both the parallel user group and the non-parallel user group and their p-values. P-values range from *** p<0.001, ** p<0.01 and *p<0.1. Residuals are insignificant.

Table 15: Parallel vs. non-parallel users

Regarding the effect of perceived risk on the future usage intention of DMS, the groups vary stronger than for the benefit effects. For the group of parallel users, the negative effect of perceived risk ($\beta = -0.199, p < 0.01$) on future usage intention was significant, while for the group of non-parallel users the effect is not significant. The overall explanation of the variance in future usage intention was nearly the same. However, while the risk variables commonly explain 42.6% of the variance of perceived risk for the parallel users of DMS, they explain 41.9% of the variance for the non-parallel users. Based on these results and the insignificance of the effect of PeR on the future usage intention of DMS for non-parallel users, H15 needs to be rejected. With regard to the single risk factors, for the parallel users only financial ($\beta = 0.397, p < 0.01$) and operational risk ($\beta = 0.206, p < 0.01$) have a significant effect on perceived risk. However, in case of the non-parallel users, financial ($\beta = 0.335, p < 0.01$), legal ($\beta = 0.035, p < 0.05$) and operational risk ($\beta = 0.202, p < 0.05$) have a significant effect on perceived risk.

5.7 Discussion and implications

To introduce the discussion of this study's results, it is important to first of all have a look on the descriptive results, again. First, the gap between the former users (11.8%) and those who intend to use DMS in the future (27.3%) is to mention, since this is more than twice as many. Beyond that, 65% of the respondents intend to use DMS parallel to fiat currencies. This outlines a great potential for a coexistence and therefore competing currencies circulating in the monetary systems worldwide. A shift from experience to expectations can be observed, at this

point. As DMS continuously gain popularity, this might go along with trust, community and commitment, which would lead to the adoption of money solutions. Therefore, it is inevitable for issuers of both DMS and fiat currencies to make the different currencies competitive. It will not be about adjusting one currency to another but rather to build on competitive advantages for different market places, as users intend to use both digital and fiat solutions. This is also an indicator for a current dissatisfaction with fiat currencies, since otherwise there would not be an incentive to switch or to use DMS additionally. In addition, the drivers for those 35% who do not intend to use fiat and DMS parallel, need to be taken into account, too. Those will be indicators for competitive advantages of central bank currencies as well as indicators for weaknesses of Digital Money Solutions. This may be in line with findings by Gerlach and Lutz (2019); Ryu (2018b) and Abramova and Böhme (2016), who also find great potentials for the future usage adoption of FinTechs in general and Bitcoin in particular. Additionally, the provider preference is of major interest, as users are more likely to demand DMS if it is issued by a central bank (52.5%), compared to a private issuance by a new entrant (13.8%). This refers to legal and security issues and might be expressed by the risk variables. Since this might be an indicator for (potential) private issuers of DMS to build on trust and backing of their currencies, the high level of uncertainty (33.7%) among the potential users is also a sign for a lack of information on the topics of trust, security and differences between private and central bank currencies. This emphasizes the findings on experience (former usage) of DMS, which is also relatively low. To further investigate, what drives those usage decisions, a closer analysis of the benefit and risk factors has to be made.

Considering the overall effect on the future usage intention of Digital Money Solutions, it is to mention that perceived risk and benefit have significant effects. As theoretically postulated, the perceived benefit has a positive effect on the users' intention, also being stronger than the negative effect of perceived risk. The results illustrate that the benefit is stronger than the risk effect, which goes along with findings by Ryu (2018b); Yiu et al. (2007) and Folkinshteyn and Lennon (2016). Therefore, the graving and belief of a possible gain is greater than the fear of a potential loss when using the technology. This may be caused by the fact that 65% tend to use it parallel to fiat currencies and not instead of or at all. This might diversify the risk and therefore increase the effect of the benefit. Nonetheless, the perceived risk is also a significant factor regarding the future usage intention. Attention has to be paid in both directions, no matter which effect is stronger. The following discussion of the single benefit and risk factors will suggest

further implications for suppliers and developers of Digital Money Solutions to counteract the reasons against a future usage intention.

Among the benefit factors we find evidence for four drivers of perceived benefit. PE has the strongest effect on the perception of benefits. When using a technology, i.e. Digital Money Solutions in this context, customers highly value the efficiency and effectiveness to improve their performance. This goes along with the perception of the daily usage and the following improvement of processes. This is also elaborated by findings on the usage type. If the performance is on a satisfying level, there is an incentive to use a currency. Furthermore, EB is of relevance for the future usage intention, too. This addresses the experienced cost-performance ratio and a cost awareness, which influence a usage decision. Low transaction fees and the expectation of financial gains are of major importance. This goes along with findings by Ryu (2018b) and Abramova and Böhme (2016), particularly for the usage of cryptocurrencies, i.e. Bitcoin. In this respect, it is inevitable for issuers and developers of Digital Money Solutions, to monitor costs and try to hold them on a reasonable level. If the usage of cryptocurrencies is more cost intense than the usage of fiat currencies, there will be no incentive to switch a currency or to use it even parallel to it, as the results of the multi-group analysis show. Moreover, the private and professional surrounding of users' has an impact of the future usage decision. This is shown by the significant effect of social influence. In decision-making theory, it is common knowledge that users of technology tend to make decisions on the recommendation and influence of a third party. Herein, some tend to trust on private, some on professional surroundings. According to DMS, this also means that a money exchange is possible between different users and goes along with theories of network effects and trust as in classical monetary theory (Fernández-Villaverde, 2018; Gandal and Halaburda, 2016). According to this point, building a community and bringing the communities of users together, is of great importance for the issuers of Digital Money Solutions. Finally, with regard to network effects, also synergy effects are a field of interest and influence. H, as the perception of implementing and getting used to a technology, is significantly affecting the perceived benefit of DMS usage. Therefore, the future usage intention increases when customers get used to an application and believe in the ease of use. This contributes to findings by Ariff et al. (2013) and Folkinshteyn and Lennon (2016). With regard to the technological conditions, this should be implemented by developers and issuers of Digital Money Solutions in making it easy and understandable, yet time, purpose and cost efficient overall. If there is no advantage in comparison to fiat currencies, habit will not be the reason to start using DMS. This is also in

line with the results of the parallel usage group. Among these, habit has also a significant positive effect on perceived benefit and thus future usage intention. Therefore, users can imagine using both solutions, if they get used to it easily.

With regard to the empirical results of the risk factors, only FR and OR significantly affect the future usage intention of Digital Money Solutions. In terms of financial risk, the results outline, that the fear of losing money is of major concern for users. Since legal or security risk are not significant at all, it is not about an official backing of the money, but rather the general risk of making a loss due to the usage of a technology. This may be caused either by the novelty of DMS or by the fact that the money is purely digital and never having a physical appearance. Regarding this risk factor, suppliers need to improve overall security issues. Despite the fact that legal and security risk are not addressed within the results of this study, they should be addressed by managerial and strategic implications, too, since the results of the multi-group analysis show that these do matter for those who do not intend to make parallel usage. As parallel usage is the best allocation for both of the currency solutions, this should be an overall target when issuing a currency or offering Digital Money Solutions. By addressing all the risk factors, special interest should also be paid to the operational risk.In this respect, the future usage intention is affected by the fear of supplier and internal mistakes significantly, which should therefore be prevented. Moreover, this is presented by the significant overall effect of perceived risk on the future usage intention, as previously outlined.

For the moderating effect of the parallel usage intention of Digital Money Solutions, we find that especially the perception of perceived benefit is influencing the future usage intention of Digital Money Solutions stronger than for non-parallel users. This is consistent with findings by Fernández-Villaverde (2018) and Fernández-Villaverde and Sanches (2016), who postulate an improvement in the usage of money for a parallel usage behavior for privately issued (crypto-) currencies and fiat currencies. Especially that the factors of performance expectancy and economic benefit are significant, empirically underlines this result. In addition, the significant effect of the perceived risk on the future usage intention for the parallel users shows an incentive for a parallel usage. If the perceived risk is higher, the intention to use DMS in the future is relatively lower. This goes along with findings by Garratt and Wallace (2018) and Rahman (2018) on the negative effect of the fear of crowding out. Thus, the effect of the financial risk, i.e. the fear to experience financial losses due to a future usage, has the strongest effect, which will be the main problem if one currency crowds out another. Interestingly, the

perceived risk is not significantly driving the future usage intention of non-parallel users. This may be caused by the fact, that for those who already made a decision against a usage, are not additionally affected by an increase of risk, but may be more likely to change their mind if the benefits of a technology usage increase. This sticks to theories and findings on experience and expectations according to Limayem and Cheung (2011) and Venkatesh et al. (2012). For issuers of DMS, this implicates improving the benefits rather than concentrating on the risks, which does not mean to disregard them. The systematic risk, however, will never fade, but one can improve the return for taking a certain risk.

In order to benefit from positive effects and to protect against negative ones, it is also important to look at the non-significant variables, which are obviously of minor interest. For the benefit variables, those are hedonic motivation, technical conditions and convenience. With regard to the special context of Digital Money Solutions, it is not surprising that hedonic motivation is not significantly affecting the future usage intention. When using DMS, it is more about the purpose itself, than the enjoyment of it. This appeals to findings by Abramova and Böhme (2016); Khatimah and Halim (2014) and Gerlach and Lutz (2019). Obviously, the technical conditions are also not affecting the usage. This may be explained by the high perception of personal digitization knowledge, as the descriptive results of the conducted survey outline. As potential users rate their own knowledge relatively high, the technical conditions may not influence the usage significantly. Not surprisingly, convenience does not have a significant influence as well. As this addresses the understanding of a certain technology or application, this may also be explained by a high personal technology and digitization perception of users. Interestingly, the time and location independence of the usage is not of major importance. This can be explained by the smart character of the technology of DMS, which is assumed to be inherent. This is also underlined by the descriptive results of the online banking (92.7%) and mobile banking (67.3%) usage, which give the users experience in time and location independence. Users do not doubt that a usage is possible everywhere and at every time, though it is not driving the future usage intention at all. This contributes to findings by Tobbin and Kuwornu (2011) and Folkinshteyn and Lennon (2016), who investigated for transaction and transfer processes of e-money and Bitcoin.

Lastly, we state, despite from the significant effect of parallel usage, that the overall drivers of future usage adoption of PE, EB, H and SI as well as FR and OR have to be taken into account for private issuers as well as central banks. In addition, users need to pay attention on the general

technological understanding and different types of currencies before using or refusing to use it. This is underlined by the generally high level of uncertainty of 32.8% regarding the future usage intention of DMS.

5.8 Conclusion

Digital Money Solutions are the future of worldwide monetary systems. However, this is meant not in a disruptive way, but rather with regard to an eventual coexistence and a parallel circulation. Nowadays, privately issued cryptocurrencies and central bank issued fiat currencies do interact simultaneously in our monetary system. The literature reveals convergence towards the factors of perceived benefit and risk, driving the future usage intention as well as a parallel usage intention. The empirical results of this study underline the hypotheses and give practical and theoretical implications as well as inducement for future research. The purpose of this study was to determine factors of future usage intention of Digital Money Solutions, especially with regard to a complementary usage with fiat currencies. Based on the previously described results, we derive implications for scholars as well as practitioners, especially from the viewpoint of issuing instances of both traditional currencies and Digital Money Solutions.

To investigate for determinants of technology acceptance, we modelled and integrated the research model of the benefit and risk framework of the TRA and the UTAUT2. In merging the relevant variables of the different models into one SEM, we investigated whether and how perceived benefit and risk affect the future usage intention of DMS. In order to address the research questions, we conducted an online-based survey. As a result, 600 observations represented our final dataset. Within out empirical analysis, we implemented a multi-group analysis for parallel and non-parallel users of DMS and fiat currencies. For the overall intention to use Digital Money Solutions complementary to fiat currencies, we find strong evidence in the descriptive as well as in the empirical results. In doing so, we do not only contribute to the current literature on technology acceptance, but also to the literature on cryptocurrencies and currency adoption as well as to currency competition and the coexistence of privately and central bank issued currencies. Moreover, as we addressed these issues theoretically and empirically, we derived theoretical and practical implications for issuers of money solutions. To the best of our knowledge, this is the first study to investigate for the parallel usage of currencies and Digital Money Solutions by incorporating both the TRA with its benefit and risk framework and the UTAUT2 into one analysis.

Resulting from our analysis, we state a gap between the former use behavior and future usage intention of DMS. As this outlines a general interest and shift to the usage of Digital Money Solutions, the reasons for this behavior have to be taken into account. The overall intention to use Digital Money Solutions is positively driven by perceived benefit and negatively driven by perceived risk. Both are significant, while the positive effect of perceived benefit is stronger than the negative effect of perceived risk. This postulates a behavior driven by effort, effectiveness, financial gains and social surroundings. The significance of PE, EB, SI and H as drivers of PeB underlines a causal relationship. For the weaker but also significant effect of perceived risk on the future usage intention, we find the financial and operational risk driving the perception of risk towards a DMS usage negatively. This indicates a high fear of financial losses and mistrust in the system itself and its internal processes. This might be due to high volatility as well as a lack of knowledge. Moreover, we tested for moderating effects by conducting a multi-group analysis for parallel and non-parallel users of DMS and fiat currencies. We tried to get insight into its ability to compete with fiat currencies in the long run and to improve the usage of money solutions overall, independent from its digital character. Otherwise, we would postulate it to be an asset instead of a currency. The moderating effect, which was grouped by parallel and non-parallel users, counteracts that result of perceived risk. Surprisingly, for those who do not intend to use DMS and fiat currencies parallel, the negative effect of perceived risk is not significantly stronger. With regard to perceived benefit, we do find a significantly stronger effect on the future usage intention for those who intent to use DMS complementary to fiat currencies. This postulates positive effects of a parallel usage, which strengthens the future usage intention of Digital Money Solutions. Consequently, this outlines that users are willing to use both traditional central bank issued fiat currencies and DMS at the same time. There is a need for an alternative but not for a replacement. With that knowledge in mind, suppliers of DMS and fiat currencies should try to strengthen their competitive advantages, since there is a demand for both.

Considering the previous results, this study contributes both scholarly and practically to a general awareness of usage drivers, especially for a complementary usage. First of all, we contribute to a better understanding of the difference between the usage groups. This is important to better understand the characteristics of each user group and effectively deliver products and services, whilst meeting the users' expectations and demands by improving the usage of both DMS and fiat currencies. Financial suppliers or issuers of currencies should try to improve the currencies to make them competitive instead of adjusting to one another. In

addition, central banks should not try to imitate the Digital Money Solutions, but to improve the fiat currencies and expand their competitive advantages as government backed institution (security and legal risk). Therefore, the currencies could coexist alongside and making each other stronger in their specific niches, instead of "crowding-out" each other. Moreover, in order to overcome security issues and the fear of losing money, the backing of Digital Money Solutions would be another potential approach. However, even though the backing by a central bank is possible, this would not maintain the private character.

Nevertheless, despite the contributions and implications, it is to mention that this study is limited to several points. First of all, the structure of the underlying sample has a geographic focus on Germany. Few respondents from other countries are not of high significance. Although there is variance in age and education, there is a great share of students among the respondents. Second, for the understanding of the topic, we totally focused on the drivers of adoption from a benefit and risk framework. We therefore excluded technical (i.e. Blockchain) and regulatory derived variables. We also limited the questionnaire to a comparison of privately issued DMS and central bank issued fiat currencies. The consideration of a central bank issued Digital Money Solution was not part of the conducted research approach.

Derived from these limitations, future research should try to reach out for several points. This study could further be an analysis of potential moderating effects of experience and social background. This could be conducted by testing for an ad-hoc development between the different groups of parallel usage behavior. In addition, a clear distinction between Bitcoin, cryptocurrencies in general and Digital Money Solutions could be made when questioning for a parallel usage intention. This could be conducted by an ad-hoc investigation on the mentioned possible moderating variables. Since the effect of benefit on the future usage intention is stronger for parallel users than for non-parallel users, we get evidence on the benefits of a parallel usage. Future research might also investigate the advantages for fiat currencies in making a vice versa test, investigating if respondents answer equal as a matter of perspective. Therefore, when examining the ability to coexist, the technological aspect has to be considered for economic reasons of usage intention. Since the construction of cryptocurrencies, i.e. DMS, is very different, it is not easy to compare it to a fiat currencies, which is, despite of some little differences, generally the same overall. Nonetheless, future research could try to detach from only the currency acceptance component of DMS and further investigate the acceptance models for the usage of assets. Likewise, the purpose of cryptocurrencies has to be considered in the

future, since many coins are created only for investment reasons and not to be an actual currency. These coins, however, do not aim to coexist or even compete with fiat currencies. This potential approach is encouraged by a high respondent rate for the asset character of DMS.

Nevertheless, the growing amount of Digital Money Solutions makes it possible to build upon the boundaries of this study. It might not only be important for scholars, but also for central banks to observe the growing influence of DMS and to be aware of factors that drive their future usage intention. The focus should not only lay in preventing disruption, but also in promoting competition with complementary money solutions. Likewise, governments and other authorities need to be aware of potential consequences for the opportunities to control inflation as well as how to react to a changing monetary system in general.

5.9 Appendix

Appendix I: Survey items

Variable	Item	References
DMS former usage	Did you ever make use of DMS? (Yes/No)	Lee (2009); Ryu (2018b); Venkatesh et al. (2012)
DMS future usage intention	I intent to use (continue the usage of) DMS in the nearest future.	Cheng et al. (2006); Ryu (2018b); Venkatesh et al. (2012)
DMS experience and usage	How would you intent to use DMS? (parallel to/instead of fiat currency) For which purpose would you intent to use DMS? (asset or currency) Would it make a difference for you, if an established financial institution or a new entrant/start up offers DMS?	Self-worded
Performance expectancy (PE)	The usage of DMS brings improvements. Using DMS is more efficient.	Lee (2009); Venkatesh et al. (2012)
Economic benefit (EB)	The usage of DMS is less cost intense. I do expect financial gains from the usage of DMS.	Lee (2009); Ryu (2018b); Yiu et al. (2007)
Convenience (C)	Using DMS is clear, understandable and easy. The usage of DMS is possible at any time and everywhere.	Ryu (2018b); Venkatesh et al. (2012)
Social influence (SI)	In my private surrounding, I know people who use DMS. In my professional surrounding, I know people who use DMS.	Venkatesh et al. (2012), self-worded
Technical conditions (TC)	I have the technological infrastructure to use DMS (e.g. smartphone, laptop with access to internet). I have sufficient technological knowledge and skills to use DMS.	Brown and Venkatesh (2005); Venkatesh et al. (2012); Yiu et al. (2007)
Hedonic motivation (HM)	Using DMS is enjoyable. The use of DMS is entertaining.	Venkatesh et al. (2012)
Habit (H)	I might get used to the usage of DMS. I can imagine to implement DMS in my regular usage of financial products and services.	Venkatesh et al. (2012)
Financial risk (FR)	I am afraid to lose money when using DMS. I am worried to be exposed to financial risks when using DMS.	Abramova and Böhme (2016); Featherman and Pavlou (2003)
Legal risk (LR)	I am worried about potential regulatory uncertainties and leakages when using DMS. I am concerned about legal uncertainties when using DMS.	Abramova and Böhme (2016); Ryu (2018b)
Security risk (SR)	I am worried about the security of my personal data when using DMS. When using DMS I am concerned about the security of my sensitive financial data.	Ryu (2018b), self-worded
Operational risk (OR)	I am concerned that internal process issues (of the supplier) may cause financial losses when using DMS. When using DMS I am afraid to suffer from losses due to mistakes by the supplier or its employees.	Abramova and Böhme (2016)
Perceived benefit (PeB)	I see many advantages in using DMS. By using DMS I can achieve a higher benefit.	Benlian and Hess (2011); Kim et al. (2008); Ryu (2018b)
Perceived risk (PeR)	I see many disadvantages in using DMS. By using DMS I am exposed to many risks.	Benlian and Hess (2011); Kim et al. (2008); Ryu (2018b)

All items have been measured on a 6-point Likert scale, unless otherwise noted, with 1 = strongly disagree and 6 = strongly agree.

Appendix J: Cronbach's alphas, variance inflation factors and average variance extracted

Variable	Cronbach's alpha (raw)	Cronbach's alpha (std)	VIF	AVE
Future usage intention	0.86	0.86	-	0.519
PeB	0.86	0.86	1.357	0.664
PeR	0.86	0.86	1.357	0.347
PE	0.86	0.86	2.678	0.647
SI	0.88	0.87	1.282	0.217
HM	0.86	0.86	2.060	0.567
H	0.85	0.86	2.492	0.736
EB	0.86	0.86	2.204	0.476
C	0.87	0.87	1.533	0.318
TC	0.88	0.88	1.146	0.870
FR	0.87	0.87	1.609	0.454
LR	0.87	0.87	1.984	0.604
SR	0.87	0.87	1.557	0.427
OR	0.87	0.87	2.073	0.658
overall	0.87	0.88	-	-

Cronbach's alphas for numeric variables calculated on 95% confidence boundaries. All items show values above 0.8. This verifies the reliability of the questionnaire design.

Appendix K: Correlations of incorporated variables

	PeB	PeR	PE	EB	C	SI	TC	HM	H	FR	LR	SR	OR
PeB	1.00												
PeR	-0.51	1.00											
PE	0.77	-0.49	1.00										
EB	0.63	-0.37	0.70	1.00									
C	0.46	-0.23	0.49	0.50	1.00								
SI	0.40	-0.14	0.32	0.26	0.18	1.00							
TC	0.21	-0.04	0.21	0.12	0.28	0.19	1.00						
HM	0.58	-0.31	0.56	0.51	0.40	0.43	0.23	1.00					
H	0.69	-0.46	0.67	0.52	0.47	0.41	0.28	0.67	1.00				
FR	-0.27	0.59	-0.31	-0.19	-0.13	-0.07	0.07	-0.22	-0.32	1.00			
LR	-0.19	0.49	-0.22	-0.11	-0.10	-0.03	0.07	-0.16	-0.22	0.58	1.00		
SR	-0.27	0.40	-0.29	-0.12	-0.08	-0.20	-0.08	-0.22	-0.30	0.38	0.47	1.00	
OR	-0.25	0.54	-0.26	-0.14	-0.13	-0.10	0.03	-0.21	-0.27	0.51	0.63	0.58	1.00

Appendix L: Results of the difference test in multi-group analysis

	df	AIC	BIC	Chisq	Chisq Diff.	Df.Diff	Pr(>Chisq)	
configural	104	21760	22094	410.90				
loadings	113	21752	22047	421.57	10.673	9	0.2988	
intercepts	123	21792	22042	480.98	59.405	10	4.695e-09	***
residuals	135	21835	22033	548.10	67.122	12	1.102e-09	***
means	137	21923	22112	640.26	92.155	2	<2.2e-16	***

Appendix M: Fit measures of the multi-group analysis

	CFI	RMSEA	CFI.delta	RMSEA.delta
configural	0.887	0.099	NA	NA
loadings	0.886	0.095	0.001	0.004
intercepts	0.868	0.098	0.018	0.003
residuals	0.848	0.101	0.020	0.002
means	0.815	0.111	0.033	0.010

5.10 Declaration of Co-authors and record of accomplishments

Title	User Perception of Digital Monel Solutions – Impact of the Complementary Usage to Fiat Currencies on Prospective Use Behavior
Authors	Julia K. T. Lutz (Heinrich-Heine-University Duesseldorf) Johannes M. Gerlach (Heinrich-Heine-University Duesseldorf)
Conferences	The paper is currently under review for presentation at the "28th Finance Forum", Carcavelos, Portugal. The paper is currently under review for presentation at the "11th International Research Meeting in Business and Management", Nice, France. The paper is currently under review for presentation at the "European Finance Association 47th Annual Meeting", Helsinki, Finland. The paper is currently under review for presentation at the "Annual International Journal of Central Banking Research Conference – Structural changes in the financial system: new theory and evidence", Copenhagen, Denmark.
Publications	Submissions are planned as soon as conference participation and presentation has taken place.

Contributions	**Julia K. T. Lutz**	**Johannes M. Gerlach**
Conceptualization Development of research question Methods specification	50%	50%
Execution		
Literature review and development of theoretical framework	100%	0%
Data collection and preparation	50%	50%
Data analysis	100%	0%
Analysis and discussion of results	100%	0%
Derivation of implications and conclusions	100%	0%
Manuscript preparation Initial draft Finalization	100%	0%
Overall contribution	**90%**	**10%**

Date, Julia K. T. Lutz

Date, Johannes M. Gerlach

6 Final remarks

Recently, the traditional financial services industry in Germany faces tremendous challenges that result in enormous structural developments and organizational restructurings. These, however, are characterized by continuing and increasing profitability issues as well as ongoing consolidation tendencies and downsizing trends. In this regard, it is inevitable to identify and understand the factors that drive these developments. Yet, it is inevitable to identify these. Rather, from an academic perspective, it is mandatory to provide comprehensive research on the responsible drivers. Correspondingly, the presented dissertation aimed at the identification, derivation and discussion of potential strategic and managerial recommended courses of action that facilitate and empower policy makers as well as managers and employees of financial institutions to implement essential, effective and efficient measures regarding two of the identified drivers. However, the continuing regulatory tightening on the one hand and the ongoing digitization tendencies on the other hand represented these two factors. The resulting implications, however, should contribute to a successful accomplishment of challenges that are of great relevance for the sustainable competitiveness of the entire German banking sector as well as its individual institutions.

In order to approach and achieve this objective, it was necessary to structure this dissertation systematically: Firstly, the herein addressed aim of research was motivated by the presentment of the already mentioned significant structural developments within the traditional banking sector in Germany. Moreover, the motivation continued by the identification and a brief explanation of the identified factors that drive these developments, i.e. the expansionary monetary policy, the ongoing regulatory intensifications and increasing digitization tendencies as well as the continuing globalization and, particularly in Germany, the demographic changes. Secondly, the introductory part of this dissertation continued by the statement of the herein conducted research approach and its scope, which was to address two of the identified drivers, namely the regulatory intensifications and the increasing digitization respectively their intersection. In doing so, this dissertation provided comprehensive research and discussions as well as the derivation of implications on how to manage these challenges successfully. In this respect, subsequently to the introductory section, this dissertation continued by the incorporation of four scientific studies. These studies, however, addressed varying areas of research, utilized differing methodological approaches and, most importantly, commonly contributed to this dissertations' aim of research.

With the incorporated studies, the presented dissertation contributed to several research gaps, matters and discussions that are of great relevance from both an academic and practical viewpoint: It contributed to not only the general understanding of FinTechs and the various areas of operations as well as offered products and services. Moreover, it added to the recent literature on the discussion of an optimal design of regulatory sandboxes and approaches on how to govern FinTechs effectively on the one hand without hindering potentially favorable innovative developments on the other hand. Thus, this dissertation contributed to the identified trade-off between sound regulation and innovation support, where the German regulator itself stated a "need for action". Moreover, the presented dissertation contributed to the literature on both the behavioral intention and the acceptance or adoption of technology as it combined two differing strands of literature. This combination, however, enriched the corresponding results, discussions and implications, since the aggregation of the differing strands of literature resulted in more comprehensive sets of variables. Finally, as the herein incorporated studies commonly combine secondary research (the analysis of existing regulatory sandboxes) and field research (two comprehensive surveys) as well as theoretical (conceptual analysis) and quantitative empirical (logistic regression design and structural modeling) research approaches, it contributed to its theoretical and empirical variation as well. This, however, implies the careful identification of limitations and future research opportunities and requirements that are associated with each of the herein incorporated studies.

However, this dissertation focused primarily on the German financial services industry, even though the herein-addressed drivers pose not only significant challenges within the German context. The rational for this geographical focus resulted from the authors' industry specific knowledge and the corresponding possibility to utilize the German banking sector as a concrete example in order to become as precise as possible. Nonetheless, it is hereby encouraged to use this dissertations' results, discussions and implications as a basis for further research and discussions that focus on other than the German financial services industry.

Ultimately, through the execution of four scientific studies, this dissertation identified, derived and discussed strategic and managerial recommended courses of actions. Commonly, these should have the potential to facilitate and empower policy makers as well as managers and employees of financial institutions to discuss and implement essential, effective and efficient measures that address the regulatory intensifications and increasing digitization tendencies respectively their intersection. Thus, this dissertation moreover contributed to the identification

of potentially constructive measures for the successful accomplishment of challenges, which are of great relevance for the sustainable competitiveness of the entire German banking sector as well as its individual institutions. Consequently, the herein formulated aim of research was addressed successfully.

In the end, the author of this dissertation would – once again – like to outline, that the identification and discussion of realizable as well as constructive strategic and managerial implications was given a central importance throughout the whole dissertation. Consequently, it is one of the authors' major concerns to finally express, that the utilization of theoretically gained knowledge for practical challenges and thus the transfer and exchange of knowledge and experiences between academic research and practice, is of central importance. However, this refers less to individual derived implications and measures. Rather, it is a question of utilizing theoretically decoded knowledge as a basis for continuous discussions in order to ultimately address practical issues and contribute to theirs effective and efficient solution. Thereby, providing valuable contributions to nations, companies, societies and thus economies and their prosperity in its entirely, should be the utmost concern and central motivation.

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Statutory declaration

Heinrich Heine
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Ich, Herr Johannes Martin Gerlach, versichere an Eides statt, dass die vorliegende Dissertation von mir selbstständig und ohne unzulässige fremde Hilfe unter Beachtung der „Grundsätze zur Sicherung guter wissenschaftlicher Praxis an der Heinrich-Heine-Universität Düsseldorf“ erstellt worden ist.

Düsseldorf, den 28.01.2020

Johannes M. Gerlach