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Essays on Digital Transformation in Organizations

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Abstract

Digital transformation of organizations as a process that is induced by the application of digital technologies and directed at enabling major organizational improvements, such as enhanced firm performance and improved relationship with customers, is currently the center of attention of researchers and practitioners. Aiming at extending the current knowledge on digital transformation, I consider this phenomenon from two different perspectives in the three empirical essays of this thesis.

In the first empirical essay of this thesis, I rely on the firm perspective to investigate how strategic emphasis on digital transformation influences market capitalization of firms across industries and whether firm size moderates this relationship. To answer these questions, I conducted a panel data analysis of the German HDAX firms from 2000 to 2017. My results indicate that a higher firm strategic emphasis on digital transformation leads to a higher market capitalization for larger firms and to a lower market capitalization for smaller firms.

In the second empirical essay of this thesis, I rely on the customer perspective to study how the implementation of financial technology in digital financial processes by the financial services firms influences customer trust in these processes, and compare different examples of financial technology with each other with respect to their ability to generate trust. To answer my research questions, I conducted an online conjoint experiment based on five currently discussed examples of financial technology in terms of peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain, with 355 participants. My results show that with the exception of peer-to-peer platforms and robo-advisors, the implementation of financial technology results in a higher customer trust in digital financial processes. Hereby, biometric authentication mechanisms tend to be the strongest technology in gaining customer trust.

In the third empirical essay of this thesis, I rely on the customer perspective to find out, how the implementation of financial technology in digital financial processes by the financial services firms influences customer intention to use these processes via the relationship, synchronism and identification and control requirements of process virtualization theory. To test my hypotheses, I used data from an online conjoint experiment with 302 participants. The experiment was based on five examples of financial technology in terms of peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. My results indicate that relationship, synchronism, and identification and control readiness jointly transmit the effect of financial technology implementation on customer intention to use financial processes. My results further suggest that the implementation of financial technology in digital financial processes generally increases customer intention to use these processes. With this thesis, I support companies on their digital transformation path.

Kurzfassung (German abstract)

Die digitale Transformation von Organisationen als ein Prozess, der durch die Anwendung digitaler Technologien ausgelöst und auf die Ermöglichung wesentlicher organisationaler Verbesserungen wie die gesteigerte Unternehmensleistung und bessere Beziehung mit den Kunden gerichtet ist, steht aktuell im Mittelpunkt der Aufmerksamkeit der Forschung und Praxis. Mit dem Ziel der Erweiterung des bestehenden Wissens auf dem Gebiet der digitalen Transformation, betrachte ich dieses Phänomen aus zwei verschiedenen Perspektiven in den drei empirischen Artikeln dieser Doktorarbeit.

Im ersten empirischen Artikel dieser Arbeit verwende ich die Unternehmensperspektive, um zu untersuchen, wie der strategische Fokus auf die digitale Transformation die Marktkapitalisierung von Unternehmen über die Branchen hinweg beeinflusst, und ob diese Beziehung von der Unternehmensgröße moderiert wird. Um diese Fragen zu beantworten, führte ich eine Paneldatenanalyse der deutschen HDAX-Unternehmen von 2000 bis 2017 durch. Meine Ergebnisse deuten darauf hin, dass ein höherer strategischer Fokus auf die digitale Transformation zu einer höheren Marktkapitalisierung bei größeren und zu einer geringeren Marktkapitalisierung bei kleineren Unternehmen führt.

Im zweiten empirischen Artikel dieser Arbeit verwende ich die Kundenperspektive, um zu erforschen, wie die Implementierung der Finanztechnologie in den digitalen Finanzprozessen durch die Unternehmen der Finanzindustrie das Kundenvertrauen in diese Prozesse beeinflusst, und um die verschiedenen Beispiele der Finanztechnologie bezüglich ihrer Fähigkeit, Vertrauen zu generieren, miteinander zu vergleichen. Um meine Forschungsfragen zu beantworten, führte ich ein Online-Conjoint-Experiment basierend auf fünf aktuell diskutierten Beispielen der Finanztechnologie in Form von Peer-to-Peer-Plattformen, Robo-Beratern, Selbstbedienungsfunktionen, biometrischen Authentifizierungsmechanismen und Blockchain mit 355 Teilnehmenden durch. Meine

Ergebnisse zeigen, dass mit Ausnahme von Peer-to-Peer-Plattformen und Robo-Beratern, die Implementierung der Finanztechnologie in einem höheren Kundenvertrauen in die digitalen Finanzprozesse resultiert. Dabei sind die biometrischen Authentifizierungsmechanismen tendenziell die stärkste Technologie im Gewinnen des Kundenvertrauens.

Im dritten empirischen Artikel dieser Arbeit verwende ich die Kundenperspektive, um herauszufinden, wie die Implementierung der Finanztechnologie in den digitalen Finanzprozessen durch die Unternehmen der Finanzindustrie die Kundenabsicht, diese Prozesse zu nutzen, über die Beziehungs-, Synchronizitäts- sowie Identifikations- und Kontrollbereitschaft der Prozessvirtualisierungstheorie beeinflusst. Um meine Hypothesen zu testen, verwendete ich Daten aus einem Online-Conjoint-Experiment mit 302 Teilnehmenden. Das Experiment basierte auf fünf Beispielen der Finanztechnologie in Form von Peer-to-Peer-Plattformen, Robo-Beratern, Selbstbedienungsfunktionen, biometrischen Authentifizierungsmechanismen und Blockchain. Meine Ergebnisse weisen darauf hin, dass die Beziehungs-, Synchronizitäts- sowie Identifikations- und Kontrollbereitschaft gemeinsam den Effekt der Finanztechnologieimplementierung auf die Absicht der Kunden übertragen, die Finanzprozesse zu nutzen. Meine Ergebnisse deuten ferner darauf hin, dass die Implementierung der Finanztechnologie in den digitalen Finanzprozessen grundsätzlich die Absicht der Kunden erhöht, diese Prozesse zu nutzen. Mit dieser Arbeit unterstütze ich Unternehmen auf ihrem Weg zur digitalen Transformation.

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1 Introduction[1]

1.1 Motivation and research questions

The topic of digital transformation is currently the center of attention of researchers and a key strategic priority for practitioners (Chanias et al. 2019; Hess et al. 2016; Vial 2019). Considered at a high level, digital transformation stands for radical economic and technological changes, which are happening in society and in different industries due to the use of digital technologies (Agarwal et al. 2010; Chanias et al. 2019; Majchrzak et al. 2016; Vial 2019). Considered at the organizational level, digital transformation describes a holistic form of business transformation (Chanias et al. 2019). This transformation requires significant changes at different levels of a company, from service processes and products via operations, leadership and structure to the entire enterprise level, concerning firm strategy and the business model (Chanias et al. 2019; Hess et al. 2016; Vial 2019). The changes at these levels are induced by the application of various information, computing, communication, and connectivity technologies, such as mobile, social media, analytics, internet of things, cloud, and platforms (Bharadwaj et al. 2013; Chanias et al. 2019; Fitzgerald et al. 2013; Sebastian et al. 2017; Vial 2019). The application of these technologies aims at enabling major business improvements in the terms of enhanced customer experience, improved operational efficiency and firm performance, as well as new value propositions (Chanias et al. 2019; Fitzgerald et al. 2013; Hess et al. 2016; Vial 2019).

As this description illustrates, digital transformation can be characterized based on four different properties: its *target entity*, *scope*, *means*, and *expected outcome* (Vial 2019). First, target entity stands for the unit of analysis that digital transformation affects. Second, scope describes the extent of changes, which are happening within the considered unit. Third, means

[1] The introduction is partly based on the three empirical essays, included in Chapters 2-4 of this thesis.

refers to the technologies that are triggering these changes. Fourth, expected outcome represents the anticipated results of the considered changes (Vial 2019). As these outcomes are always directed at improving an entity, their realization presents a central goal of digital transformation (Chanias et al. 2019; Fitzgerald et al. 2013; Hess et al. 2016; Matt et al. 2015; Vial 2019).

Taken the broad range of possible target entities, scopes, means, and expected outcomes of digital transformation (Vial 2019), I aim at improving the current knowledge on digital transformation of organizations by considering it from two different perspectives in this thesis. Within the frame of the first perspective, I address firms from different industries as my *target entities* by analyzing changes within the *scope* of firm strategy that happen by *means* of different digital technologies and target improved firm performance as an *expected outcome*. Due to considering improved firm performance as an expected outcome of digital transformation, I refer to this perspective as "firm perspective" further. My thesis includes one empirical essay that is based on this perspective. Within the frame of the second perspective, I study firms from one particular, namely financial services, industry as my *target entities* by exploring changes within the *scope* of service processes that happen by *means* of a specific digital technology, namely financial technology, and target improved relationship with customers as an *expected outcome*. Due to considering improved relationship with customers as an expected outcome of digital transformation, I refer to this perspective as "customer perspective" in the following. My thesis includes two empirical essays that are based on this perspective and investigate two central outcomes concerning firm relationship with customers. The particular research questions, considered within each perspective, are described below.

1.1.1 Firm perspective

Firms from many different industries strive to realize performance benefits, associated with digital businesses (Chanias et al. 2019; Gurbaxani and Dunkle 2019; Hess et al. 2016; Sebastian et al. 2017). One of such benefits is a superior firm performance in terms of a huge market value (Parker et al. 2017). For example, Apple, Microsoft, Amazon, and Alphabet belong to the world's top six digital firms (Forbes 2019a) and are the top four companies with the highest market value (Forbes 2019b). Accordingly, many pre-digital organizations from traditional industries aim at enhancing their market value by making digital transformation their strategic priority and starting to transform by means of different digital technologies (Chanias et al. 2019; Hess et al. 2016; Sebastian et al. 2017).

However, it remains an open question, whether firms can succeed in this endeavor. Indeed, prior research on the outcomes of digital transformation, such as its success and risks, is scarce (Chanias et al. 2019; Sebastian et al. 2017). This research has been of qualitative nature for the most part, largely utilizing case studies (e.g., Chanias et al. 2019; Hess et al. 2016). These studies have focused on describing digital transformation strategies for particular established firms (Hansen and Sia 2015), investigating signals of firm's improved application of digital technologies (Sebastian et al. 2017), studying the role of top executives in firm's digital transformation (Singh et al. 2019) and developing a framework of success factors for digital transformation (Gurbaxani and Dunkle 2019). Accordingly, prior research has failed to analyze the relationship between firm's signals of digital transformation and stock market reactions to them (Chanias et al. 2019), which are likely to arise (Dehning et al. 2003; Kohli et al. 2012) and which firms should hence be prepared for (Hess et al. 2016; Sebastian et al. 2017).

I address this research gap by studying in the first empirical essay of my thesis firm's signals of digital transformation in terms of strategic emphasis on it, which is defined as the extent, to which a firm focuses on digital transformation topics in its corporate strategy (Berghaus and Back 2017; Rubera and Tellis 2014), and its relationship to market capitalization. To study this relationship, I argue based on signaling theory (Bergh et al. 2014; Connelly et al. 2011; Spence 1973), that stakeholders such as investors, who seek to assess firm digital transformation strategy and its performance outcomes, might rely on firm strategic emphasis on digital transformation to adjust their interest in firm's shares. My first research question is:

Research Question 1. How does firm strategic emphasis on digital transformation influence its market capitalization?

In assessing firm's signals of digital transformation such as strategic emphasis on digital transformation, investors are interested in finding out, whether the firm is going to benefit from digital transformation, or in other words, undergo it successfully (Hess et al. 2016). Indeed, many digital transformation initiatives fail, and one of the most common reasons for their failure is the absence of the required resources, such as human, information, and financial resources (Eden et al. 2019; Fitzgerald et al. 2013; Hess et al. 2016; Horlacher and Hess 2016; Matt et al. 2015; Sebastian et al. 2017). Taken that firm size is considered as a typical and highly visible indicator of a large resources basis (Audia and Greve 2006; Bruderl and Schussler 1990; Kirca et al. 2011; Mitchell 1994), it is important to study, whether the relationship between strategic emphasis on digital transformation and market capitalization varies dependent on firm size. Hence, my second research question, which I also address in the first empirical essay, is:

Research Question 2. Does firm size moderate the relationship between firm strategic emphasis on digital transformation and its market capitalization?

1.1.2 Customer perspective

While digital transformation is taking place in many different industries, it might affect some industries in a more dramatic way than other industries (Chanias et al. 2019; Sebastian et al. 2017; Sia et al. 2016). One industry, which is disrupted and even exposed to an existential threat by digital transformation, is the financial services industry (Chanias et al. 2019; Goldstein et al. 2019; Sia et al. 2016; Thakor 2019). Within the frame of digital transformation, this industry faces multiple challenges (Alt et al. 2018; Gomber et al. 2018a; Puschmann 2017). To such challenges belongs fundamental transformation of financial service processes through technology integration, changing demands of customers who are acquainted with digital technologies, and market entrance of new born-digital players that come from outside the traditional sectors and alienate financial services firms their customers (Goldstein et al. 2019;

Gomber et al. 2018a; Sia et al. 2016). These challenges put value generation at financial services firms at risk of being destroyed (Goldstein et al. 2019; Gomber et al. 2018a; Sia et al. 2016).

The main driver of the existence-threatening changes that are induced by digital transformation in the financial services industry is financial technology, also called fintech (Alt et al. 2018; Goldstein et al. 2019; Gomber et al. 2018a; Gomber et al. 2018b; Puschmann 2017; Sia et al. 2016). Financial technology can be defined as any digital technology that is applied to a financial service in order to improve it by making it more efficient, convenient, and accessible for customers (Alt et al. 2018; Chen et al. 2019; Hendershott et al. 2017; Thakor 2019). To transform digitally, financial services firms are starting to implement financial technology in their digital financial processes (Alt et al. 2018; Gomber et al. 2018a; Puschmann 2017; Sia et al. 2016). Hereby, firms apply financial technology to offer their customers an enhanced service experience by either improving existing or providing new digital financial processes to them (Alt et al. 2018; Chanias et al. 2019; Gomber et al. 2018a; Sia et al. 2016).

In doing this, firms aim at retaining old and attracting new customers, as this is indispensable for them in order to survive on the financial services market (Alt et al. 2018; Goldstein et al. 2019; Gomber et al. 2018a; Puschmann 2017). However, whether firms can reach this goal, depends on customer trust as a central predictor of customer decision to use technology-based services (Lankton et al. 2014; Li et al. 2008) and customer intention to use the offered services (Chen et al. 2014; Gefen et al. 2003a; Gefen et al. 2003b; Gomber et al. 2018a; Lu et al. 2011; Ogbanufe and Kim 2018; Wang 2008). Therefore, it is important to study customer trust and intention to use the offered digital financial processes in response to the implementation of financial technology.

But what do we know about customer reactions to financial technology? Despite the growing interest of the academic community in financial technology, research on customer reactions to financial technology is scarce and fragmented (Goldstein et al. 2019; Gomber et al. 2018b; Hendershott et al. 2017). First, considering customer trust, prior research has studied trust-building mechanisms in peer-to-peer lending platforms (Duarte et al. 2012), when to trust robo-advisors with decisions (Dhar 2016), the acceptance of self-service technologies (Blut et al. 2016), trust in biometric authentication mechanisms by e-payments (Ogbanufe and Kim 2018), and a trust framework for blockchain (Ostern 2018). Yet, this research cannot answer the question, whether the implementation of financial technology influences customer trust in digital financial processes, because existing studies have either failed to investigate this question (Blut et al. 2016; Dhar 2016; Duarte et al. 2012; Ostern 2018), or generated a mixed evidence in this respect (Ogbanufe and Kim 2018). However, anticipating customer reactions to the implementation of financial technology such as customer trust is essential for firms (Dhar and Stein 2017; Dodgson et al. 2015; Goldstein et al. 2019; Gomber et al. 2018a) in order to be able to design their service offering accordingly (Vial 2019). Therefore, I study customer trust in digital financial processes in response to the implementation of financial technology in the second empirical study of this thesis. In doing so, I investigate the following research question:

Research Question 3. Does the implementation of financial technology in a digital financial process lead to a higher customer trust in this financial process?

To answer this question, I consider several examples of financial technology[2], because financial technology can be implemented in digital financial processes in many forms (e.g., Chen et al. 2019; Gomber et al. 2018a). As different forms of financial technology might differ from each other in their ability to generate trust by customers (Goldstein et al. 2019; Greiner and Wang 2010; Jung et al. 2018b; Ogbanufe and Kim 2018), I additionally investigate the following research question in the second empirical essay of my thesis:

Research Question 4. Which of the considered examples of financial technology is the strongest in gaining customer trust in a digital financial process?

[2] These examples are introduced and described in the chapter 1.3.3.

Second, considering customer intention to use digital financial processes with implemented financial technology, prior research has studied the willingness to lend in online peer-to-peer contexts (Chen et al. 2014), the use of robo-advisors to overcome inertia in investment decisions (Jung and Weinhardt 2018), and the willingness to continue using a website with biometric authentication methods (Ogbanufe and Kim 2018). In doing so, prior research has relied either on trust (Chen et al. 2014), technology usefulness, or ease of use (Blut et al. 2016) as possible mechanisms. However, this research has failed to account for the process nature of financial service processes (Alt and Puschmann 2012; Overby 2008), which consist of steps by a financial service provider and customer that are targeted at enabling digital financial transactions for the latter (Lusch et al. 2010; Vargo and Lusch 2004). Due to this process nature, customer intention to use the offered processes depends on special requirements, such as relationship building, synchronicity, and control during the process, as outlined by process virtualization theory (Balci 2015; Graupner and Maedche 2015; Overby 2008; Overby 2012). Hence, I analyze, how financial technology influences customer intention to use digital financial processes relying on the requirements of process virtualization theory as mechanisms (Overby et al. 2010) in the third empirical essay of this thesis. I formulate the according research question as follows:

Research Question 5. How does the implementation of financial technology in a digital financial process influence customer intention to use this process via the requirements of process virtualization theory?

In studying customer intention to use the offered processes as an outcome of the financial technology implementation, existing research has generated mixed results (e.g., Jung and Weinhardt 2018; Ogbanufe and Kim 2018; Yan et al. 2013). As anticipating such outcomes is important for firms (Chen et al. 2019; Gomber et al. 2018a; Vial 2019), I also address the relationship between financial technology implementation and customer intention to use digital financial processes in the third empirical essay of the thesis, investigating the following research question:

Research Question 6. Does the implementation of financial technology in a digital financial process lead to a higher customer intention to use this financial process?

1.2 Contributions

Due to studying these research questions in my thesis, I contribute to the existing literature in several ways. With the first empirical essay, I extend research on digital transformation (e.g., Sebastian et al. 2017) by responding to a call of existing studies to investigate the outcomes of digital transformation (Chanias et al. 2019), and provide to my best knowledge the first quantitative evidence on strategic emphasis on digital transformation in firms over a period of 17 years. Further, I widen the digital transformation framework (Vial 2019) by adding changes in market capitalization as a new outcome and proposing firm size as a contextual factor of digital transformation.

With the second and third empirical essays, I extend research on financial technology (e.g., Goldstein et al. 2019) by responding to the calls of prior studies to investigate customer trust in financial technology (Goldstein et al. 2019), customer adoption of financial processes based on this technology (Puschmann 2017), and market success of firms, operating with it (Gomber et al. 2018a). With the second empirical essay, I additionally put to the proof, whether trust can be an outcome of financial technology implementation (Ogbanufe and Kim 2018), and am to my best knowledge the first to compare different forms of financial technology (Gomber et al. 2018a) with respect to trust.

With the third empirical essay of my thesis, I integrate research on financial technology (e.g., Chen et al. 2019) with research on process virtualization (e.g., Overby et al. 2010) by exploring whether the effect of financial technology implementation on customer intention to use digital financial processes can be explained through the requirements of process virtualization theory (Overby 2008). Moreover, I extend research on process virtualization theory (e.g., Thomas et al. 2016) by examining whether process virtualization theory can explain the amenability of processes not only to a transition from a physical to a digital form (Overby 2008), but also to a further enhancement by means of a new digital technology.

Overall, with this thesis, I widen research on digital transformation (Vial 2019) by illuminating digital transformation from different perspectives through considering its different target entities, scopes, means, and expected outcomes. Concerning target entities of digital transformation, I include both firms from different industries and financial services firms. With regard to scopes of digital transformation, I study changes on the level of firm strategy such as setting a strategic emphasis on digital transformation and changes on the level of service processes such as implementing financial technology in digital financial processes. With respect to means of digital transformation, I consider phenomena induced by various digital technologies and those triggered by digital technology of a specific type in terms of financial technology. Referring to expected outcomes of digital transformation, I combine the firm perspective by investigating firm performance in terms of market capitalization and the customer perspective by studying the relationship with customers in terms of trust and intention to use the services of digitally transforming firms. In adopting these different perspectives on digital transformation, I aim at extending the current knowledge of this phenomenon.

My thesis has not only theoretical, but also practical implications. First, with the first empirical essay of my thesis, I aim at supporting firms in different industries on their digital transformation path by drawing their attention to the fact, that their signals of digital transformation such as strategic emphasis on digital transformation can influence their market capitalization. Additionally, I show how stock market can react to firm’s disclosure of strategic emphasis on digital transformation, depending on firm size.

Second, with the second and the third empirical essays of this thesis, I particularly target financial services firms, which are starting to transform digitally by implementing financial technology in their digital financial processes (Beinke et al. 2018; Eickhoff et al. 2017;

Puschmann 2017; Sia et al. 2016). To support financial services firms in this endeavor, I provide them with a current snapshot of customer attitude towards financial technology. To understand this attitude better, I shed light on the mechanisms of customer preferences formation towards digital financial processes with implemented financial technology (Chen et al. 2014). By these means, I outline a possibility for firms from the financial services industry to offer more customer-centric processes in order to succeed in their digital transformation endeavors (Alt et al. 2018; Gomber et al. 2018a; Lu et al. 2011; Puschmann 2017; Wang 2008). These results are also interesting for the other financial market players, such as financial technology start-ups and platform and application developers (Lee and Shin 2018).

Overall, my thesis is important for firms from different industries, which are embarking on a digital transformation journey (Chanias et al. 2019; Hess et al. 2016). First, I highlight that on their digital transformation path firms may face strategic decisions, which are common for firms from different industries, as well as technology implementation challenges, which are specific for a particular industry. Second, I show to practitioners that digital transformation is a phenomenon, which affects a firm at all its different levels, from service processes to the overall corporate strategy. Third, I emphasize that despite the variety of different technologies in the digital technology landscape, there are some technologies, which are central for firms in particular industries. Fourth, I empirically investigate and demonstrate the possible outcomes of digital transformation with respect to firm performance and relationship with customers.

1.3 Theoretical background

In order to answer the research questions, formulated in the first empirical essay of my thesis, I rely on research on digital transformation (e.g., Vial 2019) and signaling theory (e.g., Connelly et al. 2011). In order to study the research questions, addressed in the second empirical essay of my thesis, I build upon research on financial technology (e.g., Gomber et al. 2018a) and research on trust (e.g., Avgerou 2013). Finally, in order to investigate the research questions, outlined in the third empirical essay of my thesis, I use research on financial technology (e.g., Gomber et al. 2018a) and process virtualization theory (e.g., Overby 2012) as theoretical background. The key concepts and theories are described below.

1.3.1 Digital transformation

Digital transformation has emerged as one of the central topics in the strategic information systems research recently (Chanias et al. 2019; Vial 2019). Being defined as "*a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies*" (Vial 2019, pp. 118, 121), digital transformation is based on the use of digital technologies. They include a variety of technologies, whereas the most popular ones are social media, mobile technologies, analytics, cloud and the internet of things, summarized in the SMACIT acronym (Sebastian et al. 2017; Vial 2019). According to the digital transformation framework by Vial (2019), which is based on the analysis of 282 studies of this phenomenon, digital technologies and their combinations create and fuel disruptions in the society and in industries. These disruptions include changes in consumer behavior from a more passive to a more active role, increasing customer expectations regarding the provided services, disruption of the competitive landscape in different industries, as well as increasing data generation and availability (Vial 2019). Organizations respond to these disruptions by designing and implementing a digital transformation strategy (Vial 2019), which "*is supposed to coordinate, prioritize, and implement*" (Chanias et al. 2019, p. 17) a firm's transformation efforts and govern its journey towards the desired stage of digital transformation (Chanias et al. 2019; Matt et al. 2015).

In implementing the digital transformation strategy, firms rely on the different digital technologies, which they use to change the existing or uncover new value creation paths. In doing so, firms create new value propositions, redefine their value networks, implement digital distribution and sales channels, as well as enhance organizational agility and ambidexterity. In order to enable these changes in the value creation process, firms need to adjust their structure, culture, leadership, and employee roles and skills to the digital environment. During this process, firms might face barriers in terms of organizational inertia and resistance, which can hinder their digital transformation efforts. Thus, firms need to overcome these barriers in order to realize the benefits of digital transformation (Vial 2019).

The positive impacts of digital transformation at the organizational level include enhanced operational efficiency, such as automation, process improvement, and cost savings, better relationships with customers and suppliers, and improved organizational performance, such as better financial performance and reputation, higher innovativeness, firm growth, and competitive advantage (Chanias et al. 2019; Fitzgerald et al. 2013; Hess et al. 2016; Vial 2019). These benefits contribute to a better long-term performance of firms and help them to survive on the market (Hess et al. 2016; Vial 2019). Besides the organizational level, digital transformation can also have positive impacts on industries and the society such as improvement of the life quality of individuals. However, despite these positive impacts, digital transformation might also be bound to some undesirable outcomes, such as data security and privacy issues (Vial 2019).

1.3.2 Signaling theory

Signaling theory (Spence 1973) addresses a situation between two parties, which is characterized by information asymmetry (Connelly et al. 2011). One party is an insider, who has access to private information, which is not available to outsiders, such as about an individual, a product, or an organization. The other party is an outsider, who could possibly make better decisions if having the private information available to the insider. In order to reduce this information asymmetry, the insider or signaler decides, whether and how to communicate the private information to the outsider or receiver. For this purpose, the signaler communicates the unknown information intentionally by sending out signals to the receiver. These signals refer to positive characteristics of an individual, a product, or an organization. The signals have to be observable, i.e., noticeable to the receiver. The receiver of the signals then decides how to interpret and evaluate them. Based on the signals, the receiver undertakes some actions, which are strategically important to the signaler, such as purchasing, hiring, or investing. It is important to add that the signaler does not intentionally send negative signals to the receiver; thus, negative receiver reactions to the signals present unintended consequences of signaler's actions (Connelly et al. 2011; Spence 1973).

As firm's strategic decisions are typically characterized by information asymmetry, signaling theory has been widely applied in strategic management (Bergh et al. 2014) and information systems (Nishant et al. 2017) research. For instance, prior information systems research has applied signaling theory to study stock market reactions to corporate announcements of open innovation alliances (Han et al. 2012), business analytics (Teo et al. 2016), green information technology (IT) adoption (Nishant et al. 2017), and cloud service certifications (Lansing et al. 2019). These studies have argued that in order to reduce the existing information asymmetry regarding firms' future prospects, firms signal their strategic decisions and their likely performance outcomes to stakeholders such as investors (Bergh et al. 2014; Connelly et al. 2011; Spence 1973). These signals can have a form of corporate announcements such as annual reports that are considered an especially reliable form of corporate communication (Zmud et al. 2010). Investors seek out such observable signals (Bergh et al. 2014) and decide, depending on how they interpret these signals, to reward or to penalize a firm on their basis, leading to changes in a firm's valuation on a stock market (Nishant et al. 2017; Zmud et al. 2010).

1.3.3 Financial technology

As its name already reveals, financial technology or fintech is a combination of finance and technology (e.g., Goldstein et al. 2019). Financial technology serves as an umbrella term for innovative digital solutions for financial services (Puschmann 2017) that influence the way, in which financial service processes are conducted (Hendershott et al. 2017). Financial technology covers a very broad phenomenon, which is subject to continuous progress and changes (Zavolokina et al. 2016). Unsurprisingly, there is a considerable heterogeneity in the existing definitions of financial technology (Chen et al. 2019; Hendershott et al. 2017; Thakor 2019; Zavolokina et al. 2016). For instance, the term “financial technology” or “fintech” has been used to describe the application of IT in financial services, innovative start-ups, as well as financial services offered by firms (Puschmann 2017; Zavolokina et al. 2016). In this thesis, I use the first, most common (Zavolokina et al. 2016), option (e.g., Alt et al. 2018). Whereas some scholars have applied the term “financial technology” to both analog and digital technologies (e.g., Alt et al. 2018), most recent studies have used it only with regard to digital technologies (e.g., Chen et al. 2019). Following the latter, I refer only to digital technologies in this thesis.

Despite the heterogeneity in the definitions of financial technology, the existing studies agree that the goal of financial technology is to enhance customer experience (Goldstein et al. 2019) by providing new or improved financial services (Thakor 2019). Indeed, financial technology aims at extending customer access to financial services in time and place (Gomber et al. 2018a; Hendershott et al. 2017). These more accessible services are provided often without participation of the traditional financial intermediaries (Gomber et al. 2018a; Thakor 2019). Further, financial technology enables financial service providers to offer customers highly personalizable financial processes (Gomber et al. 2018a). These improved financial processes are more affordable, as they are offered typically at lower costs in order to increase customer welfare (Hendershott et al. 2017; Thakor 2019). Thus, financial processes, based on financial technology, are usually more convenient and efficient for customers (Gomber et al. 2017), and address their needs in a superior and more future-oriented way than established financial processes (Gomber et al. 2018a).

Financial technology covers a broad spectrum of digital technologies (e.g., Chen et al. 2019; Thakor 2019), which do not necessarily have to originate from the financial services sector or to be exclusively applied in it in order to qualify as financial technology (Chen et al.

2019). These technologies can be classified according to different approaches (e.g., Alt and Puschmann 2012; Chen et al. 2019; Haddad and Hornuf 2019; Puschmann 2017; Thakor 2019). One possibility presents the framework by Puschmann (2017), which classifies different types of financial technology based on their relation to the innovation object (Chen et al. 2019; Puschmann 2017; Zavolokina et al. 2016). According to this framework, solutions for financial processes, which are enabled by financial technology, are closely linked to financial innovations in one of the following categories: business models, services and products, organization, processes, and systems (Puschmann 2017). Examples of financial technology for each of these categories, which are currently discussed in research and practice (Alt et al. 2018; Chen et al. 2019; Goldstein et al. 2019; Gomber et al. 2018a; Gomber et al. 2018b), are provided below.

First, peer-to-peer platforms present an example of financial technology, which is related to business models (Puschmann 2017), because peer-to-peer platforms allow for financial transactions between private individuals (Gomber et al. 2017) through designated online platforms (Barzilay et al. 2018; Ge et al. 2017) without an intermediation of a service provider (Chen et al. 2019; Tang 2019; Xu and Chau 2018). Second, robo-advisors can serve as example for the category of services and products (Puschmann 2017), as robo-advisors facilitate the development of new services by guiding customers through an automated self-assessment process, analyzing and quantifying their answers, and providing personalized financial advice to them (Chen et al. 2019; D'Acunto et al. 2019; Jung et al. 2018a; Jung and Weinhardt 2018). Third, self-service tools can be attributed to the innovation category of organization (Puschmann 2017), because they allow for the outsourcing of service delivery to end-customers (Varadarajan 2009) by enabling them to produce a service independently of service employees (Meuter et al. 2005; Scherer et al. 2015; Stoeckli et al. 2018; Wünderlich et al. 2013). Fourth, biometric authentication mechanisms can be named as an example for processes (Puschmann 2017), due to transforming the processes of customer identification through automatically scanning user's unique physiological or behavioral characteristics via fingerprint readers or audio and video recognition systems and comparing them with a previously stored data version (Boukhonine et al. 2005; Ogbanufe and Kim 2018). Fifth, blockchain can be classified as belonging to the innovation category of systems (Puschmann 2017) due to providing a new infrastructure for financial transactions based on distributed ledgers (Goldstein et al. 2019), where information can be trusted without a third party validating it (Du et al. 2019; Nofer et al. 2017).

1.3.4 Trust

Existing research has long recognized the importance of trust in different organizational settings (e.g., Drescher et al. 2014; Lankton et al. 2014; Li et al. 2008; Mayer et al. 1995; McKnight et al. 2002; McKnight et al. 1998). Trust has been defined in various ways, such that existing studies speak of its definition variety (Gefen et al. 2003b) or even definition profusion (Avgerou 2013). In this thesis, I rely on the definition of trust, formulated by Mayer et al. (1995), which outlines the common characteristics of trust in different research fields and trusting situations (Li et al. 2008). According to it, trust can be defined as "*the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party*" (Mayer et al. 1995, p. 712). Hence, trust describes the relationship between two parties: the trustor, or the party that trusts, as well as the trustee, or the object of trust (Avgerou 2013; Mayer et al. 1995). Trust is important in all situations, where uncertainty exist or undesirable outcomes for the trustor can occur (McKnight et al. 2011). By allowing the trustor to subjectively rule out the possible undesirable consequences, which could occur, if the trustee would behave in an opportunistic way, trust helps to reduce the social complexity, which the trustor faces in interactions (Gefen et al. 2003b). For this reason, trust encourages interactions and is essential in many business relationships such as interactions of customers with online service providers (Gefen et al. 2003b).

A prominent example of such an interaction between a customer and an online service provider, in which customer trust is essential, are digital financial transactions (Dhar and Stein 2017; Pavlou 2003). Customer trust is especially important in this context, because customers feel more vulnerable in digital financial transactions than in traditional settings when entrusting financial service providers with their money (McKnight et al. 2011). Thus, to increase customer intention to use the offered digital financial processes, financial services providers need to gain customer trust in the latter (Gefen et al. 2003b; Lankton et al. 2014; Li et al. 2008; Ogbanufe and Kim 2018).

To define customer trust in digital financial processes, I rely on the existing literature on trust in the information systems field (e.g., Avgerou 2013). Similarly to electronic actions, online vendors (Gefen et al. 2003b), and digital governmental services (Lim et al. 2012), the trustee in digital financial processes can be described as a person-technology combination (Avgerou 2013). Thus, trust in these processes arises on the basis of two components: the financial services providers and the technology artefacts, implemented by them in digital financial processes (Avgerou 2013). Accordingly, I define customer trust in digital financial processes as the subjective belief of customers, that financial service providers will fulfill their obligations in order to enable digital financial transactions for customers (Gefen et al. 2003b; Ogbanufe and Kim 2018). The production of customer trust in a digital financial process can be expected to take place on the basis of technologies, which financial service providers implement in their processes (Avgerou 2013), as these technologies are assumed to mirror the intentions of their providers (Collier and Sherrell 2010; Gefen et al. 2003b; Lankton et al. 2014; Wang and Benbasat 2005). Thus, by means of implemented technologies, financial services providers can signal the customers their commitment to the relationship with them (Collier and Sherrell 2010; Gefen et al. 2003b; Lankton et al. 2014; Wang and Benbasat 2005).

1.3.5 Process virtualization theory

Process virtualization theory (Overby 2008) analyzes the migration of processes from a physical to a virtual environment (Overby et al. 2010). It is based on the assumption that some processes are more amenable to virtualization than others (Overby 2008). According to process virtualization theory, the amenability of a process to function without a physical interaction depends on the degree, to which four process requirements are fulfilled in a virtualized process (Thomas et al. 2016). These four requirements are sensory, relationship, synchronism as well as identification and control requirements (Overby 2008). First, sensory requirements refer to the need of process participants to have a full sensory experience of the process, other process participants and objects. Second, relationship requirements define the need of process participants to interact with each other in a social or professional context and develop relationships. Third, synchronism requirements address the need of process activities to happen one after another with a minimal delay. Fourth, identification and control requirements define the need to identify process participants and have control over the process (Overby 2008). Process virtualization theory suggests that all of these requirements have a negative impact on process virtualizability (Overby 2012), which is reflected in either adoption or outcomes of a virtualized process such as customer intention to use a virtualized process (Graupner and Maedche 2015).

If sensory, relationship, synchronism, as well as identification and control requirements are fulfilled, one can speak of sensory, relationship, synchronism, as well as identification and control readiness of a process (Bose and Luo 2011). Accordingly, each of process readiness types is defined as the degree, to which the corresponding requirement is fulfilled in a virtualized process (Bose and Luo 2011; Thomas et al. 2016). Process readiness is expected to positively influence process virtualizability (Bose and Luo 2011; Thomas et al. 2016).

Process virtualizability might be additionally influenced by another set of factors, if process migration from physical into a virtual environment takes place via an IT-based, or digital, mechanism. These factors are presented by the characteristics, which a digital virtualization mechanism possesses in contrast to other virtualization mechanisms (Overby 2012). To such characteristics belongs representation, i.e. the capacity of IT to present information relevant to the process, reach, i.e. the capacity of IT to allow process participation across space and time, and monitoring capability, i.e. the capacity of IT to identify process participants and check process activities (Bose and Luo 2011; Overby 2008). Representation, reach, and monitoring capability are proposed to facilitate process virtualization (Overby 2008), and thus, moderate the relationship between process requirements and process virtualizability (Overby 2012). However, if only digital virtualization mechanisms are considered, these factors can be assumed to always positively influence virtualization (Bose and Luo 2011). Hence, they do not need to be explicitly accounted for by studying digital processes (Bose and Luo 2011; Thomas et al. 2016).

1.4 Methodology

To investigate my research questions, I utilized quantitative empirical research methods. Particularly, to answer my first and second research questions, I conducted a panel data analysis. To examine my third to sixth research questions, I conducted two online conjoint experiments. These methods are described in the following.

1.4.1 Panel data analysis

Panel, or longitudinal, data, presents a time series for each of the cross-sectional units in a data set, meaning that the same units such as firms are followed over a given period of time (Wooldridge 2012). Because panel data includes multiple observations of the same units, it allows to control for certain unobserved characteristics of these units (Wooldridge 2012). Due to accounting for the unit heterogeneity, panel data analysis facilitates inferring causality (Wooldridge 2012) and thus, helps to rule out alternative explanations and make the tests of theories more robust (Certo and Semadeni 2006). Therefore, panel data analysis has been widely utilized to study the impact of the unique characteristics of firms on strategic outcomes such as firm performance (Certo and Semadeni 2006) in different research fields, for instance, in strategic management (Certo et al. 2017) and information systems (Tambe and Hitt 2012) research. In these research fields, panel data has been used to study numerous theories (Certo and Semadeni 2006) such as signaling theory (Steigenberger and Wilhelm 2018) and different topics such as firm value (Chung et al. 2019).

To study the impact of firm strategic emphasis on digital transformation on market capitalization and the moderating role of firm size on this relationship, I collected panel data on 110 German firms from the public stock index HDAX between 2000 and 2017. To construct my sample, I included those firms, which were a member of HDAX as of the last day of every year, for which the index composition reports were available. I lagged all the independent variables by one period (Hoehn-Weiss and Karim 2014; Stern and James 2016; Xia et al. 2016), as prior research has shown, that capital markets usually need some time to incorporate the available firm information (Joshi and Hanssens 2010; Tanriverdi 2006). To gather the data, I used three main sources: the homepage of STOXX Ltd., a part of Deutsche Börse Group, to obtain the list of HDAX companies for every year, the database Worldscope (Thomson One Banker) to get firm data (e.g., Flickinger et al. 2016), and firm annual reports to collect data on firm strategic emphasis on digital transformation.

To test my hypotheses, I performed a panel data analysis in Stata 14.1. In doing so, I applied the most popular technique in strategy research for this type of analysis, a fixed effects model, which uses a within-firm variation in variables and allows for arbitrary correlation between the unobserved effect and the independent variables (Certo et al. 2017; Wooldridge 2012). A fixed effects model allows for controlling for any unobserved firm-specific heterogeneity, which could potentially influence performance outcomes, thus making this model more convincing for estimating ceteris paribus effects, especially when the used sample cannot be treated as a random sample from a large population of firms (Belderbos et al. 2014; Wooldridge 2012). To control for any kind of heteroscedasticity and serial correlation, I used robust standard errors (Wooldridge 2012). Due to using a fixed effects estimator in combination with robust standard errors, I was not able to calculate a Hausman test for the comparison between a fixed and a random effects model (Wooldridge 2012). To investigate the interaction effect between strategic emphasis on digital transformation and firm size on market capitalization, I additionally used a simple slopes analysis in Stata.

1.4.2 Conjoint experiments

Conjoint analysis is a market research technique, which comes from the research field of marketing (Benlian and Hess 2011). Within the frame of this technique, a series of profiles, which contain descriptions of alternative services and products, is developed (Shepherd et al. 2013). These descriptions present combinations of different attributes of services or products that are specified at certain levels (Green et al. 2001). The combinations of attributes are created on the basis of a fractional factorial experimental design (Green et al. 2001). Participants are then required to read the profiles with different attribute combinations and to evaluate each of the profiles (Shepherd et al. 2013). By making an assessment of each profile, participants disclose their preferences, requirements, and intentions with regards to the manipulated attributes such as intention to use a service or buy a product (Green et al. 2001). Therefore, conjoint analysis has been widely applied to measure customer preferences in different research fields (Green et al. 2001) such as strategic management (Shepherd et al. 2013) and information systems research (Benlian and Hess 2011; Berger et al. 2015). Conjoint analysis is particularly important for the latter as understanding customer requirements and the antecedents of customer adoption is central in designing information systems (Naous and Legner 2017). Accordingly, information systems scholars have applied conjoint design in studies of end-user adoption of new technologies (Naous and Legner 2017).

To study customer reactions to the implementation of financial technology in digital financial processes, I used multiple examples of financial technology, because it covers a broad spectrum of digital technologies (e.g., Chen et al. 2019; Thakor 2019) and can be implemented in digital financial processes in many forms (Eickhoff et al. 2017). As these financial technologies are often simultaneously implemented in digital financial processes (Alt et al. 2018; Puschmann 2017), conjoint design presented a suitable method for my studies. As examples of financial technology, I applied peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. In both experiments, I manipulated the examples of financial technology on two levels (Shepherd et al. 2013), as either implemented or not implemented in a digital financial process. To avoid overloading the participants, I limited the number of profiles to be considered by each participant to eight according to an orthogonal design (Hahn and Shapiro 1966; Shepherd et al. 2013).

Both experiments followed the same procedure. I showed participants a brief description of the five examples of financial technology (Atzmüller and Steiner 2010), a sample profile (Shepherd et al. 2013; Siegfried et al. 2015), and eight conjoint profiles in a randomized order (Benlian and Hess 2011). For each of the presented conjoint profiles, I asked participants to indicate their respective reactions to the underlying digital financial process (Benlian and Hess 2011; Mitchell et al. 2011). In order to make my results generalizable to a larger number of settings, I implemented additional between-subjects manipulations in both experiments (Atzmüller and Steiner 2010) and distributed the experiential scenarios randomly among participants. I spread the link to the experiment via snowballing sampling method among students of a public technical university in Germany and their acquaintances and in online communities that support researchers in finding survey participants.

As each of my participants had to assess eight profiles, my data was clustered within individuals. Thus, it was important to use a data analysis technique, which accounts for this data structure. There are different analysis methods, which meet this requirement, such as Hierarchical Linear Modelling (Raudenbush and Bryk 2002) and linear regression analysis with clustering at a person level (Wooldridge 2012). In the first experiment, I applied Hierarchical Linear Modelling (Raudenbush and Bryk 2002) utilizing a maximum likelihood estimation for a random effects model (Shepherd et al. 2013). In the second experiment, I performed a linear regression analysis with clustering at a person level and using robust standard errors (Wooldridge 2012). Both analyzes were performed in Stata 14.1. To compare different examples of financial technology with respect to trust in the first experiment, I compared the 95% confidence intervals of the coefficients with each other (Kelley 2007). To analyze the mediation effects in the second experiment, I used a bootstrapping procedure (Hayes 2017; Preacher and Hayes 2008). I calculated the indirect effects using the PROCESS macro in SPSS 25 (Hayes 2017) and applied a robust inference in terms of Davidson-MacKinnon HC3 standard error estimator to account for heteroscedasticity of any form (Davidson and MacKinnon 1995; Hayes and Cai 2007).

1.5 Structure of the thesis

In the current chapter of my thesis, I have presented the motivation for studying the selected research questions around the digital transformation of organizations, outlined my contributions, introduced my theoretical background, and presented the methodology, which I used to answer these questions. The remainder of this thesis is organized as follows.

In the second chapter of my thesis, I adopt the firm perspective. Relying on this perspective, I study in my first empirical essay how strategic emphasis on digital transformation, which is induced by the use of different digital technologies, influences market capitalization of firms across industries and whether firm size moderates this relationship. To investigate these questions, I use research on digital transformation (e.g., Vial 2019) and signaling theory (e.g., Connelly et al. 2011) as theoretical background. To test my hypotheses, I collected panel data from 110 German firms from the index HDAX for the period 2000-2017.

In the third and fourth chapters of my thesis, I adopt the customer perspective. Based on this perspective, I study in my second empirical essay, which is contained in the third chapter of this thesis, how the implementation of financial technology in digital financial processes by the financial services firms influences customer trust in these processes, and compare different examples of financial technology with respect to their ability to generate trust. In doing so, I consider five prominent examples of financial technology: peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. To enable this analysis, I rely on research on financial technology (e.g., Gomber et al. 2017) and research on trust (e.g., Gefen et al. 2003b). For my empirical analysis, I gathered data from an online conjoint experiment with students from a public technical university in Germany, their acquaintances and further participants from online research communities.

Remaining within the frame of the customer perspective, I study in my third empirical essay, which is contained in the fourth chapter of this thesis, how the implementation of financial technology in digital financial processes by the financial services firms influences customer intention to use these processes via the relationship, synchronism and identification and control requirements of process virtualization theory. To study these relationships, I apply five examples of financial technology: peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. In investigating these examples of financial technology, I rely on research on financial technology (e.g., Puschmann 2017) as well as process virtualization theory (e.g., Overby 2012) as theoretical background. For this analysis, I collected data from an online conjoint experiment with students from a public technical university in Germany, their acquaintances and further persons from online research communities as participants.

Table 1 provides an overview of my empirical studies. The thesis concludes with the fifth chapter, in which I summarize and discuss the results from my empirical studies, present implications for theory and practice, and outline limitations.

Table 1. Overview of the empirical studies of the thesis.

Empirical essay	**First empirical essay**	**Second empirical essay**	**Third empirical essay**
Thesis chapter	Chapter 2	Chapter 3	Chapter 4
Perspective	Firm	Customer	

Characteristics of digital transformation

Target entities	Firms from different industries	Firms from the financial services industry	
Scope (change)	Firm strategy level (setting a strategic emphasis on digital transformation)	Service processes level (implementing a new digital technology in digital service processes)	
Means	Different digital technologies	Financial technology	
Outcomes (changes in)	Market capitalization	Customer trust	Customer intention to use the services

Study description

Research questions (RQ)	RQ 1-2	RQ 3-4	RQ 5-6
Studied phenomena	Influence of strategic emphasis on digital transformation on market capitalization	Influence of financial technology implementation on customer trust in digital financial processes	The mediating role of process virtualization theory requirements on the relationship between financial technology implementation and customer intention to use digital financial processes
	The moderating role of firm size on the relationship between strategic emphasis on digital transformation and market capitalization	Comparison of different examples of financial technologies with respect to their ability to generate trust in digital financial processes	The influence of financial technology implementation on customer intention to use digital financial processes
Theoretical background	Research on digital transformation, signaling theory	Research on financial technology, trust	Research on financial technology, process virtualization theory
Method	Panel data analysis	Online conjoint experiment	
Published in	Proceedings of the 53rd Hawaii International Conference on System Sciences (HICSS)	Proceedings of the 19th Annual Conference of the European Academy of Management (EURAM)	Proceedings of the 40th International Conference on Information Systems (ICIS)
Authors	Moker, A., Brosi, P., & Welpe, I. M.	Verbovetska, A.	Verbovetska, A.

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2 It depends on the size: How firm strategic emphasis on digital transformation predicts market capitalization

Abstract

Whereas digital businesses can have an enormous market value, it remains an open question, whether firms, embarking on a digital transformation journey, can realize similar benefits. Thus, we rely on the signaling theory to study, whether strategic emphasis on digital transformation – i.e., the extent, to which a firm focuses on digital transformation in its strategy – as well as firm size as an indicator of a large resource basis jointly influence market capitalization. To answer this question, we conducted a longitudinal panel data analysis of the largest German publicly listed companies from 2000 to 2017. Our results show, that strategic emphasis on digital transformation leads to a higher market capitalization for larger firms and to a lower market capitalization for smaller firms. Whereas larger firms should further disclose their strategic emphasis on digital transformation, smaller firms should consider sending additional signals to investors, demonstrating their ability to undergo digital transformation successfully.

Keywords

Digital transformation, strategic emphasis, firm size, market capitalization

Current status

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2.1 Introduction

Digital businesses can realize an enormous market value (Parker et al. 2017). For instance, five out of ten companies with the largest market value worldwide in 2019 are born digital pioneers (Chanias et al. 2019; Sebastian et al. 2017): Amazon, Alphabet, Facebook, Alibaba, and Tencent (Forbes 2019). Unsurprisingly, many pre-digital organizations, i.e., established firms from traditional industries, seek to realize similar benefits by starting to transform digitally (Chanias et al. 2019; Hess et al. 2016; Sebastian et al. 2017). Applying digital technologies such as mobile, social media, analytics, cloud, Internet of things, and platforms (Chanias et al. 2019; Fitzgerald et al. 2013; Sebastian et al. 2017; Vial 2019), they comprehensively transform their business, structure, processes and products to enable major business improvements such as enhanced customer experience, streamlined operations and new value propositions (Chanias et al. 2019; Fitzgerald et al. 2013; Vial 2019).

Yet, it remains an open question, whether firms, embarking on a digital transformation journey, can indeed realize a higher market value. Despite the growing interest of information systems researchers in the digital transformation (Vial 2019), existing research on the success and risks of digital transformation is scarce and fragmented (Chanias et al. 2019; Sebastian et al. 2017). This research is limited to case studies, describing signals of improved use of digital technologies as well as possible digital transformation strategies for established firms (Dremel et al. 2017; El Sawy et al. 2016; Hansen and Siew Kien 2015; Hess et al. 2016; Sebastian et al. 2017; Sia et al. 2016; Smith and Watson 2019). Hence, empirical evidence on the link between firms' signals of digital transformation and stock market reactions to them is missing (Chanias et al. 2019). This gap is of substantial importance, as the stock market is likely to react to such signals (Dehning et al. 2003; Kohli et al. 2012), and firms, facing many challenges on their digital transformation paths, need to anticipate them (Chanias et al. 2019; Hess et al. 2016; Sebastian et al. 2017).

To address this research gap, we consider firm strategic emphasis on digital transformation, which we define as the extent, to which a firm focuses on digital transformation topics in its corporate strategy (Berghaus and Back 2017; Rubera and Tellis 2014), and its link to firm valuation on a stock market. Our first research question is: *How does firm strategic emphasis on digital transformation influence its market capitalization?* To investigate this relationship, we rely on signaling theory (Bergh et al. 2014; Connelly et al. 2011; Spence 1973). According to signaling theory, in order to reduce existing information asymmetry, observers such as investors seek out visible signals of a company to be able to assess its unobservable attributes such as strategic decisions and their likely performance outcomes (Bergh et al. 2014; Connelly et al. 2011; Spence 1973). Thus, if a firm discloses its strategic emphasis on digital transformation, investors might use this information to adjust their interest in firm's shares, leading to changes in market capitalization.

Yet, firms' signals about their digital transformation might be ambivalent for investors because digital transformation requires a plenty of resources such as human, information, and financial resources (Eden et al. 2019; Hess et al. 2016; Horlacher and Hess 2016; Matt et al. 2015; Sebastian et al. 2017). One typical and highly visible indicator of a large resources base is large firm size (Kirca et al. 2011). Thus, depending on firm size, investors might react to signals of firm strategic emphasis on digital transformation with an increasing or decreasing interest in firm shares. Accordingly, we also study, how the relationship between firm strategic emphasis on digital transformation and market capitalization might vary depending on firm size. Our second research question is: *Does firm size moderate the relationship between firm strategic emphasis on digital transformation and its market capitalization?* To investigate these research questions, we conducted a longitudinal panel data analysis of the largest German publicly listed firms (HDAX) between 2000 and 2017.

With this study, we extend research on digital transformation of companies (Chanias et al. 2019; Hansen and Siew Kien 2015; Hess et al. 2016; Sebastian et al. 2017; Singh and Hess

2017; Vial 2019) in two ways. First, by exploring the effect of strategic emphasis on digital transformation on firm evaluation on a stock market, we respond to a call of existing studies to investigate the questions related to success, risks and failures of digital transformation for firms (Chanias et al. 2019). In doing so, we are to our best knowledge the first to provide quantitative empirical evidence on strategic emphasis on digital transformation in firms and its influence on their performance in a longitudinal study over 17 years using panel data (Vial 2019). Second, due to examining the effects of an interplay between firm strategic emphasis on digital transformation and firm size on market capitalization, we draw attention to firm characteristics, which might promote or hamper the realization of the benefits, connected with the digital transformation process. Thus, we extend the digital transformation framework as proposed by Vial (Vial 2019) by adding outcomes to the buildings blocks of positive and negative impacts of digital transformation and proposing an additional building block of contextual factors, which might influence the path between the changes in value creation paths and digital transformation impacts.

Our study is also important for practitioners, who are embarking on a digital transformation journey (Chanias et al. 2019; Hess et al. 2016). First, we draw their attention to the fact, that strategic emphasis on digital transformation, as signaled by their firms, can matter for firm market capitalization. Second, we provide evidence on which stock market reactions to strategic emphasis on digital transformation firms might anticipate, depending on their size. By highlighting these possible outcomes of the digital transformation process (Vial 2019), we aim at supporting firms on their digital transformation path.

2.2 Theoretical background and hypotheses

The goal of digital transformation is to improve a firm, which is undergoing it (Vial 2019). Hence, research on digital transformation of companies has highlighted different performance benefits, which a firm can realize during the process of digital transformation (Fitzgerald et al. 2013; Vial 2019). These benefits include improved operational efficiency, such as cost savings, business process improvement, and automation, as well as better organizational performance, such as firm growth, higher innovativeness, improved financial performance and competitive advantage (Vial 2019). Digital transformation further enables firms to explore new paths of value generation and create new business models (Chanias et al. 2019; Hess et al. 2016; Matt et al. 2015; Vial 2019). Thereby, digital transformation not only leads a higher firm competitiveness, but also provides a basis for its persistence on the market, contributing to a better long-term firm performance (Hess et al. 2016; Vial 2019).

Yet, not all firms might be able to realize these benefits, as digital transformation presents a very complex endeavor, which is hallmarked by a high degree of uncertainty and entails a risk of failure (Chanias et al. 2019; Fitzgerald et al. 2013; Hartl and Hess 2017; Hess et al. 2016; Sebastian et al. 2017). One of the most common reasons for failure of digital transformation's initiatives is the lack of resources, required for digital transformation, such as information, human and financial resources (Eden et al. 2019; Fitzgerald et al. 2013; Hess et al. 2016; Horlacher and Hess 2016; Matt et al. 2015; Sebastian et al. 2017). For instance, firms need knowledge and expertise to define a digital transformation strategy, employ new digital technologies as well as develop digital services platforms and operational backbones (Hess et al. 2016; Matt et al. 2015; Sebastian et al. 2017; Singh and Hess 2017). Further, firms require experienced executives such as Chief Digital Officers (CDO) to identify the right digital business opportunities and navigate digital transformation (Horlacher and Hess 2016; Singh and Hess 2017), as well as qualified employees, who can take over new roles and responsibilities in firm's IT function and other departments (Sebastian et al. 2017; Vial 2019). Finally, to finance these employees, to develop digital services platforms and finance other aspects of digital transformation, firms require financial resources (Fitzgerald et al. 2013; Hess et al. 2016; Matt et al. 2015). Thus, firms, which seek to navigate digital transformation successfully, need a large resource basis (Hess et al. 2016; Matt et al. 2015).

A primary indicator of such a broad resource base is firm size (Audia and Greve 2006; Bruderl and Schussler 1990; Kirca et al. 2011; Mitchell 1994). Prior research has shown that larger firms possess larger pools of managerial and financial resources (Audia and Greve 2006; Mitchell 1994), which can be invested into digital transformation projects (Kirca et al. 2011). These resources pools can also be used to bear the risks and costs of digital transformation (Audia and Greve 2006; Kirca et al. 2011; Mitchell 1994). Further, larger firm size increases a firm's potential to attract additional resources such as external knowledge networks (Kirca et al. 2011), well-trained employees, further capital, favorable tax conditions and governmental regulations (Audia and Greve 2006; Bruderl and Schussler 1990). Additionally, larger firms are usually powerful market players, which do not only have a better access to needed resources, but can also prevent other market participants of gaining access to such resources (Gaba et al. 2002; Kirca et al. 2011). Accordingly, larger firms face a decreased risk of failure in digital transformation initiatives (Audia and Greve 2006; Bruderl and Schussler 1990; Levinthal 1991; Mitchell 1994). Further, even if it comes to a failure, the associated losses would not threaten the survival of larger firms (Audia and Greve 2006; Bruderl and Schussler 1990; Levinthal 1991; Mitchell 1994). Hence, performance expectations for larger firms, undergoing digital transformation, are likely to be positive (Kirca et al. 2011). In contrast, this might not apply to smaller firms, which possess a smaller stock of resources, and are thus much more vulnerable to firm failure and financial losses, which might threaten their survival (Audia and Greve 2006; Bruderl and Schussler 1990; Levinthal 1991; Mitchell 1994).

According to signaling theory (Bergh et al. 2014; Connelly et al. 2011; Spence 1973), as digital transformation is bound to risk and uncertainty (Chanias et al. 2019; Fitzgerald et al. 2013; Hartl and Hess 2017; Hess et al. 2016; Sebastian et al. 2017), stakeholders such as investors seek out to reduce the arising information asymmetry. Hence, they look out for observable actions and visible signals of a company to be able to assess its strategic position concerning digital transformation and its likely performance outcomes (Bergh et al. 2014;

Connelly et al. 2011; Spence 1973). Hereby, investors can rely on such visible signals as firm strategic emphasis on digital transformation, as reflected in firm's annual reports as a central mean of corporate strategy's communication to external stakeholders (Guo et al. 2017), as well as firm size as an indicator of a sufficient resources base for digital transformation (Audia and Greve 2006; Bruderl and Schussler 1990; Hess et al. 2016; Kirca et al. 2011; Levinthal 1991; Matt et al. 2015; Mitchell 1994). Thus, if a larger firm discloses a higher strategic emphasis on digital transformation, investors will be likely to assess this firm as having a higher probability of successfully managing its digital transformation and realizing the corresponding performance benefits (Fitzgerald et al. 2013; Vial 2019). Hence, investors, who consider buying company's stock, will be willing to pay a higher price for it, resulting in an increased stock price and market capitalization (Dehning et al. 2003; Kohli et al. 2012; Schryen 2013). As opposed to this, a smaller firm's disclosure of a higher strategic emphasis on digital transformation can signal an endeavor with a higher risk of failure to investors, resulting in lower performance expectations for this firm (Audia and Greve 2006; Bruderl and Schussler 1990; Mitchell 1994). Thus, potential investors' interest in a firm stock will decrease, leading to a lower market capitalization (Dehning et al. 2003; Kohli et al. 2012; Schryen 2013). Accordingly, we hypothesize:

Hypothesis. A higher strategic emphasis on digital transformation is associated with a higher market capitalization for larger firms, and a lower market capitalization for smaller firms.

2.3 Methods

2.3.1 Sample and procedure

To test our hypotheses, we conducted a panel data analysis from 2000 to 2017 using a sample of the German firms, listed on the public stock index HDAX. It covers 110 largest German stock corporations, including the 30 largest German companies (DAX), the next 50 largest companies (MDAX) as well as the 30 largest technology companies (TecDAX). As

TecDAX emerged in 2003, until then HDAX incorporated 30 DAX and 70 MDAX companies (Deutsche Börse Group 2017). Besides including publicly listed firms, this sample is suitable for our study for three further reasons. First, HDAX includes firms of different industries. Therefore, we expect the firms in our sample to exhibit different degrees of strategic emphasis on digital transformation (Chanias et al. 2019). Second, HDAX encompasses not only large companies, but also mid-sized and smaller technology firms. Hence, it generates both variance in market capitalization and firm size among the considered companies (Tuschke et al. 2014). Third, this sample has frequently been used by prior studies (e.g., Flickinger et al. 2016; Tuschke et al. 2014), verifying its suitability to study organizational phenomena.

To construct our sample, we included those companies, which were a member of HDAX as of December, 30th for each year from 2000 to 2017. The year 2012 was the only exception, as we had to use the data as of December, 28th 2012 due to a missing availability of later data for this year. Because we accounted for changes in the HDAX composition, our data was unbalanced.

We gathered our data from three main sources. First, we obtained the list of companies, which were a member of HDAX in each year, from STOXX Ltd., a part of Deutsche Börse Group. Second, we collected firm data from the database Worldscope (Thomson One Banker), which has already been utilized as a source of firm data by existing studies (e.g., Flickinger et al. 2016). Third, we gathered data on firm strategic emphasis on digital transformation from the annual reports.

We faced the problem of missing data (Sanders and Tuschke 2007; Tuschke and Gerard Sanders 2003; Tuschke et al. 2014), especially with respect to firm financial data and Research & Development (R&D) expenditures. Our sample was further reduced because we used lagged values (t-1) for all our independent variables (Hoehn-Weiss and Karim 2014; Stern and James 2016; Xia et al. 2016), as prior research has shown, that capital markets usually need some time to incorporate the available firm information (Joshi and Hanssens 2010; Tanriverdi 2006). Hence, our final sample comprised 1,203 firm-year observations.

2.3.2 Measures

We measured our dependent variable, *market capitalization*, as firm's market capitalization in the respective year in Euro.

We measured our independent variable, *firm strategic emphasis on digital transformation*, as the count of words, related to digital transformation, by 1,000 words in a firm's annual report (Shin and You 2017). For this purpose, we counted the absolute number of words, beginning with "digit*", divided it by the total number of words in an annual report in the respective year (Guo et al. 2017), and then multiplied the result with a factor of 1,000 (Shin and You 2017). This measurement approach is appropriate for our study for three main reasons. First, both in German and English languages, the root word "digit*" covers a wide range of words, connected with digital transformation, such as "digital" (transformation, markets, products, processes, technologies, strategies, etc.), "digitalization", "digitization", etc. Second, annual reports constitute a representative form of firm's communication, which does not noticeably differ in its language choice from other sources of organizational communication such as press releases (Guo et al. 2017). Annual reports are directed at external stakeholders such as investors or financial analysts, who use these reports as a central information source in order to understand firm's strategic decisions (Guo et al. 2017). Indeed, not only financial analysts (Lehavy et al. 2011), but also investors can be expected to read companies' qualitative announcements in the form of annual reports (Jegadeesh and Wu 2013; Lehavy et al. 2011; Liebmann et al. 2012). Hereby, especially long-term oriented investors, who are interested in a future development of firm's strategic and intangible assets such as strategic emphasis on digital transformation, usually have profound skills in monitoring and detecting the relevant information, which is positioned outside the balance sheet in firm's annual reports (Schäfferling and Wagner 2013). Third, a word-count approach in annual reports or their selected parts has been widely used in strategic management research to approach an orientation of a company or its executives (e.g., Gamache et al. 2015; Guo et al. 2017; Shin and You 2017). Therefore, the chosen operationalization of firm strategic emphasis on digital transformation is capable of covering company's language, related to digital transformation; relies on a data source, which addresses appropriate stakeholders; presents a suitable means of expressing strategic emphasis of a firm; and is a representative and valid source of a firm's strategy communication (Guo et al. 2017). To implement this operationalization, we developed a supporting macro in Microsoft Excel 2016, which counted the words, beginning with "digit*" as well as the total number of words, in firms' annual reports in each year.

Additionally, this macro also recoded the words, beginning with "digit*" as well as the words, which followed them. Table 2 shows the ten most frequently used words of the both groups. The most frequently used word, beginning with "digit*", was "digital" in its different declensions (n = 77.47%), followed by "digitalization" (n = 14.19%) and "digitalized" (n = 0.98%). The ten presented most frequently used words accounted for 95.35% of all words, beginning with "digit*". Considering words, which followed those containing "digit*", the most frequently found word was "lifestyle" (n = 2.69%), followed by "adjacent" (n = 2.51%) and "media" (n = 2.47%). The ten presented most common second words accounted for 16.37% of all words, which followed those containing "digit*". Overall, these words indicate strategically relevant topics, connected with digital transformation of companies, thus providing support for our measure.

We measured *firm size* as the natural logarithm of the number of firm's employees (Chen et al. 2011), which represents a reliable measure of an overall firm size in a given industry (Audia and Greve 2006).

Additionally, we controlled for firm's *R&D expenditures* in order to address the magnitude of the required financial resources for the ongoing digital transformation projects (Kim et al. 2017; Wunderlich and Beck 2018), *firm performance* as well as *industry* *performance* as these factors could both influence firm strategic emphasis on digital transformation and market capitalization (Mithas et al. 2012; Tanriverdi 2006). We measured R&D expenditures as the total amount of firm's R&D expenses in Euro divided by the number of employees (Mithas et al. 2012). We operationalized firm performance as Return on Assets (ROA) (Guo et al. 2017). We measured industry performance as the average ROA values of all firms operating in the firm's industry (Tanriverdi 2006) according to the Industrial Classification Benchmark (Cincera and Veugelers 2014). Further, we controlled for the presence of a *CDO*. The presence of this executive might influence strategic emphasis on digital transformation by leveraging digital transformation (Horlacher and Hess 2016; Horlacher et al. 2016; Singh and Hess 2017) such as helping the Chief Executive Officer (CEO) to infuse the digital transformation strategy into all business areas (Hansen and Siew Kien 2015). Further, the presence of a CDO can influence market capitalization by making the formulation of the digital transformation strategy more focused and sending an additional signal to the investors (Hansen and Siew Kien 2015). We collected information on the presence of the CDO position from firms' web pages and their annual reports, and performed an internet-based search via the search engine Google to verify the results. CDO was coded 1 if a position with the title "Chief Digital Officer" or "CDO" existed in the company or there was a board member, who was responsible for digital transformation topics (identified as any words including the letter combination "digit*" in the area of the responsibility), and 0 otherwise. Finally, to account for macroeconomic trends or shocks such as the financial crisis of 2007-2008, which could have influenced both firm strategic emphasis on digital transformation and market capitalization, we also included *year fixed effects* into our model (Calabrò et al. 2018).

2.3.3 Analysis

To estimate the effect of firm strategic emphasis on digital transformation and firm size on market capitalization, we used a panel data analysis in Stata 14.1. We calculated a fixed effects model, which uses a within-firm variation in independent and dependent variables and

Table 2. Ten most frequently used words, beginning with "digit", and following them*

"Digit*" words			Following words		
Word	**Frequency**	**Percent**	**Word**	**Frequency**	**Percent**
Digital [a]	13,483	77.47%	Lifestyle [c]	458	2.69%
Digitalization	2,470	14.19%	Adjacent [c]	427	2.51%
Digitalized [a]	170	0.98%	Media	420	2.47%
Digital printing [b]	108	0.62%	Transformation	284	1.67%
Digital cameras [b]	83	0.48%	World	246	1.45%
Digitalization strategy [b]	69	0.40%	Business [c]	211	1.24%
Digitalize	67	0.38%	Company	208	1.22%
Digital business [b]	62	0.36%	Entertainment [c]	197	1.16%
Digital sector [b]	50	0.29%	Subscriber [c]	179	1.05%
Digital technology [b]	33	0.19%	Limited liability company (GmbH)	156	0.92%
Total		**95.35%**			**16.37%**

Note: Analysis for 2000-2016 due to lagged values. Translation from German. [a] includes different declensions of this word in German. [b] is written as one word in German. [c] not translated.

allows for arbitrary correlation between the unobserved effect and the independent variables (Certo et al. 2017; Wooldridge 2012). By these means, a fixed effects model allows to control for any unobserved firm-specific heterogeneity, which could play a role for performance outcomes (Belderbos et al. 2014; Wooldridge 2012). This makes a fixed effects model more convincing for estimating ceteris paribus effects, especially when the used sample cannot be treated as a random sample from a large population of firms (Wooldridge 2012). To additionally control for any kind of serial correlation and heteroscedasticity, we allowed for unobserved firm effects in our data by using robust standard errors (Wooldridge 2012). Hence, we used the command *xtreg, fe cluster(id)* in Stata. Due to using a fixed effects estimator in combination with robust standard errors, it was not possible to calculate a Hausman test for the comparison between fixed and random effects (Wooldridge 2012). Further, we calculated simple slopes of the interaction between strategic emphasis on digital transformation and firm size on market capitalization using the *margins, dydx* command in Stata.

2.4 Results

Table 3 reports descriptive statistics and correlations for our variables. Although some correlations between independent variables were significant, none of them exceeded the critical value, which is considered 0.80 or higher (Hair et al. 2009; Saunders et al. 2007). Hence, multicollinearity did not appear to present a problem for our data. Table 4 presents the results of a fixed-effects regression for our Hypothesis. Figure 1 shows an interaction graph for strategic emphasis on digital transformation and firm size on market capitalization.

2.4.1 Hypothesis testing

Our Hypothesis predicted that a higher strategic emphasis on digital transformation would be associated with a higher market capitalization for larger firms, and a lower market capitalization for smaller firms. When the interaction effect between strategic emphasis on digital transformation and firm size on market capitalization was included into the regression model (Model 3), we were able to explain 31.7% of variance within our firms. This model provided a higher goodness of fit than a model only with control variables (Model 1, R-sq. within = 28.5%), and a model with main effects of strategic emphasis on digital transformation and firm size (Model 2, R-sq. within = 29.3%). The interaction effect between strategic emphasis on digital transformation and firm size on market capitalization was positive and significant ($\beta = 0.252$, $p < 0.01$, Model 3). Figure 1 illustrates this relationship. A simple slope analysis revealed, that if Z-scores of firm size were less or equal to -1.190 (small to medium firm size), the average marginal effects of strategic emphasis on digital transformation on market capitalization were negative and significant ($p < 0.01$). If Z-scores of firm size were greater or equal to 0.810 (large firm size), the average marginal effects of strategic emphasis on digital transformation on market capitalization were positive and significant ($p < 0.01$). Therefore, our Hypothesis was supported.

Table 3. Descriptive statistics and correlations

Variable		Obs.	Mean	SD	1	2	3	4	5	6
1.	Market capitalization (100 million)	1,946	95.280	167.472						
2.	Strategic emphasis on digital transformation $_{t-1}$	1,679	0.141	0.401	0.005					
3.	Firm size $_{t-1}$	1,674	9.371	1.946	0.569*	-0.064*				
4.	CDO $_{t-1}$	1,682	0.024	0.152	0.252*	0.287*	0.096*			
5.	R&D expenditures (thousand) $_{t-1}$	1,213	12.603	21.347	0.033	0.047	-0.305*	0.044		
6.	Firm performance $_{t-1}$	1,661	5.375	7.566	-0.025	0.027	-0.093*	-0.008	-0.127*	
7.	Industry performance $_{t-1}$	1,661	5.080	1.871	0.080*	0.080*	0.193*	-0.004	0.013	0.205*

Note: * $p < 0.05$.

Table 4. Results of a fixed effects regression with robust standard errors

	Model1	**Model 2**	**Model3**
Intercept:	0.587	0.568	0.462
Controls:			
R&D expenditures $_{t-1}$	0.052	0.063	0.073
Firm performance $_{t-1}$	-0.042	-0.036	-0.016
Industry performance $_{t-1}$	-3.226	-3.225	-2.857
CDO $_{t-1}$	0.770 *	0.775 *	0.643 †
Main effects:			
Strategic emphasis on digital transformation $_{t-1}$		0.067	0.059
Firm size $_{t-1}$		0.264	0.328 †
Interaction effect:			
Strategic emphasis on digital transformation $_{t-1}$ x Firm size $_{t-1}$			0.252 **
F-statistic	5.06 ***	5.21 ***	5.80 ***
R-sq within	0.285	0.293	0.317
R-sq between	0.008	0.001	0.000
R-sq overall	0.014	0.004	0.002

Note: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Dependent variable: market capitalization $_t$. All models include year fixed-effects. Regression with standardized coefficients. N=1,203 observations, clustered in 154 firms.

2.4.2 Endogeneity and robustness checks

To ensure that our independent variable, strategic emphasis on digital transformation, was not endogenous, i.e., correlated with an error term, e.g. due to omitted variables (Wooldridge 2012), we conducted two endogeneity tests. First, we used an instrumental variables approach by finding two proxy variables for strategic emphasis on digital transformation (Certo et al. 2017; Wooldridge 2012). As such instrumental variables we used an average strategic emphasis on digital transformation as well as an average prevalence of a CDO among firm's peers from the same industry in our sample (Germann et al. 2015). These instruments can be considered as appropriate, because on the one hand, they are unlikely to be correlated with the focal firm's omitted variables, and on the other hand, firms from the same industry face a similar market situation and are likely to have similar expectations about it (Germann et al. 2015). Utilizing these instrumental variables, we ran a generalized two stage least squares regression and calculated an endogeneity test. As a result, the test was not significant (Chi-sq. = 1.252, p = 0.535), indicating no evidence of endogeneity. Second, we used a control function approach by regressing strategic emphasis on digital transformation on all the other independent variables and the two instrumental variables, obtaining the residuals, and adding them to the estimation function of our dependent variable, market capitalization (Petrin and Train 2010; Wooldridge 2012). As a result, the coefficient of the residuals was not significant (β = 35.338, p = 0.213), letting us conclude that strategic emphasis on digital transformation was not endogenous (Wooldridge 2012).

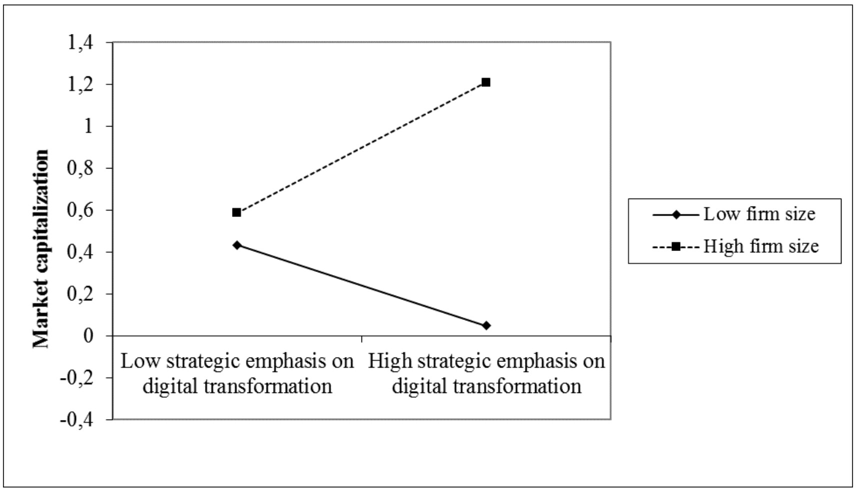

Figure 1. Interaction between strategic emphasis on digital transformation and firm size

To verify the results of our hypothesis testing, we conducted several robustness checks. First, we repeated our analysis only for the period between 2010 and 2017, as during the last decade, companies have started to pay a considerably higher attention to the digital transformation topics (Hess et al. 2016; Vial 2019). Second, we considered the period from 2000 to 2017, but utilized a slightly different measure for strategic emphasis on digital transformation, by using only an absolute number of words, beginning with “digit*”, from firms’ annual reports, while including the total number of words in the report as a control variable (Guo et al. 2017). Third, we used a different operationalization of strategic emphasis on digital transformation, by counting the words, beginning with “digit*”, only in firm’s letters to shareholders, which are published in annual reports, dividing this word count by the total number of words in the letter, and multiplying the result with a factor of 1,000 (Gamache and McNamara 2019; Gamache et al. 2015; Shin and You 2017). Fourth, we measured strategic emphasis on digital transformation as the absolute number of words, beginning with "digit*", in firm's letters to shareholders, while controlling for the total number of words in the letter (Gamache and McNamara 2019; Gamache et al. 2015; Guo et al. 2017; Shin and You 2017). Fifth, we repeated the analysis by using another operationalization of firm size, which we calculated as a natural logarithm of firm sales (Shin and You 2017). Our results remained robust in each of these robustness checks.

2.5 Discussion

In this study, we analyzed the joint impact of firm strategic emphasis on digital transformation and firm size on market capitalization. To perform this analysis, we used a panel data set of largest German publicly listed companies between 2000 and 2017. Our results revealed that a higher firm strategic emphasis on digital transformation leads to a higher market capitalization for larger firms and to a lower market capitalization for smaller firms.

We explain these results relying on the signaling theory (Bergh et al. 2014; Connelly et al. 2011; Spence 1973). Particularly, we believe, that larger firms, embarking on a digital transformation journey, send clearer and more credible signals to investors, that they are likely to realize performance benefits, connected to digital transformation (Fitzgerald et al. 2013; Vial 2019), because of relying on a sufficient resources basis (Audia and Greve 2006; Bruderl and Schussler 1990; Hess et al. 2016; Kirca et al. 2011; Levinthal 1991; Matt et al. 2015; Mitchell 1994). As opposed to this, investors might perceive the digital transformation journey of smaller firms, having a limited resources basis, as riskier and more prone to failure (Audia and Greve 2006; Bruderl and Schussler 1990; Mitchell 1994).

2.5.1 Theoretical implications

With this study, we extend research on digital transformation of companies (Chanias et al. 2019; Hansen and Siew Kien 2015; Hess et al. 2016; Sebastian et al. 2017; Singh and Hess

2017; Vial 2019) in two ways. First, by exploring the effect of strategic emphasis on digital transformation on firm evaluation on a stock market, we respond to a call of existing studies to investigate the questions related to success, risks and failures of digital transformation for firms (Chanias et al. 2019). Hereby, we show that an increased strategic emphasis on digital transformation leads to a higher evaluation of larger firms and to a lower evaluation of smaller firms on a stock market (Dehning et al. 2003; Kohli et al. 2012). Hence, we demonstrate, that is might be easier for larger firms to be successful in their digital transformation endeavors (Sebastian et al. 2017), because they are rewarded by the stock market in a timely way. At the same time, smaller firms have to face an additional challenge (Chanias et al. 2019; Hess et al. 2016) on their digital transformation paths in terms of skeptically reacting investors and decreasing market capitalization. In revealing these results, we are to our best knowledge the first to provide quantitative empirical evidence on strategic emphasis on digital transformation in firms and its influence on their performance in a longitudinal study over 17 years using panel data (Vial 2019).

Second, due to examining the effects of an interplay between firm strategic emphasis on digital transformation and firm size on market capitalization, we draw attention to firm characteristics, which might promote or hamper the realization of the benefits, connected with the digital transformation process. Thus, we extend the digital transformation framework as proposed by Vial (Vial 2019) by adding an outcome of positive stock market reactions in terms of increased market capitalization to the building block of positive impacts, and of negative stock market reactions in terms of decreased market capitalization to the building block of negative impacts of digital transformation. Additionally, we propose a further building block of contextual factors such as firm size, which might radically influence the result of the link between the changes in value creation paths and digital transformation impacts (Vial 2019).

2.5.2 Limitations and future research

While the utilization of longitudinal research methods in terms of panel data analysis contributes to establishing causality in our results (Podsakoff et al. 2012), our study has limitations. First, we faced the problem of missing data for our sample (Sanders and Tuschke 2007; Tuschke and Gerard Sanders 2003; Tuschke et al. 2014). Among the variables used in our study, this problem especially affected firm R&D expenditures and financial data. Although we relied on complete 1,203 firm-year observations for our analysis, the reduced sample size might limit the generalizability of our results to those firms, which did not disclose their R&D expenditures. Further, while we controlled for R&D expenditures to address the magnitude of the required financial resources for digital transformation (Kim et al. 2017; Wunderlich and Beck 2018), due to the poor data availability for the HDAX firms (Sanders and Tuschke 2007; Tuschke and Gerard Sanders 2003; Tuschke et al. 2014), we were not able to control for other aspects, which might be related to digital business strategy and its risk, such as IT investments (Mithas et al. 2013). Therefore, future research may address this limitation by repeating the study using another sample with a better data availability, and in doing so, include additional control variables such as IT investments.

Second, we approached digital transformation through firm strategic emphasis on digital transformation, while controlling for the presence of a CDO. Although these aspects provide a basis for formulating and implementing a digital transformation strategy (Chanias et al. 2019; Hess et al. 2016; Horlacher and Hess 2016; Matt et al. 2015; Singh and Hess 2017), it encompasses more practices such as setting up governance structures (Chanias et al. 2019), working together with customers and other business partners on digital transformation projects (Horlacher and Hess 2016), developing digital services platforms and operational backbones or generating revenue, coming from digital products or services (Sebastian et al. 2017). Thus, future research may address an interplay of these aspects of digital transformation with firm size on market capitalization.

Third, our measure of strategic emphasis on digital transformation was based on the count of words, beginning with "digit*", in firms' annual reports. Although our analysis of the most frequently used words, beginning with this word root, indicated topics, connected with digital transformation of companies, we cannot rule out a potential bias, which could arise if firms would use these words differently depending on their industry. Hence, future research might investigate the exact meaning of the words, used by companies from different industries.

Fourth, even HDAX generates a considerable amount of variance with respect to firm size (Tuschke et al. 2014), we have to acknowledge that even the smallest company in our sample still had a market capitalization of multiple million. Thus, future research might explore the relationship between strategic emphasis on digital transformation and firm size on market capitalization by considering smaller firms.

2.5.3 Practical implications

Our study is also important for practitioners, who are embarking on a digital transformation journey (Chanias et al. 2019; Hess et al. 2016). First, we draw attention of practitioners to the fact, that strategic emphasis on digital transformation, as signaled by their firms, can matter for firm market capitalization. Second, we provide evidence, that larger firms might anticipate a higher market capitalization as a result of signaling a higher strategic emphasis on digital transformation. Thus, larger companies can be advised to continue disclosing their strategic emphasis on digital transformation, while paying attention also to other signals, which they send in this respect to the public. At the same time, smaller companies might have a more difficult start (Chanias et al. 2019; Hess et al. 2016) on their digital transformation paths because investors can react to their signaling of a higher strategic emphasis on digital transformation skeptically, leading to a decreased market capitalization. Hence, smaller firms should be aware of these possible difficulties and should consider sending other signals to investors, demonstrating that they are able to successfully undergo and manage digital transformation as well as risks, associated with it. With these results, we aim at supporting firms on their digital transformation paths.

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3 Understanding which financial technologies generate customer trust in digital financial processes: Evidence from an online experiment

Abstract

To be successful on the market, firms need to gain customer trust when implementing financial technology in their digital financial processes. However, it remains unclear, which effect the introduction of this technology is going to have on customer trust. Therefore, we study the impact of the implementation of five currently discussed examples of financial technology – peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain – on customer trust in digital financial processes, and compare these examples of financial technology with each other to identify which of them is the strongest in gaining trust. Using data from an online conjoint experiment with 355 participants, we show that the implementation of self-service tools, biometric authentication mechanisms and blockchain generates customer trust in digital financial processes, and that biometric authentication mechanisms tend to be the strongest technology in gaining trust. With these results, we extend the scarce body of research on the intersection of financial technology and trust, and provide recommendations to practitioners, on which financial technologies to implement in order to enhance customer trust in their processes.

Keywords

Financial technology, trust, peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, blockchain.

Current status

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3.1 Introduction

The digitalization in the financial services industry, which focuses on financial technology that is also referred to as fintech, increasingly gains attention from both researchers and practitioners (Gomber et al. 2018a). Financial technology not only digitalizes, but also reorganizes and enhances established financial processes (Puschmann 2017). In fact, financial technology is expected to revolutionize and completely reshape the financial services industry (Gomber et al. 2018a; PwC 2016).

When introducing financial technology in their processes, it is essential for firms to gain customer trust in order to be successful (Gefen et al. 2003a; Ogbanufe and Kim 2018). In general, trust is considered as a central predictor of customer decision to use technology-based services, offered by a firm (Lankton et al. 2014; Li et al. 2008). Customer trust is especially important in the context of digital financial transactions (Dhar and Stein 2017; Pavlou 2003), because customers feel more vulnerable than in traditional settings when entrusting financial service providers with their money (McKnight et al. 2011).

Given the recent topicality (Gomber et al. 2018a), first studies have already started to examine the intersection of financial technology and trust (Avgerou 2013). This research covered trust-building mechanisms among participants of peer-to-peer lending platforms (Duarte et al. 2012; Greiner and Wang 2010), a decision map on when to trust robo-advisors with decisions (Dhar 2016), antecedents of acceptance of self-service technologies using examples from banking (Blut et al. 2016), trust in biometric authentication methods (Ogbanufe and Kim 2018), and a trust framework for blockchain (Ostern 2018). Given that this nascent research highlights trust issues in a broad range of different examples of financial technology, one may assume that customers generally distrust digital financial processes, which utilize financial technology (e.g., Dhar and Stein 2017; Greiner and Wang 2010; Jung et al. 2018b).

Yet, this generalization might be premature. Given that the financial technology landscape is very heterogeneous (Gomber et al. 2018a), financial technologies differ in important dimensions. For example, peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain correspond with different financial technology innovations categories: business models, services and products, organizational issues, processes, and systems (Puschmann 2017). Peer-to-peer platforms change financial business models through disintermediation (Gomber et al. 2018a). Robo-advisors facilitate the development of new services by substituting human employees (Jung et al. 2018a). Self-service tools address organizational issues due to the outsourcing of service delivery to end-customers (Varadarajan 2009). Biometric authentication mechanisms transform the processes of customer identification (Ogbanufe and Kim 2018). Blockchain redefines systems by providing a new infrastructure for financial transactions (Puschmann 2017). Due to these differences, research is necessary to test if all of these financial technologies reduce trust in digital financial processes, based on these technologies.

Some technologies might even increase trust such as blockchain, which is said to redefine trust due to enabling secure transactions (Gomber et al. 2018a), or biometric authentication mechanisms, which provide a higher level of safety and security than traditional authentication mechanisms (Ogbanufe and Kim 2018). Furthermore, given that financial technologies are often introduced simultaneously in digital financial processes (Puschmann 2017), the question arises, which of these technologies might be the strongest in gaining customer trust in digital financial processes. Knowing the latter is particularly important for research and practice, as it gives an important indication, into which financial technology efforts to address customer trust need to be invested.

We therefore conducted an online conjoint experiment to jointly examine customer trust in digital financial processes in reaction to five examples of financial technology: peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. With this study, we extend current literature (Greiner and Wang 2010; Ogbanufe and Kim 2018) in three ways. First, we test whether just the implementation of the above-mentioned financial technologies can already hurt or build trust in digital financial processes on the customer side (Ogbanufe and Kim 2018). Hence, we put to the proof, whether trust can be an outcome of financial technology implementation (Ogbanufe and Kim 2018). Second, in doing this, we examine the five indicated technologies. Analyzing these technologies is particularly important because they are currently broadly discussed by practitioners and researchers and increasingly implemented in digital financial processes (Alt et al. 2018; Gomber et al. 2018a; Gomber et al. 2018b). Therefore, existing research has already called upon further investigation of customer reactions to these financial technologies (e.g., Gomber et al. 2018a; Gomber et al. 2017). Third, we examine, how the effects of the financial technology implementation on trust in digital financial processes differ among peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain, and which of these technologies might be the strongest in gaining customer trust (Gomber et al. 2018a). By these means, we shed light on the possible differences in customer perception of financial technologies and are, to our best knowledge, the first to compare these technologies with respect to trust.

In addition to these theoretical contributions, our study has also practical implications. Particularly, we provide a current snapshot of customer trust in digital financial processes, in which five currently discussed financial technologies are implemented. We thus give advice to all the interested market players such as financial technology start-ups, traditional financial institutions as well as platform and application developers (Lee and Shin 2018), on which technologies to implement in their processes to gain customer trust.

3.2 Theoretical background and hypotheses

3.2.1 Trust in digital financial processes

Trust is defined as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (Mayer et al. 1995, p.

712). Thus, trust describes the relationship between two parties: the trustor, e.g., a customer, and the trustee, e.g., a financial service provider (Avgerou 2013).

In this study, we consider trust in digital financial processes. Digital financial processes can be defined as the use of resources and competencies of a financial service provider, e.g. in the form of applied digital technologies (Gefen et al. 2003b), to create benefit in terms of digital financial solutions for a customer (Fichman et al. 2014; Lusch et al. 2010; Vargo and Lusch 2004). In this context, we define *trust in a digital financial process* as the subjective belief of a customer that a financial service provider will fulfill her obligations in order to enable digital financial transactions for a customer (Gefen et al. 2003b; Ogbanufe and Kim 2018).

3.2.2 Financial technologies and trust into digital financial processes

Peer-to-peer platforms. In general, peer-to-peer systems refer to self-organizing groups of private individuals, which use shared distributed resources in a networked environment without a central party guiding the transactions (Gomber et al. 2017). Applied to the financial context, peer-to-peer platforms present online platforms (Ge et al. 2017), i.e. information technology (IT) architectures embedded within economic networks (Kazan et al. 2018), which enable transactions between private individuals (Gomber et al. 2017). In peer-to-peer transactions, these individuals interact with each other directly without the intermediation of a service provider (Xu and Chau 2018), that is, a traditional financial intermediary (Jiang et al. 2018) such as a bank, a credit institution (Gomber et al. 2018a), or an insurance firm (Gomber et al. 2017).

In peer-to-peer financial processes, transaction partners tend to be unrelated persons, who are not personally known to their peers. Due to this anonymity, a higher information asymmetry compared to traditional providers arises, making a digital financial process a potential target to opportunistic behavior and fraud actions. Due to the absence of a central authority, individuals in peer-to-peer transactions have no securities, provided by such an authority, and, therefore, no possibility to request their money back. Peer-to-peer platform providers offer only very few institutional mechanisms, such as in case of fraud actions, customers would only get a very small amount of their original sum of money back. This makes peer-to-peer processes more uncertain and risky for customers (Greiner and Wang 2010; Jiang et al. 2018). Taken that the design of financial processes in terms of e.g. implemented technologies is assumed to mirror the intentions of their providers (Lankton et al. 2014), customers of peer-to-peer processes can think that the providers do not make effort to offer them safe transactions and do not invest into the relationship with them (Gefen et al. 2003b; Wang and Benbasat 2005). Accordingly, we expect the implementation of peer-to-peer platforms in digital financial processes to reduce trust by customers. This leads us to our first hypothesis:

Hypothesis 1: The implementation of a peer-to-peer platform in a digital financial process will lead to a lower trust in this financial process.

Robo-advisors. Robo-advisors are digital algorithms (Gomber et al. 2017), which involve intelligent and interactive user assistance and recommendation aid components that guide customers through an automated advisory process (Jung et al. 2018a). To fulfill this function, robo-advisors first perform a customer assessment in a self-reporting process based on an online questionnaire, where customers are asked about their goals, special interests, preferences, and their risk attitude (Jung et al. 2018a). After this assessment, which is usually simple for customers to perform, their data is analyzed and quantified by algorithms (Jung et al. 2018a) in order to generate predefined parameters that create a basis for the personalized financial advice (Gomber et al. 2017). During this process, customers usually do not interact with human employees, with exception of issues, which are neither directly related to the customer assessment nor to the financial advice, such as IT support or fraud management (Jung et al. 2018a).

On the one hand, advisory services, performed by human employees, can be prone to information and interest asymmetries, which arise when an advisor is more knowledgeable than her customer, and/or when she is using this information to take advantage of the customer (Nussbaumer et al. 2012). As digital financial processes, based on robo-advisors, usually do not involve an interaction with human employees (Gomber et al. 2018a), they can be perceived as reducing these asymmetries (Jung et al. 2018b; Ruf et al. 2015). Further, as robo-advisors are capable of quickly analyzing a large amount of data, their recommendations concerning the best options, such as investment options (Jung et al. 2018a) or insurance rates (Stoeckli et al. 2018), may be perceived as more trustworthy by customers (Wang et al. 2016). Therefore, if financial service providers utilize robo-advisors in their processes, customers can interpret this as a signal that providers try to be fair with customers in providing financial advice (Wang and Benbasat 2005). Hence, the implementation of robo-advisors could help to enhance customer trust.

On the other hand, as transparency in advisory processes plays a very important role for customers (Nussbaumer et al. 2012), digital financial processes with robo-advisors can generate trust, only if customers understand, on which basis a robo-advisor calculates the best options, determines the price of a service, etc. (Jung et al. 2018b; Ruf et al. 2015). However, implementing transparency is challenging, so that the existing robo-advisors do not fulfill this requirement in many cases (Jung et al. 2018b; Nussbaumer et al. 2012). Therefore, if service providers offer financial processes with implemented robo-advisors, which do not disclose e.g., how the search for the best options is performed and the recommendation determined, customers can think that providers are trying to create information asymmetries to potentially take advantage of the customers (Jung et al. 2018b; Nussbaumer et al. 2012). Hence, it could also be possible that digital financial processes with implemented robo-advisors reduce customer trust. Therefore, we formulate a two-sided hypothesis:

Hypothesis 2a: The implementation of a robo-advisor in a digital financial process will lead to a higher trust in this financial process.

Hypothesis 2b: The implementation of a robo-advisor in a digital financial process will lead to a lower trust in this financial process.

Self-service tools. Self-service tools describe technological interfaces that enable customers to actively participate in the service delivery by producing a service independent of a direct involvement of service employees (Meuter et al. 2000). In this paper, we consider only digital self-service tools, such as Web-based self-service portals (Scherer et al. 2015). Using such self-service portals, customers can inform themselves about financial services in, for instance, online accessible "frequently asked questions", order the needed financial service, conduct the service process such as online banking, update personal account information or change the financial service modalities (Scherer et al. 2015; Stoeckli et al. 2018).

Customers, conducting digital financial processes with self-service tools, have a high degree of control over the process (Collier and Sherrell 2010). As they perform the process on their own, they can customize it according to their needs and preferences (Scherer et al. 2015; Xiao and Benbasat 2007). They can, for instance, decide about the speed of the financial transaction, the interactivity level and the outcome of the service process (Collier and Sherrell 2010), as the performance of self-service tools is predictable and, therefore, reliable (Wünderlich et al. 2013). A higher level of control over the process is expected to result in lower risk perceptions of customers (Collier and Sherrell 2010; Lee and Allaway 2002). Accordingly, prior research has showed that perceived control over a service process is positively related to customer trust (Bart et al. 2005; Lee and Turban 2001). This is also valid in the context of digital self-service transactions, because offering customers self-service tools, and, therefore, a high level of process control, can be interpreted as a signal that service providers invest into the relationship with customers (Collier and Sherrell 2010). Hence, we expect digital financial service processes, utilizing self-service tools, to enhance trust by customers.

Hypothesis 3: The implementation of self-service tools in a digital financial process will lead to a higher trust in this financial process.

Biometric authentication mechanisms. Biometric authentication mechanisms refer to an automated electronic use of unique human physiological or behavioral characteristics for the process of verification of a person's identity for using a financial service such as account entry (Ogbanufe and Kim 2018). Examples of such biometric characteristics are fingerprints (Berger and Nakata 2013), retina (Li et al. 2008) or iris scans and facial recognition (Goodman 2017). Biometric data can be captured via fingerprint readers as well as audio and video recognition systems on, e.g., digital devices of customers (Goodman 2017).

Financial processes with implemented biometric authentication mechanisms offer a high degree of safety and security (Ogbanufe and Kim 2018). In such financial processes, biometric data is automatically scanned and customers do not need to use traditional identification mechanisms such as passwords and Personal Identification Numbers (PIN) (Gomber et al. 2018a; Ogbanufe and Kim 2018). This reduces the risk of losing or forgetting passwords or getting them stolen by others (Clodfelter 2010; Ogbanufe and Kim 2018). Consequently, if financial service providers offer customers digital financial processes, in which biometric authentication mechanisms are implemented, customers can be positive that providers make an effort to keep customer data safe and protected from fraud actions as well as fulfill customer expectations with regards to financial transaction (Kleist 2007; Ogbanufe and Kim 2018). Accordingly, we expect these processes to enhance customers trust. We hypothesize:

Hypothesis 4: The implementation of biometric authentication mechanisms in a digital financial process will lead to a higher trust in this financial process.

Blockchain. Blockchain is a distributed ledger technology, which enables decentralized digital trust verification through digital signatures and allows for very fast or even immediate transactions (Gomber et al. 2018a; Nofer et al. 2017). Blockchain consists of data sets, which contain a chain of data packages or blocks. A block includes multiple transactions. With each new block, a blockchain is extended. The data blocks of a blockchain are validated in the network by means of cryptography, as besides the transactions, the data blocks encompass a timestamp, the hash value of the previous block in a blockchain as well as a random unique number for verifying the hash. If new transactions need to be added to the ledger, the majority of nodes in the network must agree on the validity of transactions in a block as well as on the validity of the block itself. Therefore, a third party is not needed to validate the data in a blockchain, which makes the intermediaries in transactions obsolete (Nofer et al. 2017).

As the hash values of a blockchain are unique, fraud actions can be prevented because a change in a block would immediately change the respective hash value, so that information in the blockchain cannot be changed afterwards (Nofer et al. 2017). Furthermore, due to the blocks-based structure, blockchain comprises the complete transaction history (Nofer et al. 2017). Therefore, blockchain is stated to redefine trust in financial transactions (Gomber et al. 2018a), such that financial processes, based on blockchain, are very safe from fraud and manipulation attempts (Nofer et al. 2017). Hence, if financial service providers implement blockchain in their processes, they signal to the customers that they carry about customer data and transaction safety (Gefen et al. 2003b; Gomber et al. 2017). We expect digital financial processes, based on blockchain, to enhance customer trust in a digital financial process:

Hypothesis 5: The implementation of blockchain in a digital financial process will lead to a higher trust in this financial process.

As argued above, the implementation of the considered financial technologies might generate or hinder customer trust in digital financial processes. Therefore, peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication, and blockchain can differ concerning the extent, to which they influence customer trust. As we are particularly interested in finding out, which financial technology is the strongest in gaining customer trust, we formulate the following research question for all considered technologies except peer-to-peer platforms, for which we expect a negative relationship to trust:

Research Question: Which of the financial technologies – robo-advisors, self-service tools, biometric authentication, and blockchain – is the strongest in gaining customer trust in a digital financial process?

3.3 Methods

3.3.1 Research design

To investigate this research question and test our hypotheses, we conducted an experiment utilizing a conjoint design. Conjoint design has already been used in numerous studies to investigate customer judgements and preferences (Green et al. 2001; Schillebeeckx et al. 2016). In this study, we asked participants to indicate their trust in a digital financial service process based on five examples of financial technology considered.

Hereby, we collected our data online. At the beginning of the experiment, we introduced participants to the five financial technologies studied by presenting them with a brief description of these technologies (Atzmüller and Steiner 2010). These five technologies – a peer-to-peer platform, a robo-advisor, self-service tools, biometric authentication mechanisms, and blockchain – were each manipulated on two levels (Shepherd et al. 2013), as either implemented or not implemented in a digital financial process. Therefore, there were 32 (2^5) possible profile combinations. As making the assessment for so many profiles would have overloaded the participants, we have reduced the number of profiles to eight by utilizing an orthogonal design, which allowed us to analyze all main effects (Hahn and Shapiro 1966; Shepherd et al. 2013).

To make the participants acquainted with the experiential procedure, we presented a sample profile to participants (Shepherd et al. 2013). A sample profile is illustrated by Table 5. To account for possible order effects, participants were shown the profiles in a randomized order (Mitchell et al. 2011). After viewing each profile, participants were asked to indicate their trust in the underlying digital financial process (Mitchell et al. 2011).

Table 5. Sample profile

		Process
Peer-to-peer platform	Not implemented	The payment is proceeded via online banking using a homepage or an application of a bank (it is necessary to enter account data, passwords, TAN, etc.)
Robo-advisor	Implemented	Advice and support in case of questions are offered in an automated way via a robo-advisor.
Self-service tools	Implemented	Personal account data can be changed by oneself using a homepage or an application.
Blockchain	Not implemented	The payment data is saved in a digital form and stored centrally by a financial provider.
Biometric authentication mechanisms	Implemented	Financial provider uses biometric authentication mechanisms.

Note. Sample profile for a payment process. Translation from German, as the authors have originally developed the sample profiles in German.

In order to be able to generalize our results to a larger number of settings, we implemented additional manipulations between-subjects (Atzmüller and Steiner 2010). First, to account for different types of financial processes (Puschmann 2017), we implemented the assessment task for three central types of financial processes – payment, raising of credit, and insurance processes (Alt and Puschmann 2012; Gomber et al. 2017). Second, as customers might react differently to financial processes of high and low transaction value (de Haan et al. 2018; Greiner and Wang 2010; Kim and Benbasat 2009), we varied the transaction value for each of the financial process types as either high or low. This resulted in six (3 x 2) experiential scenarios. In these scenarios, participants were asked to imagine that using a considered financial process they would like to 1) transfer money in the amount of 1,000 Euro or alternatively 100 Euro; 2) raise a credit in the amount of 110,000 Euro or alternatively 10,000 Euro; 3) insure a new Porsche 911 of an approximate value of 110,000 Euro or alternatively a new Dacia of an approximate value of 10,000 Euro. These six scenarios were distributed randomly among participants.

3.3.2 Sample

Our final sample comprised 355 participants. The average age of the participants was 26.47 years (*SD*=7.94), ranging from 18 to 64 years; 58% were female. Nearly three-fourths (73.2%) of the respondents were students; the rest accounted for employees in private (14.9%) and public (6.2%) sector. With respect to the highest education level, 42.8% of the respondents completed a bachelor degree, 36.1% had a higher education entrance qualification, 16.1% held a master degree; whereas the remaining participants accounted for professional training (3.4%), PhD (1.1%) and elementary education (0.6%).

3.3.3 Measures

Trust in a digital financial process. We measured our dependent variable, trust in a digital financial process, by asking customers to indicate the extent, to which they would trust the presented financial process. Such a single-item measure is common in experiential conjoint settings, as it helps to reduce the overload for participants (Atzmüller and Steiner 2010). Trust in a digital financial process was measured on an 11-point scale (Shepherd et al. 2013), ranging from “not trust at all” (0%) to “completely trust” (100%).

Control variables. First, we controlled for the financial process type (payment, raising of credit, insurance) by creating a dummy variable for the last two process categories. Second, we controlled for a high transaction value, by creating an according dummy variable.

3.3.4 Analysis

The design of our experiment resulted in eight observations per participant, generating 2,840 observations. Because our data was nested within individuals, we applied Hierarchical Linear Modelling (HLM) to account for the hierarchical data structure (Raudenbush and Bryk 2002; Shepherd et al. 2013). To estimate the effect of the implementation of peer-to-peer a platform, a robo-advisor, self-service tools, biometric authentication mechanisms and blockchain on customer trust in a digital financial process, we used a mixed methods data analysis in Stata 14.1., utilizing a maximum likelihood estimation for a random effects model

(Shepherd et al. 2013). To analyze, which of the considered financial technologies is the strongest in gaining customer trust, we compared the 95% confidence intervals of the coefficients with each other. We considered the effects as significantly different, if the coefficients were not contained in the other's confidence interval (Kelley 2007).

3.4 Results

3.4.1 Hypotheses testing

Table 6 presents descriptive statistics in terms of means, standard deviations, and correlation coefficients for our variables. Table 7 shows the regression results.

Table 6. Descriptive statistics and correlations

Variable	Obs.	M	SD	Min	Max	1	2	3	4
1. Process credit	2,840	0.35	0.48	0	1	-			
2. Process insurance	2,840	0.32	0.47	0	1	-0.51 *	-		
3. High transaction value	2,840	0.49	0.50	0	1	-0.02	0.01	-	
4. Trust	2,840	56.27	25.38	0	100	-0.05 *	-0.05 *	-0.05 *	-

Note: * $p < 0.05$.

Hypothesis 1 predicted that the implementation of a peer-to-peer platform in a digital financial process would lead to a lower trust in this financial process. The effect of the implementation of peer-to-peer platform on trust was negative, but not significant (b = -0.74, *ns*, Model 1). Therefore, Hypothesis 1 was not supported.

Hypothesis 2a suggested that the implementation of a robo-advisor would be associated with a higher trust in a digital financial process, whereas Hypothesis 2b predicted just the opposite. As Table 7 shows, the effect of the implementation of a robo-advisor on trust was negative and not significant (b = -0.15, *ns*, Model 1). Hence, both Hypotheses 2a and 2b were not supported.

According to Hypothesis 3, we expected a positive relationship between the implementation of self-service tools and trust in a digital financial process. The effect of the implementation of self-service tools on trust was positive and highly significant (b = 4.02, $p < 0.001$, Model 1), supporting Hypothesis 3.

In Hypothesis 4, we proposed a positive relationship between the implementation of biometric authentication mechanisms and trust. The corresponding coefficient in Table 7 was positive and highly significant (b = 8.27, $p < 0.001$, Model 1). This fully supports Hypothesis 4.

Finally, Hypothesis 5 predicted that the implementation of blockchain in a digital financial process would lead to a higher customers trust. The coefficient in Table 7 was positive and highly significant (b = 5.37, $p < 0.001$, Model 1), thus fully supporting Hypothesis 5.

Further, we examined our Research Question, exploring, which of the studied financial technologies was the strongest in gaining customer trust in a digital financial process. In doing this, we considered only significant coefficients, thus leaving non-significant coefficients for a peer-to-peer platform and a robo-advisor out from consideration. As Table 7 (Model 1) illustrates, the following rank order for the considered technologies arose based on their coefficients: 1) biometric authentication mechanisms (b = 8.27, $p < 0.001$, Model 1), 2) blockchain (b = 5.37, $p < 0.001$, Model 1), and 3) self-service tools (b = 4.02, $p < 0.001$, Model 1). The comparison of the corresponding confidence intervals reveals that the coefficient of biometric authentication mechanisms (b = 8.27, CI: 6.67; 9.88) was not contained in the confidence interval of the coefficient of blockchain (b = 5.37, CI: 3.94; 6.81) as well as self-service tools (b = 4.02, CI: 2.68; 5.36) and vice versa. Hence, the effect of biometric authentication mechanisms on trust was significantly stronger than the effect of blockchain and self-service tools. Further, the coefficient of self-service tools was contained in the confidence interval of the coefficient of blockchain. Thus, no significant differences resulted between the effect of blockchain and self-service tools.

Table 7. Results of Hierarchical Linear Modelling, Model 1-4

	Model 1			Model 2			Model 3			Model 4		
	Main analysis	LL	UL	Payment	LL	UL	Credit	LL	UL	Insurance	LL	UL
Intercept:	51.97 ***	48.29	55.64	51.29 ***	46.15	56.43	48.09 ***	43.95	52.24	46.80 ***	41.83	51.77
Controls:												
Process credit	-4.62 *	-8.76	-0.48									
Process insurance	-4.76 *	-8.99	-0.53									
High transaction value	-1.89	-5.30	1.52	0.05	-6.37	6.46	-4.40 †	-9.35	0.55	-0.66	-7.10	5.77
Main effects:												
Peer-to-peer platform	-0.74	-2.53	1.05	2.09	-0.76	4.94	-4.02 *	-7.38	-0.66	-0.02	-2.88	2.83
Robo-advisor	-0.15	-1.66	1.37	0.63	-2.06	3.31	-0.22	-2.90	2.46	-0.86	-3.37	1.66
Self-service tools	4.02 ***	2.68	5.36	2.61 *	0.20	5.02	4.46 ***	2.15	6.77	4.98 ***	2.79	7.17
Biometric authentication	8.27 ***	6.67	9.88	8.81 ***	5.83	11.80	9.38 ***	6.93	11.83	6.51 ***	3.61	9.42
Blockchain	5.37 ***	3.94	6.81	3.38 *	0.76	6.01	7.22 ***	4.88	9.56	5.37 ***	2.89	7.85
Wald-Chi2	199.26 ***			46.64 ***			115.80 ***			57.66 ***		
Number of observations	*2,840*			*928*			*1,000*			*912*		
Number of individuals	*355*			*116*			*125*			*114*		

Note: † p < .10, * p < .05, ** p < .01, *** p < .001. Dependent variable: Trust, scale: 0-100. Method: mixed-effects ML regression in Stata 14.1. Regression with unstandardized coefficients.

3.4.2 Robustness checks

To test these results further, we conducted robustness checks. Particularly, we verified, whether our results held for different types of financial processes, as the effect of the financial process types, which we controlled for, on trust was significant in the main analysis (Model 1). Hence, we separately repeated our analyses for three considered process types – payment, raising of credit, and insurance. Table 7 depicts the results of this robustness check.

Concerning Hypothesis 1, the results for the implementation of a peer-to-peer platform on customer trust in a digital financial process remained robust for payment (b = 2.09, *ns*, Model 2) and insurance (b = -0.02, *ns*, Model 4). For raising of credit, the effect was negative and significant (b = -4.02, $p < 0.05$, Model 3), therefore providing support for Hypothesis 1.

The results of testing of all other hypotheses, concerning the implementation of a robo-advisor (payment: b = 0.63, *ns*, Model 2; raising of credit: b = -0.22, *ns*, Model 3; insurance: b = -0.86, *ns*, Model 4); self-service tools (payment: b = 2.61, $p < 0.05$, Model 2; raising of credit: b = 4.46, $p < 0.001$, Model 3; insurance: b = 4.98, $p < 0.001$, Model 4); biometric authentication mechanisms (payment: b = 8.81, $p < 0.001$, Model 2; raising of credit: b = 9.38, $p < 0.001$, Model 3; insurance: b = 6.51, $p < 0.001$, Model 4); and blockchain (payment: b = 3.38, $p < 0.05$, Model 2; raising of credit: b = 7.22, $p < 0.001$, Model 3; insurance: b = 5.37, $p < 0.001$, Model 4) proved robust. Therefore, with exception of finding marginal support for Hypothesis 1 in case of processes of raising of credit, all other results of hypotheses testing remained robust.

Regarding our Research Question, the rank order for financial technologies based on their coefficients proved robust for all variations. The results of technologies comparison based on their confidence intervals proved robust for processes of payment (biometric authentication mechanisms: b = 8.81, CI: 5.83; 11.80; blockchain: b = 3.38, CI: 0.76; 6.01; self-service tools: b= 2.61, CI: 0.20; 5.02). For processes of raising of credit, only the results of the comparison between biometric authentication mechanisms (b = 9.38, CI: 6.93; 11.83) and self-service tools (b = 4.46; CI: 2.15; 6.77) remained robust. Apart from that, the effect of biometric authentication mechanisms on trust was not significantly stronger than the effect of blockchain (b = 7.22, CI: 4.88; 9.56), which was significantly stronger than the effect of self-service tools. For insurance processes, only the results of the comparison between blockchain (b = 5.37, CI: 2.89; 7.85) and self-service tools (b = 4.98; CI: 2.79; 7.17) proved robust. Other than that, the effect of biometric authentication mechanisms (b = 6.51, CI: 3.61; 9.42) on trust was not significantly different from the effect of blockchain and self-service tools.

3.5 Discussion

The goal of this study was to analyze the impact of the implementation of five currently discussed examples of financial technology – peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain – on customer trust in digital financial processes and to investigate, which of these technologies is the strongest in gaining customer trust. We tested these effects on three types of financial processes – payment, raising of credit, and insurance – combining them with two financial contexts – high and low value of the considered financial transaction, in order to make our results better generalizable across different financial settings.

As our results show, the implementation of a peer-to-peer platform in digital financial processes mostly did not influence customer trust in these processes. However, the implementation of a peer-to-peer platform significantly decreased trust when processes of raising of credit were considered. Further, we found that the implementation of a robo-advisor in digital financial services did not influence customer trust. Our results also reveal that the implementation of self-service tools, biometric authentication mechanisms, and blockchain increased customer trust in digital financial processes.

In line with this, biometric authentication mechanisms, blockchain and self-service tools covered the first three positions in the rank order of technologies with regard to gaining customer trust. Biometric authentication mechanisms were across different settings almost always stronger in generating customer trust than self-service tools, and sometimes stronger as blockchain. Blockchain was in most cases not significantly stronger in gaining customer trust than self-service tools. With these results, biometric authentication mechanisms tended to be the strongest financial technology in gaining customer trust, followed by blockchain and self-service tools.

Whereas our results concerning the effects of the implementation of self-service tools, biometric authentication mechanisms, and blockchain on trust were consistent with our theoretical reasoning and the hypothesized relationships, our findings concerning a peer-to-peer platform and a robo-advisor were for the most part unexpected. For a peer-to-peer platform, we expected a negative relationship between its implementation and trust, but found support for a negative relationship only for processes of raising of credit. A possible explanation of these findings could be that customers consider financial risk in this case as being particularly high. Peer-to-peer processes of raising of credit are usually conducted with unrelated and, therefore, anonymous transaction partners, leading to a higher transaction risk (Greiner and Wang 2010; Jiang et al. 2018), whereas in peer-to-peer payment and insurance processes, transaction partners can also be family and friends (Gomber et al. 2017), reducing therefore the transaction risk. Therefore, enhanced risk perceptions of individuals concerning raising of credit in peer-to-peer contexts could be linked to decreased trust.

For a robo-advisor, we formulated a two-sided hypothesis, as we found arguments in literature, which can support both a positive and a negative effect of the implementation of a robo-advisor in digital financial processes on customer trust. However, we found no significant effect. A possible explanation of this finding could be that an implementation of a robo-advisor in digital financial processes does not lead to trust building per se. Instead, it could be that robo-advisors are very heterogeneous in their design and functionalities, such that customer trust first develops based on a specific design of a robo-advisor (Jung et al. 2018b), such as the degree of transparency (Nussbaumer et al. 2012), usability (Jung et al. 2018b), social presence, or mitigation of privacy concerns (Ruf et al. 2015).

3.5.1 Theoretical contributions

With these results, we extend current literature at the intersection of financial technology and trust (Greiner and Wang 2010; Ogbanufe and Kim 2018) in three ways. First, we tested whether just the implementation of financial technology can already hurt or build trust in digital financial processes on the customer side (Ogbanufe and Kim 2018). As a result, we found that the implementation of self-service tools, biometric authentication mechanisms, and blockchain built customer trust in a digital financial process, whereas the implementation of a peer-to-peer platform hurt it under certain circumstances. We are, thereby, able to show that trust in digital financial processes can be an outcome of the implementation of different forms of financial technology in these processes (Ogbanufe and Kim 2018). Herewith, we extend prior research, which has predominantly considered trust as an outcome of trust-building mechanisms such as characteristics of customer (Duarte et al. 2012), service provider (Li et al. 2008) or technology interface (Gefen et al. 2003b), but mainly not as an outcome of financial technology implementation (Ogbanufe and Kim 2018).

Second, in doing this, we examined five examples of financial technology – peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication, and blockchain. This is particularly important because these examples of financial technology are currently broadly discussed by practitioners and researchers and are increasingly implemented in digital financial processes (Alt et al. 2018; Gomber et al. 2018a; Gomber et al. 2018b). Therefore, existing research has already called upon further investigation of customer reactions to these financial technologies (e.g., Gomber et al. 2018a; Gomber et al. 2017). Examples are calls for an investigation of trust issues in peer-to-peer platforms (Dodgson et al. 2015), potentials and opportunities of robo-advisors (Gomber et al. 2017) in terms of e.g. user acceptance and related outcomes (Morana et al. 2018), customer reactions to self-service tools in the digital financial context (Gomber et al. 2018a), analysis of biometric authentication mechanisms from the consumer acceptance perspective (Miltgen et al. 2013), as well as creating trust through blockchain in the absence of intermediaries (Dodgson et al. 2015). We are able to address these calls in our study, by providing a snapshot of customer trust in digital financial processes, which makes use of the above-mentioned technologies. This snapshot reveals that trust is currently missing in the context of peer-to-peer platforms and still has to be developed, especially for processes of raising of credit (Greiner and Wang 2010). Further, it shows that robo-advisors currently neither enhance nor reduce customer trust, so attempts to develop trust in processes, using robo-advisors, should be intensified for different customer groups (Jung et al. 2018b). Finally, this snapshot provides empirical evidence that self-service tools, biometric authentication mechanisms and blockchain are already able to generate trust by customers.

Third, we examined, how the effects of the financial technology implementation on trust in digital financial processes differ among peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication, and blockchain. We also explored, which of these technologies might be strongest in gaining customer trust (Gomber et al. 2018a). As our results revealed, biometric authentication mechanisms tended to be the strongest financial technology in gaining customer trust, followed by blockchain and self-service tools. Our study is herewith, to our best knowledge, the first to compare these financial technologies with respect to trust empirically. By these means, we highlight against the backdrop of the heterogeneous financial technology landscape (Gomber et al. 2018a) that not only financial technologies, but also their perceptions by customers can differ. For instance, customers might perceive not all financial technologies as being trustworthy. Those financial technologies, which are perceived as being trustworthy, can differ in the extent, to which they are able to generate trust by customers.

3.5.2 Limitations and future research

Our study also has limitations. First, whereas we are able to establish causality between the implementation of financial technology in digital financial processes and trust due to the experiential conjoint design (Atzmüller and Steiner 2010; Shepherd et al. 2013), we have to acknowledge for a limited external validity of our findings. Due to the experiential design and, therefore, controlled artificial setting, our findings may not be directly generalizable to other settings (Spence and Keeping 2010), such as real-world situations or other financial contexts. With respect to the generalizability of our results to real-world situations, although we carefully designed our experiment and attached great importance to making the experiential profiles as close to real decision situations as possible, these profiles still presents an approximation of real financial transactions (Shepherd et al. 2013). Though prior research has shown that hypothetical profiles, used in such experiments, are able to generate decisions, very similar to real decisions (Shepherd et al. 2013), future research might examine the effects of the implementation of peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication, and blockchain on customer trust under non-experimental conditions. With respect to the generalizability of our results to other financial contexts, although we implemented additional scenarios in terms of payment, raising of credit, and insurance processes as well as high and low transaction value to increase the external validity (Atzmüller and Steiner 2010), future research might explore further contexts, such as digital investments (Gomber et al. 2017).

Second, although the age of our sample ranged between 18 and 64 years, the average age of our participants was 26.47 years. Hence, persons of other age groups were underrepresented in our sample. This might be important because age can play a role for customer attitude towards innovative digital technologies and, therefore, limit the generalizability of our results (Miltgen et al. 2013). Therefore, future research might repeat our study using another sample and accounting for a fairer age distribution.

Third, we conducted our experiment with participants from only one country – Germany. This could potentially limit the generalizability of our results to other countries (Shepherd et al. 2013). Despite the fact that in 2017, the adoption of financial technology by population in Germany was only 2% above the average worldwide adoption of 33% (EY 2017), future research might investigate the influence of financial technology implementation on customer trust on a cross-country sample.

3.5.3 Practical implications

In this study, we provide a current snapshot of customer trust in digital financial processes, in which five currently discussed examples of financial technology – peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication, and blockchain – are implemented. According to this snapshot, customers might distrust digital financial processes, making use of peer-to-peer platforms, particularly in the case of transactions of raising of credit. At the same time, customer trust might not be affected by the implementation of robo-advisors. Further, customers trust in digital financial processes can be increased, if these processes utilize self-service tools, biometric authentication mechanisms, and blockchain. Among all these financial technologies, biometric authentication mechanisms tend to be the strongest technology in gaining customer trust, followed by blockchain and self-service tools. These results provide important implications to practitioners.

First, financial technology start-ups, traditional financial institutions such as banks and insurance companies as well as financial technology platform and application developers (Lee and Shin 2018), should be aware of the fact that customer reactions to different financial technologies differ. Therefore, these firms should carefully design digital financial processes, which they offer to customers, in order to be able to gain their trust. Second, if these firms intend to implement peer-to-peer platforms and robo-advisors, they should appreciate that they might not gain customer trust in their financial processes just through the implementation of these technologies. Instead, firms should think of possibilities, how to develop customer trust in processes with such technologies. This might be particularly important in the context of peer-to-peer platforms, as customers might even distrust processes, based on peer-to-peer platforms, under certain circumstances. Third, in order to gain customer trust in their processes, such firms could implement self-service tools, biometric authentication mechanisms, and blockchain, as already the implementation of these technologies increases customer trust in digital financial processes. Fourth, by designing their processes, these firms should be sensible of the finding that biometric authentication mechanisms tended to be the strongest among technologies considered with respect to generating customer trust. Therefore, firms can think of implementing this technology in different financial processes that they offer customers. Beyond financial technology start-ups, traditional financial institutions as well as platform and application developers, these results are also relevant for companies from different industries such as electronic vendors, which offer their customers financial transactions such as online payments and seek to gain customer trust (Gefen et al. 2003b; Ogbanufe and Kim 2018).

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4 The impact of financial technology on customer intention to use financial services through the lenses of process virtualization theory

Abstract

The ongoing digitalization in the financial services industry induces firms to implement financial technology in their digital processes to attract customers. However, research on mechanisms, by which financial technology affects customer intention to use financial processes, is very fragmented. Thus, relying on process virtualization theory, we study the effect of financial technology implementation on intention to use via relationship, synchronism, and identification and control readiness of processes. The results of our conjoint experiment with 302 participants indicate that relationship, synchronism, and identification and control readiness jointly transmit the effect of financial technology implementation on customer intention to use financial processes. Our results further suggest that financial technology implementation generally increases customer intention to use financial processes. Our study integrates research on financial technology and process virtualization by explaining customer intention to use processes with financial technology through process readiness, and supports practitioners in addressing the needs of financial services customers.

Keywords

Financial technology, digital financial processes, intention to use, process virtualization theory.

Current status

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4.1 Introduction

The ongoing digitalization in the financial services industry transforms and dramatically changes the existing financial service processes through financial technology, also called fintech (e.g., Alt et al. 2018; Gomber et al. 2018a). Financial technology primarily encompasses any digital technology that enhances an existing financial service process by making it more convenient, accessible and efficient for customers (Alt et al. 2018; Hendershott et al. 2017). By these means, the use of financial technology implicates a shift to a customer-centric perspective for firms (Alt et al. 2018; Puschmann 2017).

By implementing financial technology in their service processes, firms in the highly competitive financial services market (Christensen et al. 2016) seek to improve customer experience (Alt et al. 2018; Gomber et al. 2018a) to be able to acquire new and retain old customers (Gomber et al. 2018a). This is essential since even a small improvement in a customer retention rate can help firms to realize enormous financial benefits (Wang 2008). However, whether firms can succeed in this endeavor, depends on customer intention to use the resulting service offering (Lu et al. 2011; Wang 2008).

But how does the implementation of financial technology influence customer intention to use digital financial processes? In this respect, the emerging research on financial technology (Hendershott et al. 2017; Puschmann 2017) has generated a mixed and fragmented evidence (e.g., Jung and Weinhardt 2018; Ogbanufe and Kim 2018; Yan et al. 2013), relying either on trust (Chen et al. 2014) or technology usefulness or ease of use (Blut et al. 2016) as possible mechanisms. In doing so, it has missed to account for the process nature of financial processes (Alt and Puschmann 2012; Overby 2008), which present a series of steps by a service provider and customer in order to enable digital financial transactions for a customer (Lusch et al. 2010; Vargo and Lusch 2004). As outlined by process virtualization theory (Balci 2015; Overby 2008), customer intention to use the offered processes based on the implementation of financial technology such as blockchain (Steininger 2019), can be predicted by the special process requirements such as relationship building, synchronicity or control (Graupner and Maedche 2015). Therefore, we study how financial technology influences customer intention to use digital financial processes based on process virtualization theory (Overby 2008). For this purpose, we collected data from an online conjoint experiment.

Our results have three theoretical contributions. First, we integrate research on financial technology (Alt et al. 2018) with research on process virtualization (Graupner and Maedche 2015) by applying process virtualization theory to financial processes. Particularly, we explore, whether the impact of the financial technology implementation in digital financial processes on customer intention to use them can be explained through the requirements of process virtualization theory (Overby et al. 2010). Second, we extend research on process virtualization theory (Thomas et al. 2016) by testing it in an entirely digital context. Herewith, we examine, whether process virtualization theory can explain the amenability of processes not only to a transition from a physical to a digital form (Overby 2008), but also to a further enhancement by means of a new digital technology. Third, we extend research on financial technology through investigating customer reactions to it in terms of customer intention to use digital financial processes with financial technology implemented. By these means, we address open questions, positioned by scholars from the financial technology field, of whether customers are going to adopt financial processes, based on financial technology (Puschmann 2017) and how firms, operating with financial technology, can increase their market success (Gomber et al. 2018a).

This study has also practical implications. We shed light on the mechanisms, by which financial technology shapes customer preferences concerning digital financial processes (Chen et al. 2014). By these means, we help financial market players such as traditional firms, financial technology start-ups, and technology developers (Lee and Shin 2018) to better understand the customers and their preference formation. Further, we provide firms with a snapshot of a customer attitude towards financial technology, which these firms are currently discussing and already starting to implement in their processes (Beinke et al. 2018; Eickhoff et al. 2017; Puschmann 2017).

The remainder of this study is organized as follows. First, we present our theoretical background and formulate the hypotheses. Next, we describe our conjoint experiment and show its results. Finally, we discuss our results, outline theoretical and practical contributions, and identify areas for future research.

4.2 Theoretical background

4.2.1 Process virtualization theory

Process virtualization theory (Overby 2008) addresses the migration of processes from a physical to a virtual environment (Overby et al. 2010). Particularly, it explains why some processes are more amenable to being conducted virtually than others (Overby 2008). According to this theory, the amenability of a process to function without a physical interaction depends on the degree, to which four process requirements are fulfilled in a virtualized process (Thomas et al. 2016). These four requirements are sensory, relationship, synchronism as well as identification and control requirements (Overby 2008). First, *sensory* requirements refer to the need of process participants to have a full sensory experience of the process, other process participants and objects. Second, *relationship* requirements define the need of process participants to interact with each other in a social or professional context and develop relationships. Third, *synchronism* requirements address the need of process activities to happen one after another with a minimal delay. Fourth, *identification and control* requirements define the need to identify process participants and have control over the process (Overby 2008). If sensory, relationship, synchronism, as well as identification and control requirements are fulfilled, one can speak of sensory, relationship, synchronism, as well as identification and control readiness of a process (Bose and Luo 2011). Accordingly, each of process readiness types is defined as the degree, to which the corresponding requirement is fulfilled in virtualized process (Bose and Luo 2011; Thomas et al. 2016). Process readiness is expected to positively influence process virtualizability (Bose and Luo 2011; Thomas et al. 2016), which is reflected in either adoption or outcomes of the virtualized process, such as customer intention to use a virtualized process (Graupner and Maedche 2015). If process virtualization happens by means of digital technologies, it is called digitalization (Graupner and Maedche 2015).

Although initially developed to explain the transition of processes from a physical to a virtual form, process virtualization theory (Overby 2008) provides a suitable framework for studying the digitalization of financial processes by means of financial technology. Indeed, with the exception of sensory readiness, which has no explanatory power in the financial context because it is not possible to assess the importance of touching, tasting, hearing and smelling financial processes and financial technology (Overby 2012), relationship, synchronism as well as identification and control readiness have not lost their importance in an entirely digital environment. For instance, customers still seek social presence of service providers in digital financial processes such as financial advisory (Jung et al. 2018b), wish to get financial solutions quickly (Jung et al. 2018b), and have high data privacy concerns (Belanger and Crossler 2019). Therefore, we rely on process virtualization theory to study, how the implementation of financial technology affects customer intention to use digital financial processes.

4.2.2 Financial technology and process readiness

Relationship readiness. The implementation of financial technology in a digital financial process can involve anonymity concerning both the service provider and transaction partners (Jiang et al. 2018a). For instance, the use of financial technology (e.g., blockchain) often does not require the process participation of traditional financial intermediaries such as banks (Du et al. 2019), whose representatives customers often personally know. Thus, customer counterparts in digital processes, based on financial technology, are service providers or application development teams, who usually remain anonymous for customers (Ostern 2018). Further, in processes, based on financial technology (e.g., peer-to-peer platforms), transaction partners can be unrelated persons, which can be located all around the globe. Therefore, customers typically do not know their transaction partners in such processes (Greiner and Wang 2010; Jiang et al. 2018a; Jiang et al. 2018b).

Besides involving anonymous transactions, the implementation of financial technology in a digital financial process can reduce the need of customers to interact with customer support due to a superior service offering (Ogbanufe and Kim 2018). For instance, financial technology (e.g., biometric authentication mechanisms) can replace traditional functionalities such as passwords and Personal Identification Numbers, which can more often be subject to customer inquiries, as they can easily be forgotten, lost or even stolen by others (Boukhonine et al. 2005; Ogbanufe and Kim 2018). Hence, the implementation of financial technology can make customer support requests regarding such functionalities obsolete.

Not only can financial technology reduce customer contact with customer support, it can also substitute interactions between customers and human employees with technological applications (Gomber et al. 2018a). For example, the implementation of financial technology (e.g., self-service tools) allows customers to use the offered functionalities without being assisted by service provider employees (Blut et al. 2016). Further, in financial advisory processes, the implementation of financial technology (e.g., robo-advisors) can entirely substitute personal interviews with human employees through online questionnaires (Jung et al. 2018a). Accordingly, a human counterpart, who could responsively react to customer ad-hoc problems, is not present during the service process, giving customers no possibility to directly interact and communicate with service employees (Jung et al. 2018a; Scherer et al. 2015).

Therefore, the implementation of financial technology in a digital financial process can result in anonymity, reduced interaction need with customer support or even in an entire substitution of interactions between customers and human employees through technology. Hence, it should be more difficult for customers to participate in interpersonal interactions, establish social connections or develop relationships with service provider employees or other transaction partners in digital financial processes, implying financial technology (Jung et al.

2018b). Therefore, we propose, that the implementation of financial technology in a digital financial process will lead to a lower relationship readiness of this process (Overby 2008):

H1: The implementation of financial technology leads to a lower relationship readiness of a digital financial process.

Synchronism readiness. The implementation of financial technology can enable seamless transactions (Gomber et al. 2018a; Ryu 2018). For example, as the use of financial technology (e.g., peer-to-peer platforms) can make intermediaries obsolete (Du et al. 2019), a third party is not required to verify such transactions (Du et al. 2019; Nofer et al. 2017). Further, due to financial technology (e.g., blockchain), manual inputs from operators to verify transactions are removed and substituted by an automated process (Du et al. 2019).

Besides enabling seamless transactions, the implementation of financial technology can make financial processes independent from the availability of human employees (Gomber et al. 2018a; Scherer et al. 2015). For instance, due to the absence of human employees in many processes, based on financial technology (e.g., self-service tools or robo-advisors), customers can conduct the process online at any time, from any place and at any speed desired (Baer and Leyer 2016; Jung et al. 2018a; Scherer et al. 2015; Yan et al. 2013).

The increased speed of the financial process, based on financial technology, can result not only from the independence of the process from human employees, but also from a higher process efficiency. For instance, due to financial technology (e.g., robo-advisors), large amounts of data can be analyzed and recommendations concerning the best financial options can be provided very quickly (Jung et al. 2018a). As another example, in an authentication process using financial technology (e.g., biometric authentication mechanisms), user's biometric data is scanned automatically, such that a user does not need to perform any actions (Boukhonine et al. 2005; Ogbanufe and Kim 2018), making the process much quicker compared with traditional authentication methods (Miltgen et al. 2013).

Thus, the implementation of financial technology can lead to seamless transactions, independence from the availability of human employees and a higher process efficiency. Accordingly, the implementation of financial technology in digital financial processes should result in very fast or even immediate transactions (Baer and Leyer 2016; Du et al. 2019; Gomber et al. 2018a; Gomber et al. 2017; Ryu 2018; Yan et al. 2013). Hence, we expect it to have a positive impact on synchronism readiness (Overby and Konsynski 2010):

H2: The implementation of financial technology leads to a higher synchronism readiness of a digital financial process.

Identification and control readiness. The implementation of financial technology can allow customers to have a better control over the financial process. For instance, in processes, based on financial technology (e.g., peer-to-peer platforms), customers can decide, with which partners to transact, based on their own preferences (Jiang et al. 2018b). Furthermore, when using processes with financial technology (e.g., self-service tools), customers can perform the financial process according to their needs (Scherer et al. 2015; Xiao and Benbasat 2007). For example, they can determine the speed, with which they want to conduct the process, the actions, which will be performed (Collier and Sherrell 2010), as well as whether to follow the recommendations, provided by financial technology applications (e.g., robo-advisors) or to reconfigure their profile to receive alternative suggestions (Jung et al. 2018a; Jung and Weinhardt 2018).

Additionally to control over the financial process, financial technology can provide customers with better possibilities to have control over their data. For instance, when using financial technology (e.g., robo-advisors or self-service tools), customers can decide, which information about their financial profile they would like to enter during the financial process such as robo-advisory (Collier and Sherrell 2010; Jung et al. 2018a). Further, financial technology (e.g., blockchain) allows customers to retain control over their data, as it encrypts data before sharing it on the distributed ledgers (Du et al. 2019).

Besides providing customers with possibilities to control their data, financial technology can offer customers a high degree of safety and security for their transactions (Boukhonine et al. 2005; Gomber et al. 2018a; Ogbanufe and Kim 2018). For example, due to implemented financial technology (e.g., peer-to-peer platforms), customers do not have to share their bank account data with other individuals (Gomber et al. 2017). Additionally, the implementation of financial technology (e.g., biometric authentication mechanisms) reduces the risk of losing or forgetting passwords or getting them stolen by others (Clodfelter 2010; Ogbanufe and Kim 2018). Further, financial technology (e.g., blockchain) offers safety from information manipulation attempts due to its blocks-based structure, which comprises the complete transaction history and enables very transparent transactions (Gomber et al. 2018a; Nofer et al. 2017).

Hence, digital financial processes, involving financial technology, can be expected to offer customers a better control over the process and their data as well as a high degree of safety and security (Collier and Sherrell 2010; Du et al. 2019; Nofer et al. 2017; Ogbanufe and Kim 2018). Accordingly, the implementation of financial technology should positively influence identification and control readiness (Overby 2012):

H3: The implementation of financial technology leads to a higher identification and control readiness of a digital financial process.

4.2.3 The effect of financial technology on intention to use via process readiness

As argued above, the implementation of financial technology in a digital financial process can be expected to influence the degree, to which customers assess their needs of relationship development, synchronicity, as well as identification and control as being met or at least addressed in a digital financial process. If this degree is high, customers will assess the quality of the financial process outcomes as well as the benefits, associated with the process use, as being higher (Overby 2008; Ryu 2018). According to process virtualization theory (Overby 2008), customers will hence be more willing to use the offered financial processes

(Bose and Luo 2011; Graupner and Maedche 2015; Ryu 2018). Thus, we expect financial technology to influence customer intention to use the process via relationship, synchronism as well as identification and control readiness.

We expect these mediating effects to be present simultaneously (Overby 2008). Due to the proposed negative link between the implementation of financial technology and relationship readiness, and positive links between financial technology and synchronism as well as identification and control readiness, these mediating effects are partially of opposite direction. Therefore, to determine the direction of the total effect, it is necessary to consider the relative importance of the three types of process readiness for customers.

Nowadays, financial services customers attach great importance to an increased transaction speed, wish seamless financial transactions (Ryu 2018), and demand financial processes, which can be accessed anytime customers need them (Gomber et al. 2017). Further, due to growing data privacy concerns, it becomes increasingly important for customers to have a higher control over their data in financial transactions (Belanger and Crossler 2019). Although social aspects may be important for customers (Jung et al. 2018b), the majority of them has nevertheless greatly reduced their branch visits and switched to an online version of financial processes, thus choosing more convenient and controllable transactions over processes with personal relationship building (Gomber et al. 2018a; Gozman et al. 2018; Puschmann 2017). Therefore, if it comes to a trade-off between relationship building and synchronicity as well as data control, we expect customers to place higher value on the latter two. Thus, we expect the positive effects of synchronism and identification and control readiness to overweigh the negative effect of relationship readiness together, resulting in a positive effect of financial technology on intention to use:

H4: The implementation of financial technology has a positive a) indirect effect via relationship, synchronism as well as identification and control readiness, and b) total effect on customer intention to use a digital financial process.

Our overall research model is presented in Figure 2.

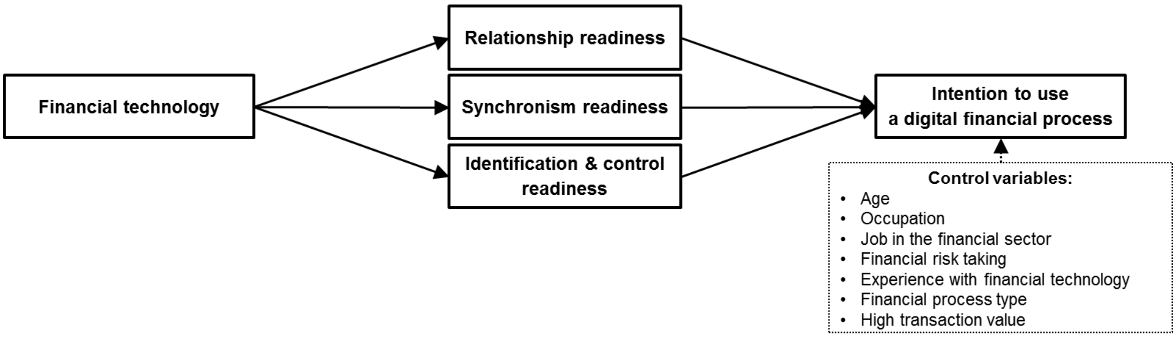

Figure 2. Research Model

4.3 Methods

4.3.1 Research design

To test our hypotheses, we used multiple examples of financial technology, because it can be implemented in digital financial processes in many forms (Eickhoff et al. 2017), such as applications, authentication, and blockchain (Gomber et al. 2018a; Gomber et al. 2017; Puschmann 2017). Particularly, we considered peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain, since these examples of financial technology address different financial innovation categories (Puschmann 2017), and are currently broadly discussed in research and practice (Alt et al. 2018; Gomber et al. 2018a; Gomber et al. 2018b). As these financial technologies are often simultaneously implemented in digital financial processes (Alt et al. 2018; Puschmann 2017), we conducted an online conjoint experiment. Conjoint design has been widely applied to measure customer preferences in different research fields (Green et al. 2001), such as information systems research (Benlian and Hess 2011; Berger et al. 2015), particularly in studies of end-user adoption of new technologies (Naous and Legner 2017). In our study, we asked participants to assess the relationship, synchronism, and identification and control readiness of a digital financial process as well as their intention to use it based on five examples of financial technology.

Table 8. Financial technologies and their levels used, credit process example

Technology	Description	Implemented	Not implemented
Peer-to-peer platform	A website or an application, which allows private individuals to grant credits among themselves without participation of a financial institution.	The raising of credit is conducted from a private individual to a private individual via a peer-to-peer website or an application.	The raising of credit is conducted via a website or an application of a financial institution.
Robo-advisor	Automated credit advice, which is performed by digital algorithms based on personal information.	Advice concerning the raising of credit takes place in an automated way via a robo-advisor.	Advice concerning the raising of credit takes place digitally via employees of a financial service provider.
Self-service tools	Digital services around a credit contract, which customers can conduct on their own without an interaction with employees of a financial service provider.	The modalities of credit repayment can be adjusted independently via a website or an application.	The modalities of credit repayment can be adjusted only via employees of a financial service provider.
Biometric authentication	Technology for prevention of fraud actions through scanning of biometric user information such as face recognition, fingerprint and retina scan.	The financial service provider uses biometric authentication mechanisms.	The financial service provider uses personal login data.
Blockchain	Technology for decentralized storage and encryption of credit data.	The credit data is stored in a digital and decentralized way in a blockchain.	The credit data is stored in a digital and centralized way by a financial service provider.

Note. Translation from German, as the author originally developed the experiential tasks in German.

At the beginning of our experiment, we showed participants a brief description of the five examples of financial technology (Atzmüller and Steiner 2010), which were manipulated on two levels (Shepherd et al. 2013), as either implemented or not implemented in a digital financial process. An example of the description of financial technologies and their levels is presented in Table 8. Considering every possible combination of financial technologies and levels would have generated 2^5=32 profiles. As assessing so many profiles would have overloaded the participants, we decided in favor of a reduced design, limiting the number of profiles to eight based on an orthogonal design (Hahn and Shapiro 1966; Shepherd et al. 2013). This allowed us to analyze the main effects of financial technologies, which we were interested in (Hahn and Shapiro 1966; Shepherd et al. 2013). The description of the eight conjoint profiles is provided in Table 9 (Siegfried et al. 2015).

Table 9. Description of the eight conjoint profiles

Conjoint profile		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Peer-to-peer platform		Used	Not used	Not used	Not used	Not used	Used	Used	Used
Robo-advisor		Used	Used	Not used	Not used	Used	Not used	Used	Not used
Self-service tools		Not used	Used	Not used	Used	Not used	Used	Used	Not used
Biometric authentication		Used	Used	Not used	Used	Not used	Not used	Not used	Used
Blockchain		Not used	Not used	Not used	Used	Used	Not used	Used	Used
Relationship readiness	**Mean**	**0.588**	**0.588**	**0.719**	**0.636**	**0.584**	**0.642**	**0.606**	**0.648**
	SD	0.256	0.269	0.301	0.259	0.266	0.249	0.272	0.256
Synchronism readiness	**Mean**	**0.619**	**0.653**	**0.426**	**0.642**	**0.611**	**0.586**	**0.703**	**0.597**
	SD	0.222	0.235	0.295	0.221	0.227	0.215	0.243	0.226
Identification & control readiness	**Mean**	**0.515**	**0.572**	**0.440**	**0.612**	**0.505**	**0.552**	**0.601**	**0.549**
	SD	0.242	0.243	0.303	0.260	0.255	0.234	0.277	0.250
Intention to use	**Mean**	**0.552**	**0.617**	**0.476**	**0.639**	**0.532**	**0.566**	**0.644**	**0.577**
	SD	0.235	0.245	0.317	0.235	0.249	0.234	0.263	0.233

Note. Number of observations per profile is 302.

In the next step, to introduce participants to the experiential procedure, we showed them a sample profile (Shepherd et al. 2013; Siegfried et al. 2015). To account for possible order effects during the experiment, we presented profiles to participants in a randomized order

(Benlian and Hess 2011). For each of the presented conjoint profiles, we asked participants to indicate the perceived relationship, synchronism, and identification and control readiness of the described digital financial process as well as their intention to use this process (Benlian and Hess 2011).

To enhance the generalizability of our results to a larger number of settings, we implemented additional between-subjects manipulations (Atzmüller and Steiner 2010). First, to make the assessment task as concrete as possible while accounting for different types of financial processes (Puschmann 2017), we used three most common types of financial processes – payment, raising of credit, and insurance (Alt and Puschmann 2012; Gomber et al. 2017). Second, as high or low value of the underlying financial transaction might increase the perceived risk and thus make customers react to financial processes differently (de Haan et al. 2018; Greiner and Wang 2010; Kim and Benbasat 2009), we varied the transaction value for each of the financial process types as either high or low. Finally, we obtained 3 x 2=6 experiential scenarios. These scenarios comprised a money transfer of 1,000 Euro or 100 Euro, raising of credit of 110,000 Euro or 10,000 Euro, and insurance for a new Porsche 911 (approximate value of 110,000 Euro) or a new Dacia (approximate value of 10,000 Euro). We distributed these scenarios randomly among participants. In a final step, we collected control variables via an accompanying survey. Both the experiential task and the survey were pretested with two academic experts, two PhD students and two students (one undergraduate, one graduate) from the area of information systems and management. The link to the survey was spread via snowballing sampling method among students of a public technical university in Germany and their acquaintances as well as in online communities, which support researchers in finding survey participants.

4.3.2 Sample

We received 303 completed survey responses, but had to exclude one response due to data quality concerns[3]. Thus, our final sample comprised 302 participants. The average age of the participants was 27.29 years (SD=7.32), ranging from 18 to 66 years[4]; 54.64% were female. Concerning their occupation, 61.92% of the respondents were students, 25.17% were employed in a private and 6.95% in a public sector. The remainder accounted for househusbands/housewives, self-employed and unemployed persons, pupils and retirees. Additionally, 14.24% of the participants indicated a current or previous employment in the financial sector: 4.64% of them were working for a traditional financial service provider and 4.30% for a fintech start-up currently, while 4.30% used to be employed by a traditional service provider and 0.99% by a fintech start-up in the past. With respect to their highest education level, 50.33% of the participants had a bachelor degree, 23.18% completed a master degree, and 21.52% had a higher education entrance qualification, whereas the remaining participants completed a professional training or PhD.

4.3.3 Measures

We measured our dependent variable, *intention to use a digital financial process*, by using a single-item measure, which is despite a lower reliability compared to multi-item scales (MacKenzie et al. 2011) a common practice in experiential conjoint settings to reduce the overload for participants (Atzmüller and Steiner 2010). We asked participants to indicate the likelihood of using the presented financial process on an 11-point scale (Shepherd et al. 2013), ranging from “very unlikely” (0%) to “very likely” (100%).

To measure our mediators – relationship, synchronism as well as identification and control readiness – we followed the recommendations of prior research (Overby 2012) by

[3] This participant chose the highest scale points for all experiential and survey questions presented and indicated an age of 99 years while stating an employment in a private sector.
[4] One participant indicated an age of two, which we replaced with a sample mean age. This seemed reasonable as the participant stated to be a student in the eighth semester. We did not exclude this response, as there were no other indications of data quality issues.

deducing our measurement items from the existing scales (Balci 2015; Barth and Veit 2011; Graupner and Maedche 2015; Overby and Konsynski 2010), and tailoring them to the financial context. Each of the constructs was measured with a one-item measure (Atzmüller and Steiner 2010). We asked respondents to indicate the extent, to which they think that in the presented financial process 1) they would miss the interaction with other process participants such as transaction partners and customer support (*relationship readiness*, reverse-coded), 2) their financial request would immediately be proceeded (*synchronism readiness*), and 3) they would have control over their data (*identification and control readiness*). We modelled identification and control readiness as one construct, because its dimensions are linked conceptually and their main effects can be expected to be similar (Overby 2012). For all three constructs, we used an 11-point scale (Shepherd et al. 2013), ranging from "not at all" (0%) to "to a very high extent" (100%). For the subsequent data analysis, we recoded all percentage scales (0-100%) into fractional scales (0-1).

To measure our independent variable – financial technology, we created dummy variables – *peer-to-peer platform*, *robo-advisor*, *self-service tools*, *biometric authentication mechanisms*, and *blockchain* – which were coded one, when the respective financial technology was implemented, and zero otherwise.

As prior research has shown, that demographic and personal characteristics of customers might influence their intention to use new technologies (e.g., Blut et al. 2016), also in the financial sector (Yan et al. 2013), we included appropriate control variables. First, we controlled for a person's *age* in years (Basoglu et al. 2014). Then, we controlled for a person's occupation, by including dummy variables for the three largest occupation groups from our sample: *student*, *occupation private sector*, and *occupation public sector* (Gounaris and Koritos 2012). As especially a job in the financial sector might influence customer attitude towards digital financial processes with implemented financial technologies, we controlled for a current or previous *job* by a *traditional provider* or *fintech* start-up by creating an according dummy variable. Further, as using digital financial processes based on new technologies might be considered risky (Blut et al. 2016), we controlled for a person's financial risk attitude by accounting for willingness to take investment risk and gambling risk (Weber et al. 2002). We measured willingness to take *investment risk* by using five items (Fernandes et al. 2014; Weber et al. 2002), e.g. "Investing 10% of your annual income in a moderate growth mutual fund" ($\alpha = 0.837$) on a five-point scale, ranging from "very unlikely" (1) to "very likely" (5) as well as "not at all willing" (1) to "very willing" (5). *Gambling risk* was measured with four items (Weber et al. 2002), e.g. "Gambling a week's income at a casino" ($\alpha = 0.883$) on a five-point scale, ranging from "very unlikely" (1) to "very likely" (5). As prior experience with financial technology might influence customer intention to use it (Chen et al. 2014), we controlled for *experience* with a *peer-to-peer platform*, a *robo-advisor*, *self-service tools*, *biometric authentication mechanisms*, and *blockchain*. For this purpose, we asked participants to indicate, how often they use digital financial services, involving these technologies, on a four-point scale (Reinders et al. 2008), ranging from "never use" (1) to "use regularly" (4). Finally, we accounted for different experiential scenarios by including a dummy variable for the financial process type *payment* and *raising of credit* and for a *high transaction value*.

4.3.4 Analysis

The design of our experiment generated eight observations per participant, resulting in 2,416 observations. In our data, each person presented a cluster (Wooldridge 2012). As the outcomes within clusters are likely to be correlated, we allowed for unobserved cluster effects by using standard errors that are robust to any kind of serial correlation and heteroscedasticity (Wooldridge 2012). Hence, we applied a linear regression analysis with clustering at a person level, using the command *regress, cluster(id)* in Stata 14.1.

To assess the indirect effects of financial technology on intention to use via relationship, synchronism as well as identification and control readiness, we followed the recommendations of prior research by including multiple mediators into the same model to make the estimation results more precise (Hayes 2017; Preacher and Hayes 2008). Further, we used a bootstrapping procedure to assess the indirect effects, as this technique is nowadays preferred to the traditional causal steps approach (Baron and Kenny 1986) and the Sobel test (Sobel 1982) and can be applied if the assumption of multivariate normality is not fulfilled (Hayes 2017; Preacher and Hayes 2008). Bootstrapping has been widely utilized in information systems research (e.g., Fortmann-Müller 2018; Rauch et al. 2017; Siegfried et al. 2015). In this study, we used 95% percentile bootstrap confidence intervals (Hayes 2017, p. 107), obtained from 5,000 bootstrap samples (Preacher and Hayes 2008). We calculated the indirect effects using the PROCESS macro in SPSS 25 (Hayes 2017). To account for heteroscedasticity of any form, we used a robust inference in terms of Davidson-MacKinnon HC3 standard error estimator (Davidson and MacKinnon 1995; Hayes and Cai 2007).

4.4 Results

Table A1 in the appendix presents descriptive statistics and correlations. Although several correlations were significant, their coefficients did not exceed the critical value of 0.80 (Hair et al. 2009; Saunders et al. 2007). Hence, multicollinearity did not seem to present a problem for our data. This is also important in multiple mediator models, as the specific indirect effects might be attenuated to the extent, to which the mediators are correlated with each other (Preacher and Hayes 2008). Table 10 depicts our regression results. The results of our mediation analysis are presented in Table 11.

4.4.1 Hypotheses testing

Hypothesis 1 predicted that the implementation of financial technology would lead to a lower relationship readiness of a digital financial process. The effect of the implementation of all financial technologies on relationship readiness was negative and, with the exception of a peer-to-peer platform ($b=-0.010$, *ns*, Model 1), significant (robo-advisor: $b=-0.070$, $p<0.001$; self-service tools: $b=-0.017$, $p<0.05$; biometric authentication mechanisms: $b=-0.022$, $p<0.01$;

blockchain: b=-0.016, p<0.05; Model 1). Therefore, Hypothesis 1 was supported for all financial technologies except a peer-to-peer platform.

Hypothesis 2 argued that the implementation of financial technology would positively influence synchronism readiness. As a result, the regression coefficients were positive and significant for all financial technologies (peer-to-peer platform: b=0.043; robo-advisor: b=0.084; self-service tools: b=0.083; biometric authentication mechanisms: b=0.046; blockchain: b=0.067; p<0.001, Model 2). Hence, Hypothesis 2 was fully supported.

According to Hypothesis 3, we expected a positive relationship between the implementation of financial technology and identification and control readiness. The effect of the implementation of all financial technologies on identification and control readiness was positive and, with the exception of a robo-advisor (b=0.010, *ns*, Model 3), significant (peer-to-peer platform: b=0.022, p<0.05; self-service tools: b=0.082, p<0.001; biometric authentication mechanisms: b=0.037, p<0.001; blockchain: b=0.047, p<0.001; Model 3). Thus, with the exception of a robo-advisor, Hypothesis 3 was supported for all other technologies.

Hypothesis 4a) proposed a positive indirect relationship between the implementation of financial technology and customer intention to use via relationship, synchronism as well as identification and control readiness of a digital financial process. An examination of specific indirect effects reveals, as depicted in Table 11, that the specific indirect effect of financial technology via relationship readiness was not significant in case of a peer-to-peer platform, self-service tools, and blockchain. Further, the indirect effect of financial technology via identification and control readiness was not significant in case of a robo-advisor. All other specific indirect effects were significant, negative for relationship readiness and positive for synchronism as well as identification and control readiness. As Table 11 further demonstrates, the total indirect effect of the implementation of all financial technologies on intention to use via the above-mentioned mediator set was positive and significant (peer-to-peer platform: b=0.0217, CI=0.0099 to 0.0335; robo-advisor: b=0.0255, CI=0.0127 to 0.0380, self-service tools: b=0.0576, CI=0.0451 to 0.0698; biometric authentication mechanisms: b=0.0279, CI=0.0158 to 0.0399; blockchain: b=0.0391, CI=0.0270 to 0.0512). Hence, Hypothesis 4a) was supported 1) with the exception of relationship readiness in case of a peer-to-peer platform, self-service tools, and blockchain, as well as identification and control readiness in case of a robo-advisor, or 2) if relationship, synchronism as well as identification and control readiness were considered as a mediator set.

Table 10. Results of a linear regression analysis

Variables	Model 0 **Intention to use**	Model 1 **(H1)** **Relationship readiness**	Model 2 **(H2)** **Synchronism readiness**	Model 3 **(H3)** **Identification & control readiness**	Model 4 **(H4b)** **Intention to use**	Model 5 **Intention to use**
Peer-to-peer platform		-0.010 (0.009)	0.043 *** (0.010)	0.022 * (0.009)	0.019 (0.012)	-0.003 (0.008)
Robo-advisor		-0.070 *** (0.009)	0.084 *** (0.008)	0.010 (0.007)	0.022 ** (0.008)	-0.004 (0.007)
Self-service tools		-0.017 * (0.008)	0.083 *** (0.008)	0.082 *** (0.009)	0.082 *** (0.009)	0.024 ** (0.007)
Biometric authentication		-0.022 ** (0.007)	0.046 *** (0.007)	0.037 *** (0.009)	0.042 *** (0.009)	0.014 (0.007)
Blockchain		-0.016 * (0.006)	0.067 *** (0.008)	0.047 *** (0.011)	0.046 *** (0.009)	0.007 (0.007)
Relationship readiness						0.071 ** (0.025)
Synchronism readiness						0.317 *** (0.039)
Identification & control readiness						0.398 *** (0.039)
Constant	0.325 *** (0.085)	0.639 *** (0.101)	0.261 ** (0.070)	0.243 ** (0.089)	0.220 * (0.086)	-0.058 (0.072)
F-statistics	7.87 ***	9.00 ***	12.19 ***	8.67 ***	12.77 ***	49.67 ***
R-squared	0.0971	0.1208	0.1437	0.1089	0.1399	0.4660
Root MSE	0.246	0.254	0.231	0.250	0.240	0.190

Note. Robust standard errors (clustered by person) in parentheses.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Number of observations: 2,416. Number of persons: 302. Dependent variables: relationship, synchronism, identification and control readiness, intention to use, scale 0-1. Control variables are included but suppressed due to page limitations.

Table 11. Results of a parallel multiple mediation analysis (Bootstrapping, H4a)

		Effect	Boot SE	LLCI	ULCI	Mediation
Peer-to-peer platform	Relationship readiness	-0.0007	0.0008	-0.0024	0.0007	No
	Synchronism readiness	0.0137	0.0031	0.0079	0.0200	Yes
	Identification & control readiness	0.0087	0.0041	0.0006	0.0168	Yes
	TOTAL indirect effect	**0.0217**	**0.0060**	**0.0099**	**0.0335**	**Yes**
Robo-advisor	Relationship readiness	-0.0049	0.0014	-0.0079	-0.0024	Yes
	Synchronism readiness	0.0265	0.0037	0.0193	0.0339	Yes
	Identification & control readiness	0.0039	0.0041	-0.0041	0.0120	No
	TOTAL indirect effect	**0.0255**	**0.0065**	**0.0127**	**0.0380**	**Yes**
Self-service tools	Relationship readiness	-0.0012	0.0008	-0.0029	0.0003	No
	Synchronism readiness	0.0262	0.0037	0.0192	0.0336	Yes
	Identification & control readiness	0.0326	0.0046	0.0238	0.0421	Yes
	TOTAL indirect effect	**0.0576**	**0.0063**	**0.0451**	**0.0698**	**Yes**
Biometric authentication	Relationship readiness	-0.0016	0.0008	-0.0034	-0.0001	Yes
	Synchronism readiness	0.0147	0.0032	0.0087	0.0211	Yes
	Identification & control readiness	0.0148	0.0042	0.0068	0.0233	Yes
	TOTAL indirect effect	**0.0279**	**0.0061**	**0.0158**	**0.0399**	**Yes**
Blockchain	Relationship readiness	-0.0011	0.0008	-0.0029	0.0003	No
	Synchronism readiness	0.0214	0.0035	0.0147	0.0285	Yes
	Identification & control readiness	0.0189	0.0042	0.0107	0.0274	Yes
	TOTAL indirect effect	**0.0391**	**0.0062**	**0.0270**	**0.0512**	**Yes**

Note. 5,000 bootstrap samples. 95% percentile-based bootstrap confidence intervals. Seeding number is 5.

Finally, Hypothesis 4b) predicted a positive total effect of the implementation of financial technology on customer intention to use a digital financial process. As Model 4 in Table 10 illustrates, the regression coefficients for all technologies were positive and, except a peer-to-peer platform ($b=0.019$, *ns*, Model 4), significant (robo-advisor: $b=0.022$, $p<0.01$; self-service tools: $b=0.082$, $p<0.001$; biometric authentication mechanisms: $b=0.042$, $p<0.001$; blockchain: $b=0.046$, $p<0.001$; Model 4). Consequently, Hypothesis 4b) was supported for all financial technologies except a peer-to-peer platform.

4.4.2 Robustness checks

To verify the results of our main analysis (Hypotheses 1-3 and 4b), we repeated the analysis without substituting an implausible age value with sample mean age; including the excluded observation; excluding all observations with a response time of less than three and a quarter minutes; without control variables; and using other estimation methods (logit, probit, and HLM) in Stata 14.1. To prove the results of our mediation analysis (Hypothesis 4a), we conducted the Sobel test (Sobel 1982) by using the online Sobel test calculator (Preacher 2019) and plugging in the respective coefficients and standard errors, obtained from a linear regression analysis as presented in Table 10. All results remained robust.

4.5 Discussion

The goal of this paper was to study the effects of the implementation of financial technology in digital financial processes on customer intention to use these processes via relationship, synchronism and identification and control readiness. To investigate these relationships, we used five currently discussed examples of financial technology: peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. As a result, we found that the implementation of financial technology 1) except a peer-to-peer platform, led to a lower relationship readiness, 2) resulted in a higher synchronism readiness, and 3) except a robo-advisor, was associated with a higher identification and control readiness of a digital financial process. Considering how process readiness transmits the effects of financial technology on intention to use, we found 1) a negative *specific indirect* effect via relationship readiness only for a robo-advisor and biometric authentication mechanisms, 2) a positive specific indirect effect via synchronism readiness for all technologies, and 3) a positive specific indirect effect via identification and control readiness for all technologies except a robo-advisor. Hence, relationship readiness (for a robo-advisor and biometric authentication mechanisms), synchronism readiness (for all technologies), as well as identification and control readiness (for all technologies except a robo-advisor) had a unique ability to mediate the considered relationship, above and beyond other mediators included in the model (Hayes 2017; Preacher and Hayes 2008). As predicted, the specific indirect effects summed up to a positive and significant *total indirect* effect for all examples of financial technology. Thus, taken as a set, relationship, synchronism as well as identification and control readiness mediated the relationship between the implementation of financial technology and intention to use, and the positive effects of synchronism as well as identification and control readiness were able to outweigh the negative impact of relationship readiness. Finally, we found that the implementation of all financial technologies except a peer-to-peer platform had a positive *total* effect on intention to use a process.

In the first place, these results show, that the broad range of technologies, summarized under the term "financial technology" (Hendershott et al. 2017), shares commonalities and can be expected to have similar effects on the financial processes, in which these technologies are implemented, as well as on customer attitude towards them. In general, the implementation of different types of financial technology decreases relationship readiness of digital financial processes and increases their synchronism as well as identification and control readiness. Via relationship readiness in some cases, but mainly via synchronism as well as identification and control readiness, the implementation of financial technology influences customer intention to use these processes. Hereby, although the different types of process readiness have partially opposing effects, they sum up to a positive total indirect effect on intention to use. Thus, the implementation of financial technology generally leads to a higher intention of customers to use the offered processes.

In the second place, these findings suggest that despite the general similarities, various financial technologies can also differ from each other (Gomber et al. 2018a) in aspects, relevant for relationship building and process control possibilities, in the relation to the mechanisms, by which they affect customer intention to use, and finally in the caused customer reactions. For instance, the implementation of a peer-to-peer platform may lead to a lower relationship readiness only in some contexts such as credit processes, which are hallmarked by a high degree of anonymity (Greiner and Wang 2010; Jiang et al. 2018a; Jiang et al. 2018b), but not in other contexts such as payment or insurance processes, where transaction partners can be related persons such as family and friends (Gomber et al. 2017). Further, the implementation of a robo-advisor may not provide such a high degree of identification and control possibilities as other financial technologies due to the current implementation quality of this application in practice, as currently existing robo-advisors are subjects to major transparency issues concerning their overall functioning and especially dealing with customer data (Jung et al. 2018b). Beyond that, the implementation of a robo-advisor and biometric authentication mechanisms may decrease customer intention to use a process due to a lower relationship readiness, because using these applications, customers might experience an absence of human counterparts in the financial process stronger, knowing, that they are only dealing with algorithms (Jung et al. 2018b). Furthermore, digital financial processes, based on peer-to-peer platforms, may not increase customer intention to use them due to presenting a comparatively new type of service compared e.g., to processes using self-service tools (Gomber et al. 2018a), and thus leading to an absence of a clearly formed attitude towards these processes by customers.

4.5.1 Theoretical contributions

With these results, we contribute to existing research in three ways. First, we integrate research on financial technology (Alt et al. 2018) with research on process virtualization

(Graupner and Maedche 2015) by applying process virtualization theory (Overby 2008) to digital financial processes. Particularly, we show, that the requirements of process virtualization theory in terms of relationship, synchronism and identification and control readiness (Overby et al. 2010) can jointly explain the impact of the financial technology implementation in digital financial processes on customer intention to use them. In doing so, we explore the interplay of the underlying effects. We demonstrate that although financial technology generally decreases relationship readiness, while increasing synchronism as well as identification and control readiness, for the case of digital financial processes, the positive effects of higher process synchronicity and control outweigh the negative effect of reduced relationship building in the eyes of customers. Hence, we uncover, how the process of customer preference formation in terms of their intention to use digital financial processes takes place, and draw attention to such underlying mechanisms, which prior research on financial technology (Blut et al. 2016; Chen et al. 2014) has not considered.

Second, in doing so, we extend research on financial technology. In the first place, we investigate customer reactions to financial technology in terms of customer intention to use digital financial processes, in which financial technology is implemented. By showing that the implementation of financial technology mostly leads to a higher customer intention to use the offered processes, we address the call by prior research upon a deeper investigation of financial technology (Gomber et al. 2018a; Gomber et al. 2017). Beyond that, we provide empirical evidence which contributes to answering open questions, positioned by scholars from the financial technology field, of whether customers are going to adopt financial processes, based on financial technology (Puschmann 2017) and how firms, operating with financial technology, can increase their market success (Gomber et al. 2018a). In the second place, the results of our study suggest the existence of some differences among financial technologies concerning their relation to process readiness and customer reactions to them. Hence, we empirically support the comments of existing research on the existence of some heterogeneity in the financial technology landscape (Alt and Puschmann 2012; Gomber et al. 2018a).

Third, we also extend research on process virtualization theory (Thomas et al. 2016) by applying it to an entirely digital context. Hereby, we empirically show that the relationship, synchronism as well as identification and control readiness (Bose and Luo 2011) of process virtualization theory can explain the amenability of processes not only to a transition from a physical to a digital form (Overby and Konsynski 2010), but also to a further enhancement by means of new digital technologies. With this, we demonstrate that process virtualization theory, originally developed to explain the transition of processes from a physical to a digital form (Overby et al. 2010), has not lost its relevance in an entirely digital context and can thus be used to study different process digitalization phenomena, which are currently taking place.

4.5.2 Practical implications

Our study has important practical implications. First, we shed light on the mechanisms, by which financial technology shapes customer preferences concerning digital financial processes (Chen et al. 2014). In doing so, we help financial market players such as traditional financial firms, financial technology start-ups, and technology developers (Lee and Shin 2018) to better understand the customers and their preference formation, which is a critical insight for firms (Ryu 2018). Firms should be aware that the process of customer preference formation is complex, due to being based on multiple mechanisms with partially opposing effects. Thus, to enhance customer intention to use digital financial processes, firms should think of ways to increase the possibilities for customers to establish social connections or build relationships during a process, while keeping a high degree of synchronicity and speed as well as process and data control.

Second, we provide firms with a snapshot of a current customer attitude towards financial technology, which these firms discuss and are already starting to implement in their digital financial processes (Beinke et al. 2018; Eickhoff et al. 2017; Puschmann 2017). Showing that the implementation of financial technology generally increases customer intention to use the offered processes, we outline a possibility for firms to offer more customer-centric processes in order to be more successful in the financial services market (Gomber et al. 2018a; Lu et al. 2011; Wang 2008).

Third, we highlight that there could be differences among financial technologies, with respect to the degree, to which they contribute to different types of process readiness, and influence customer intention to use digital financial processes. Therefore, we recommend firms to explore the features of the implemented financial technology as well as its outcomes for the financial process exactly prior to launching a new service.

4.5.3 Limitations and future research

We want to acknowledge some limitations of this study. First, whereas the experiential conjoint design allows us to establish causality between the use of financial technology and process readiness as well as intention to use (Atzmüller and Steiner 2010; Shepherd et al. 2013), it limits the external validity of our findings. Though we used five examples of financial technology and included different types of financial processes and transaction value to increase the external validity (Atzmüller and Steiner 2010), future research might consider further financial contexts, such as digital investments (Gomber et al. 2017) or further financial technologies, such as digital wallets (Gomber et al. 2018a). In this respect, future research might explore the unique characteristics of these financial technologies and study, whether the application of process virtualization theory might be different based on these characteristics and whether they might result in different customer behaviors regarding the adoption intention. Further, although we carefully designed the experiment and tried to make experiential profiles as close to real situations as possible, the profiles still present an approximation of real financial processes (Shepherd et al. 2013). Although research has shown, that experiential profiles are able to generate decisions, very similar to real ones (Shepherd et al. 2013), future research might explore the considered relationships in a field study.

Second, we addressed relationship readiness of a digital financial process through the subjective preference of participants to interact and form relationships with each other during the process. However, a subjective wish for interaction might not correspond with an objective necessity for it. Although our approach is in line with existing studies, which assessed relationship readiness through customers' subjective preferences such as enjoyment and importance of social interactions (e.g., Balci 2015; Graupner and Maedche 2015; Overby and Konsynski 2010; Thomas et al. 2016), future research might investigate the impact of the financial technology implementation on the objective necessity for interaction among process participants.

Third, although the age of our participants ranged between 18 and 66 years, the average age in our sample was 27.29 years. Even though we controlled for age, this might limit the generalizability of our results, because age can determine customer experience in financial transactions and influence their attitude towards new digital technologies (Miltgen et al. 2013). Hence, future research might repeat our analysis using another sample with a fairer age distribution.

Fourth, our sample included participants only from Germany. Thus, our results might not be directly generalizable to other countries (Shepherd et al. 2013). Although the adoption of financial technology by population in Germany in 2017 was only 2% above the worldwide average of 33% (EY 2017), future research might use a cross-country sample.

4.6 Appendix

Table A1. Descriptive statistics and correlations

	Variables	Mean	SD	1	2	3	4	5	6	7	8
1	Peer-to-peer platform	0.500	0.500								
2	Robo-advisor	0.500	0.500	0.000							
3	Self-service tools	0.500	0.500	0.000	0.000						
4	Biometric authentication	0.500	0.500	0.000	0.000	0.000					
5	Blockchain	0.500	0.500	0.000	0.000	0.000	0.000				
6	Relationship readiness	0.626	0.269	-0.019	-0.129 *	-0.031	-0.042 *	-0.030			
7	Synchronism readiness	0.605	0.248	0.087 *	0.169 *	0.167 *	0.093 *	0.136 *	-0.090 *		
8	Identification & control readiness	0.543	0.264	0.041 *	0.019	0.155 *	0.071 *	0.090 *	-0.130 *	0.504 *	
9	Intention to use	0.575	0.258	0.037	0.042 *	0.159 *	0.082 *	0.089 *	-0.033	0.531 *	0.594 *

Note: * $p < 0.05$. The number of observations is 2,416. Control variables are suppressed due to page limitations. None of the correlations among control variables or between control and other variables exceeds the critical of 0.80 (Hair et al. 2009; Saunders et al. 2007).

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5 Discussion

Digital transformation of organizations, which is defined as a process induced by the application of digital technologies and directed at enabling major organizational improvements, such as improved performance and relationship with customers, is currently the center of attention of researchers and practitioners (Bharadwaj et al. 2013; Chanias et al. 2019; Fitzgerald et al. 2013; Sebastian et al. 2017; Vial 2019). Aiming at extending the current knowledge on digital transformation, I considered digital transformation of organizations in this thesis from two different perspectives: the firm and the customer perspective.

Relying on the firm perspective, I analyzed changes, which are trigged by digital transformation in firms across industries, happen at the level of firm strategy, are induced by the use of different digital technologies and target improved firm performance as an expected outcome. These changes include setting a strategic emphasis on digital transformation by firms. Hence, I studied in my first empirical essay how strategic emphasis on digital transformation influenced market capitalization of firms across industries and whether firm size moderated this relationship.

Relying on the customer perspective, I considered changes, which are triggered by digital transformation in firms from the financial services industry, happen at the level of service processes, are induced by financial technology and target an improved relationship with customers as an expected outcome. These changes refer to implementing financial technology in digital financial processes. Accordingly, I investigated in my second empirical essay how the implementation of financial technology in digital financial processes by the financial services firms influenced customer trust in these processes, and compared different examples of financial technology with each other with respect to their ability to generate trust. Additionally, based on the same perspective, I studied in my third empirical essay how the implementation of financial technology in digital financial processes by the financial services firms influenced customer intention to use these processes via the relationship, synchronism and identification and control requirements of process virtualization theory. The findings of the three essays are summarized and discussed below.

5.1 Summary and discussion of findings

To analyze the joint impact of strategic emphasis on digital transformation and firm size on market capitalization in my first empirical essay, I used a panel data set of 110 German HDAX companies between 2000 and 2017. My results showed that a higher strategic emphasis on digital transformation led to a higher market capitalization for larger firms and to a lower market capitalization for smaller firms. These results can be explained based on the signaling theory (e.g., Bergh et al. 2014). Accordingly, investors could perceive larger firms that are transforming digitally to send more credible signals of successfully realizing performance benefits connected to digital transformation (Vial 2019) than smaller firms due to differences in a resources basis (Audia and Greve 2006; Bruderl and Schussler 1990; Hess et al. 2016; Kirca et al. 2011; Levinthal 1991; Matt et al. 2015; Mitchell 1994).

To investigate the impact of financial technology implementation on customer trust in digital financial processes and to compare examples of this technology regarding their ability to generate trust in my second essay, I conducted an online conjoint experiment using five currently discussed examples of financial technology in terms of peer-to-peer platforms, robo-advisors, self-service tools, biometric authentication mechanisms, and blockchain. According to my results, the implementation of two out of five examples either did not influence (robo-advisor) or reduced (peer-to-peer platform in case of credit processes) trust in a digital financial process, whereas the implementation of three other examples of financial technology (self-service tools, biometric authentication mechanisms, and blockchain) increased customer trust. Hereby, biometric authentication mechanisms tended to be the strongest financial technology in gaining customer trust, followed by blockchain and self-service tools.

To study the effects of financial technology implementation on customer intention to use digital financial processes via relationship, synchronism and identification and control readiness in my third empirical essay, I conducted a further online conjoint experiment using the same examples of financial technology as in the second essay. My results revealed that the implementation of financial technology led to a lower relationship (except a peer-to-peer platform), higher synchronism, and higher identification and control readiness (except a robo-advisor) of a digital financial process, whereas the three types of process readiness jointly transmitted the effect of financial technology implementation on customer intention to use financial processes. Further, the implementation of financial technology (except a peer-to-peer platform) increased customer intention to use financial processes.

The results of my second and third essay demonstrate that different digital technologies, summarized under the term "financial technology" (Hendershott et al. 2017), share commonalities and can be expected to have similar effects on digital financial processes, in which they are implemented, and on customer reactions to them. For example, the implementation of financial technology often generates customer trust in digital financial processes and generally leads to a higher intention of customers to use the offered processes. Further, the implementation of different types of financial technology in general decreases relationship readiness of digital financial processes and increases their synchronism as well as identification and control readiness.

However, these findings also indicate that despite the general similarities, financial technologies can also differ from each other (Gomber et al. 2018), such as with respect to the aspects, relevant for relationship building and process control possibilities, the mechanisms, by which financial technologies affect customer intention to use, and the caused customer reactions. For instance, digital financial processes, based on peer-to-peer platforms, may not generate customer trust or increase customer intention to use them due to presenting a comparatively new type of service compared e.g., to processes using self-service tools (Gomber et al. 2018), and thus leading to an absence of a clearly formed attitude towards these processes by customers. Further, the implementation of peer-to-peer platforms might even decrease customer trust in some situations such as credit processes, because these situations could be associated with a higher financial risk by customers (de Haan et al. 2018; Greiner and Wang 2010; Jiang et al. 2018; Kim and Benbasat 2009). Additionally, the implementation of robo-advisors might not be able to generate customer trust due to a high heterogeneity in the design and functionalities of this application as well as possible biases in its development such as prioritizing firm profits instead of investors' interests (D'Acunto et al. 2019; Jung et al. 2018b; Nussbaumer et al. 2012; Ruf et al. 2015).

Taken together, the both essays based on the customer perspective suggest that whereas the implementation of a particular digital technology such as a robo-advisor might not be able to generate trust by customers, it might still lead to customer intention to use the process based on this technology. This finding can be explained through the benefits, which digital technologies offer customers such as processing of customer requests in real time (Jung et al. 2018a), which might convince customers of using the service despite having some concerns about the underlying technology.

Overall, the thesis visualizes that digital transformation might be linked not only to benefits, such as increased market capitalization for larger firms, customer trust, synchronism and identification and control readiness of processes and intention to use the services, but also to negative outcomes (Vial 2019), such as reduced market capitalization for smaller firms, missing customer trust, and decreased relationship readiness. These findings can be explained through the challenges that are entailed by digital transformation. To these challenges belongs a high complexity and uncertainty of digital transformation projects (Fitzgerald et al. 2013), a potentially low familiarity of organizational stakeholders with selected technologies due to a quickly changing technology landscape (Gomber et al. 2018), and a limited ability of digital technologies to completely replace personal interactions due reduced possibilities to transmit interpersonal warmth (Overby 2008).

5.2 Implications for theory

With this thesis, I make several contributions to the existing literature. With the first empirical essay, I extend research on digital transformation (e.g., Sebastian et al. 2017) by responding to a call of existing studies to investigate the outcomes of digital transformation (Chanias et al. 2019). Particularly, I demonstrate, that is might be easier for larger than for smaller firms to realize benefits, connected to digital transformation (e.g., Sebastian et al. 2017), due to being rewarded by the stock market in a timely way. In doing so, I provide to my best knowledge the first quantitative empirical evidence on strategic emphasis on digital transformation in firms and its influence on their performance over a period of 17 years. Further, I widen the digital transformation framework by Vial (2019) by adding an increase and decrease in market capitalization to the building blocks of positive and negative impacts respectively, and by proposing a further building block of contextual factors such as firm size that might influence the impacts of digital transformation (Vial 2019).

With the second and third empirical essays, I extend research on financial technology (e.g., Goldstein et al. 2019) by responding to the calls of prior studies to investigate customer trust in financial technology (Goldstein et al. 2019), customer adoption of financial processes based on this technology (Puschmann 2017), and market success of firms, operating with it (Gomber et al. 2018). I address these calls in my thesis by providing a snapshot of customer trust in digital financial processes and customer intention to use these processes based on the implementation of financial technology. This snapshot reveals that with a few exceptions, the implementation of financial technology leads to a higher customer trust in digital financial processes and a higher intention to use them. With the second empirical essay, I additionally show that trust can be an outcome of financial technology implementation in digital financial processes (Ogbanufe and Kim 2018) and am to my best knowledge the first to compare different forms of financial technology (Gomber et al. 2018) with respect to trust.

With the third empirical essay of my thesis, I integrate research on financial technology (e.g., Chen et al. 2019) with research on process virtualization (e.g., Overby et al. 2010) by exploring whether the effect of financial technology implementation on customer intention to use digital financial processes can be explained through the requirements of process virtualization theory (Overby 2008). Particularly, I show that the requirements of process virtualization theory in terms of relationship, synchronism and identification and control readiness (Overby et al. 2010) can jointly explain the impact of the financial technology implementation in digital financial processes on customer intention to use them. Moreover, I extend research on process virtualization theory (e.g., Thomas et al. 2016) by demonstrating that the relationship, synchronism as well as identification and control readiness can explain the amenability of processes not only to a transition from a physical to a digital form (Overby and Konsynski 2010), but also to a further enhancement by means of new digital technologies.

As an overarching contribution, I extend research on digital transformation (Vial 2019) by providing an integrated view of this phenomenon, which illuminates digital transformation from different perspectives by combining its different target entities, scopes, means, and expected outcomes. With respect to target entities, by considering firms from different industries and financial services firms in this thesis, I visualize that digital transformation is a phenomenon of a long range, which affects firms across industries and triggers changes that are common for firms from different industries as well as changes that are specific for firms from a particular industry. Concerning scopes of digital transformation, by studying changes on the level of firm strategy such as setting a strategic emphasis on digital transformation and changes on the level of service processes such as implementing financial technology in digital financial processes, I emphasize that digital transformation is a complex phenomenon, which affects an organization holistically at its different levels. With regard to means of digital transformation, by including different digital technologies and explicitly considering financial technology, I highlight that although a variety of digital technologies is available for firms, there might be some key technologies for firms from a particular industry, which might not be necessarily the most frequently used technologies across industries (Vial 2019). Referring to expected outcomes, by combining the firm perspective through exploring firm performance in terms of market capitalization and customer perspective through investigating firms' relationship with customers in terms of their trust and intention to use the services of digitally transforming firms, I empirically investigate the outcomes of digital transformation. My results indicate that digital transformation might not only be linked to performance benefits, such as an increased market capitalization, customer trust, process speed and control as well as customer intention to use the services, but also to negative impacts, such as reduced market capitalization, missing customer trust, and decreased relationship readiness.

5.3 Limitations and future research

Whereas the use of panel data in my first empirical essay facilitates causal inference (Podsakoff et al. 2012; Wooldridge 2012) and the application of an experiential conjoint design in the second and third essays allows me to establish causality in my results (Atzmüller and Steiner 2010; Shepherd et al. 2013), my thesis has important limitations. These limitations are acknowledged in the following.

Concerning the first empirical essay of my thesis, I faced the problem of the poor data availability for the HDAX firms (Sanders and Tuschke 2007; Tuschke and Gerard Sanders 2003; Tuschke et al. 2014), such as with respect to R&D expenditures, financial data and other aspects concerning a digital business strategy and its risk (Mithas et al. 2013). Therefore, future research may repeat my study using another sample with a better data availability, which allows including additional control variables such as IT investments. Further, I approached digital transformation through firm strategic emphasis on digital transformation and controlled for the presence of a CDO, potentially missing to account for other aspects of a digital transformation strategy, such as the development of digital governance structures (Chanias et al. 2019), digital services platforms and operational backbones (Sebastian et al. 2017). Hence, future research may incorporate these aspects of digital transformation and address their interplay with firm size with respect to market capitalization. What is more, my measure of strategic emphasis on digital transformation was based on the count of words, beginning with "digit*", in firms' annual reports, not allowing to rule out a potential bias, which could arise if firms from different industries would use these words differently. Thus, future studies might investigate the exact meaning of the words, used by companies from different industries. Additionally, even my sample generated a considerable amount of variance with respect to firm size (Tuschke et al. 2014), even the smallest HDAX company had a market capitalization of multiple million. Accordingly, future research might explore the relationship between strategic emphasis on digital transformation and firm size on market capitalization by considering much smaller firms.

Concerning the second and the third empirical essay of my thesis, the applied experiential conjoint design limits the external validity of my findings. Though I used multiple examples of financial technology, different types of financial processes and transaction value to increase the external validity (Atzmüller and Steiner 2010), future research might consider further financial contexts such as digital investments (Gomber et al. 2017) or financial technologies such as digital wallets (Gomber et al. 2018) and explore the considered relationships in a field study. Next, my participants in both experiments were relatively young on average, thus limiting the generalizability of my results to other age groups (Miltgen et al. 2013). Hence, future research might repeat my studies using another sample with a fairer age distribution. Beyond that, my sample for the both experiments included participants only from Germany, hence making my results not directly generalizable to other countries (Shepherd et al. 2013). Accordingly, future research might use cross-country samples. In addition, in the third empirical essay, I operationalized relationship readiness of a digital financial process through the subjective preference of participants to interact and form relationships with each other during the process (e.g., Balci 2015; Graupner and Maedche 2015; Overby and Konsynski 2010; Thomas et al. 2016), thus not accounting for an objective necessity for interaction. Thus, future research might explore the impact of the financial technology implementation on the objective necessity for interaction for process participants.

Overall, aiming at providing an integrated view of digital transformation that illuminates this phenomenon from different perspectives, I was nevertheless able to include only a limited number of target entities, scopes, means, and expected outcomes of digital transformation in this thesis. Although I considered firms from different industries and the financial services industry as target entities, changes at the level of firm strategy and service processes as scopes, various digital technologies and financial technology as means, and market capitalization, customer trust and intention to use the services as expected outcomes, my findings might not be generalizable to other contexts. Thus, to improve our understanding of digital transformation and its outcomes, future research might provide a more comprehensive view of this phenomenon. In doing so, future studies might collect a comprehensive list of challenges, which are most common for firms from different industries, as well as challenges, which apply to firms from a particular industry. Further, future research might create a complete overview of all the organizational levels affected by digital transformation and complement it by indicating different changes, which happen during the process of digital transformation on these levels. What is more, researchers might map the key digital technologies for particular industries against the backdrop of currently available digital technologies. In addition, scholars might create a detailed overview of all the different outcomes of digital transformation, which have been investigated to the present day.

5.4 Implications for practice

My thesis is also important for practitioners. First, with the first empirical essay of my thesis, I aim at supporting firms in different industries on their digital transformation path by drawing their attention to the fact, that firms' signals of digital transformation such as strategic emphasis on digital transformation can influence firm valuation on a stock market. As based on my results, larger firms might anticipate an increase in market capitalization due to signaling a higher strategic emphasis on digital transformation, these firms can be advised to continue disclosing it, while paying attention also to other signals, which they send in this respect to the public. At the same time, as smaller companies might potentially face skeptical reactions of investors to their digital transformation signals, leading to a decreased market capitalization, these firms should be aware of the possible difficulties and consider sending other signals to investors, demonstrating that they are able to successfully undergo and manage digital transformation and its risks.

Second, with the second and the third empirical essays of this thesis, I aim at supporting financial services firms, which are starting to transform digitally by implementing financial technology in their digital financial processes (Beinke et al. 2018; Eickhoff et al. 2017; Puschmann 2017; Sia et al. 2016). Particularly, I provide these firms with a current snapshot of customer attitude towards financial technology, showing that the implementation of financial technology, with a few exceptions, increases customer trust and intention to use the offered processes. Thus, firms should consider starting or continuing implementing financial technology in their processes. To help firms understand customer attitude better, I shed light on the mechanisms of customer preferences formation towards digital financial processes with implemented financial technology (Chen et al. 2014), demonstrating that that the process of preference formation is complex due to being based on multiple mechanisms with partially opposing effects. Hence, firms should think of ways to increase the possibilities for customers to establish social connections or build relationships during a process, while keeping a high degree of synchronicity, speed as well as process and data control. In addition, I also highlight that despite similarities, selected examples of financial technology might also differ from each other in the concrete customer reactions, caused by them. Therefore, I recommend firms to explore the features of the financial technology as well as its outcomes for the financial process exactly prior to implementing it in a service process. With these recommendations, I outline a possibility for firms from the financial services industry to realize the customer-related benefits of digital transformation (Alt et al. 2018; Gomber et al. 2018; Lu et al. 2011; Puschmann 2017; Vial 2019; Wang 2008). These results can also be interesting for the other financial market players, such as financial technology start-ups and platform and application developers (Lee and Shin 2018) as well as for companies from other industries, which integrate digital payments in the processes, which they offer to customers (Gefen et al. 2003; Ogbanufe and Kim 2018).

Overall, my thesis is important for firms from different industries, which are embarking on a digital transformation journey (Chanias et al. 2019; Hess et al. 2016). First, I highlight that on their digital transformation path firms may face strategic decisions, which are common for firms from different industries, as well as technology implementation challenges, which are specific for a particular industry. Therefore, companies should on the one hand look out for best practices of firms from other industries and on the other hand account for the specifics of their own industry when they design and implement their digital transformation strategy. Second, I show to practitioners that digital transformation is a phenomenon, which affects a firm at all its different levels, from service processes to the overall corporate strategy. Thus, firms should consider, include and integrate all these levels in their digital transformation strategy. Third, I emphasize that despite the variety of different technologies in the digital technology landscape, there are some technologies, which are central for firms in particular industries. Accordingly, firms should on the one hand be aware of digital technologies, driving digital transformation in different industries and on the other hand clearly identify the key digital technologies for their own industry. Fourth, I empirically show that although digital transformation is primarily associated with performance benefits for firms, such as an increased market capitalization, customer trust, process speed and control as well as customer intention to use the services, it can also be linked to negative impacts, such as reduced market capitalization, missing customer trust, and decreased relationship readiness of processes. Hence, digitally transforming firms should anticipate these outcomes, such as explore the potential stock market reactions to their digital transformation signals by considering similar situations of firms from different industries and their own industry and asking investors' and stock market analysts' opinion and investigate customer reactions to new technologies by letting customers test and evaluate applications based on these technologies.

5.5 Conclusion

Aiming at extending the current knowledge on digital transformation, I have considered digital transformation of organizations from different perspectives in the three empirical essays of this thesis. Relying on the firm perspective in the first empirical essay, I have investigated how strategic emphasis on digital transformation, which is induced by the use of different digital technologies, influences market capitalization of firms across industries and whether firm size moderates this relationship. Relying on the customer perspective in the second empirical essay, I have studied how the implementation of financial technology in digital financial processes by the financial services firms influences customer trust in these processes, and compared different examples of financial technology with respect to their ability to generate trust. Relying on the same perspective in the third empirical essay, I have explored how the implementation of financial technology in digital financial processes by the financial services firms influences customer intention to use these processes via the relationship, synchronism and identification and control requirements of process virtualization theory.

With these three essays, I emphasize that digital transformation influences firms across industries and entails both cross-industrial and industry-specific challenges; is a complex phenomenon that affects an organization holistically at its different levels; and while being linked to different digital technologies, includes some key technologies for a particular industry. My empirical results indicate that although digital transformation is primarily associated with performance benefits for firms, such as an increased market capitalization, customer trust, process speed and control as well as customer intention to use the services, it can also be linked to negative impacts, such as reduced market capitalization, missing customer trust and decreased relationship readiness of processes. Therefore, firms that are starting to transform digitally, should try to carefully investigate the possible outcomes of their digital transformation initiatives such as explore the potential stock market reactions to their digital transformation signals and anticipate customer reactions to the implementation of new digital technologies. With this thesis, I aim at supporting companies on their digital transformation path.

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6 Appendix: Contributions and Acknowledgements

6.1 Contributions Chapter 2: It Depends on the Size: How Firm Strategic Emphasis on Digital Transformation Predicts Market Capitalization

Anna Moker (née Verbovetska) is the first author of this paper; Prisca Brosi and Isabell M. Welpe are contributing authors. Isabell M. Welpe suggested the main research question for the study. In developing the research design, Prisca Brosi and Isabell M. Welpe developed the measure of firms' digital transformation (as a word count of "digit*" in firms' annual reports), which was executed by Anna Moker, who further developed the research model supported by Prisca Brosi and added all the other variables based on the existing literature. Anna Moker gathered and analyzed the data. Anna Moker wrote the manuscript, receiving and implementing suggestions and feedback, also concerning the interpretation of results, from Prisca Brosi and Isabell M. Welpe.

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Anna Moker (née Verbovetska)

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Prisca Brosi

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Isabell M. Welpe

6.2 Acknowledgements Chapters 3 and 4

As Anna Moker (née Verbovetska) wanted to study process virtualization theory in one particular industry, Prisca Brosi suggested to use the financial services for this purpose and to apply a conjoint analysis as a research design for the third study. The second study was initiated in response to feedback by Isabell M. Welpe to include trust as a dependent variable during the development of the third study. Because the number of dependent variables is limited in conjoint designs, Prisca Brosi suggested collecting trust in a separate study to Anna Moker. Under the guidance and supervision of Prisca Brosi, Anna Moker developed the conjoint designs. Anna Moker collected and analyzed the data for the both studies, deciding, which analysis methods and statistical tests are the most appropriate for the gathered data. Anna Moker wrote the manuscript for the second study. Prisca Brosi provided feedback on the abstract, introduction and the beginning of the theory section of the second study. Anna Moker developed the final paper story, the theoretical background, and the contributions, decided on the statistical analyses and the presentation of results, and wrote the manuscript for the third study.