FINTECHS AND THE NEW WAVE OF FINANCIAL INTERMEDIARIES

Completed Research Paper

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Abstract

The financial services industry is undergoing a massive transformation similar to what was observed when other industries underwent digitization. The FinTech revolution has given rise to a vast number of technology-oriented market entrants who challenge many parts of the financial services industry. This research seeks to provide a better understanding of how FinTechs across various business functions fundamentally impact the value chain in this industry. To this end, we built on top of financial intermediation theory, and developed a taxonomy of FinTechs' intermediating functions. The following hierarchical clustering analysis identified six archetypes of FinTech intermediaries as observed in the real world, i.e. the different ways in which FinTechs across business functions act as financial intermediaries by transforming assets, reducing transaction cost, and alleviating information asymmetries. Finally, we discuss how FinTechs impact financial intermediation in itself, and to what extent the notion of FinTechs disintermediating the financial value chain is accurate.

Keywords: FinTech, Financial Intermediation, Taxonomy Development, Cluster Analysis

Introduction

The FinTech revolution is in full swing, with a vast number of market entrants challenging incumbents and their business models around the world (e.g. Arner et al. 2015; Gomber et al. 2017). Consequently, previous research has analysed specific FinTech verticals such as crowd-funding or peer-to-peer lending in detail, how technology is used to create entirely new business models or improve on existing products and services, and described the FinTech revolution as a whole, e.g. by providing a more holistic overview of the value propositions observed amongst FinTechs. However, existing work often at best touches the topic of financial intermediation marginally, which is surprising since intermediation is one of the key reasons why financial services provides (e.g. banks, insurers) exist in the first place: They facilitate and enable transactions between market participants, e.g. they help connect capital-givers and -seekers (in lending, capital raising), and they facilitate money transfers between individuals or firms. In addition, FinTechs are often said to disintermediate the financial services value chain (e.g. Arner et al. 2015; Xu 2015), a proposition this paper challenges. We seek to investigate if and to what extent FinTechs act as intermediaries themselves, as is reflected in the following research question:

RQ: To what extent do FinTechs act as financial intermediaries, and what archetypes exist?

This question is addressed with a theoretically grounded and empirically validated taxonomy of FinTechs' intermediating functions. We develop our taxonomy based on the financial intermediation theory and empirical observations from a detailed dataset of 190 globally diverse FinTechs. Moreover, this study contributes to our understanding of how FinTechs impact financial intermediation in itself, by discussing to what extent the popular notion of FinTechs disintermediating the financial services value chain can be supported, and how they integrate with incumbent intermediaries.

Background and Related Work

FinTechs and the FinTech Revolution

A plethora of research has been conducted over the last decades on how several technologies changed the financial services industry and shaped the banking infrastructure we use today, ranging from core banking systems, credit cards, interbank payment systems, and self-service systems like ATMs, online

and mobile banking (Arner et al. 2015). Gu et al., for instance, provide an excellent overview of research conducted on the technology acceptance and adoption of both online and mobile banking (Gu et al. 2009). However, the term "FinTech", a short form of "Financial Technology" has only emerged recently (Zavolokina et al. 2016), and the FinTech revolution stands for more than a mere evolution of self-service channels. Some of the more profound novelties that the FinTech revolution has brought about have already been subject to rather extensive academic research. For example:

- **Peer-to-peer (P2P) lending** platforms facilitate the provision of loans by individual investors (peers) rather than financial institutions (e.g. Bachmann et al. 2011)
- **Crowdfunding** platforms implement a two-sided market, which differs from P2P lending in that capital-givers do not expect their capital to be paid back directly, but instead either pre-order innovative, yet-to-be-produced products, pledge money for altruistic reasons, or receive future profits or shares in the capital-receiving company (e.g. Belleflamme et al. 2012; Haas et al. 2014)
- **Robo-advisors** provide personalized advice (e.g. investment advice) at zero marginal costs, since they rely on machine learning instead of direct human input, thus making it economically viable to expand such offerings to new customer segments (Jung et al. 2018)
- **Distributed ledger technologies** (DLT) like blockchain and **crypto-currencies** such as Bitcoin have the potential to more fundamentally challenge the banking and payment infrastructure including the store and transfer of value, and have consequently received large interest by the academic community (see e.g. Nakamoto 2008, the original Bitcoin paper)

While these are fine examples of what embodies the FinTech revolution, defining FinTech as an umbrella term for the above list would fall short of what FinTech encompasses. Some FinTechs innovate on traditional banking products, such as offering an everyday bank account or credit cards with improved properties. Others attempt to set up better payment infrastructures both in developing countries and more prosperous economies. Yet another category of FinTechs makes formerly unapproachable, hard-to-understand financial instruments accessible to the masses. The list continuous, seemingly ad infinitum. We follow the FinTech definition by Eickhoff et. al, which also captures many aspects of other definitions well: "FinTechs are companies that operate at the intersection of (i) financial products and services and (ii) information technology, they are usually (iii) relatively new companies (often startups) with (iv) their own innovative product or service offerings" (Eickhoff et al. 2017).

Researchers have taken first steps into investigating the FinTech revolution as a whole, with several conference tracks and journal special issues dedicated to this phenomenon. Still, we found that most work focused on a particular topic like DLT or crowd-funding. Gomber et. al provide an excellent overview of prior research and introduce their digital finance cube, which helps the reader better understand FinTechs (Gomber et al. 2017). Its three axes represent i) technologies (e.g. blockchains or social networks), ii) business functions (e.g. investments or payments), and iii) finance institutions (traditional providers or FinTechs). Choosing a more empirical approach, Eickhoff et. al proposed a taxonomy for and discussed archetypes of FinTechs' service offerings, such as payment services, robo-advisors, information aggregators and extractors, etc. (Eickhoff et al. 2017). Gimpel et. al analysed the service offering configuration of FinTechs in terms of monetization, data usage, and interaction with their customers (Gimpel et al. 2017). They identified two to three archetypes for each dimension, such as "standard processing" and "advanced analytics" in the data dimension. While both papers offer valuable, specific perspectives for analysing FinTechs, this work seeks to understand on a more fundamental level how FinTechs across different business functions play into the financial value chain. We therefore consult the theory of financial intermediation and analyse to what extend FinTechs take over intermediating functions (if any), which have traditionally been executed by incumbents.

Financial Intermediation Theory

A financial intermediary (FI) is an entity such as a bank, insurer, or other financial service provider, which adds value by enabling or facilitating economic transactions between market participants (Allen and Santomero 1998, 2001; Brealey et al. 1977; Diamond 1984; Hasman et al. 2014; Holmstrom and Tirole 1997; Scholtens and van Wensveen 2000). According to traditional financial intermediation theory, the root cause for the existence of intermediaries lies in the absence of complete and perfect markets as defined in the classic Arrow-Debreu model of resource allocation (Allen and Santomero 1998; Diamond and Dybvig 1983). Imperfect markets reflect in asymmetrically-distributed information amongst market participants and greater-than-nil transaction costs (TC), both of which FIs seek to

alleviate (Allen and Santomero 1998, 2001; Brealey et al. 1977; Diamond 1984; Haas et al. 2014; Hasman et al. 2014; Scholtens and van Wensveen 2000). TC can arise in a number of activities, such as searching and verifying information, negotiating terms of a financial transaction, monitoring, and enforcing the agreement made (Dahlman 1979; Ferguson and Keen 1996).

Information asymmetries (IA) may lead to unfavourable effects like adverse selection or moral hazard, and can be mitigated through strategies such as signalling or screening (Brealey et al. 1977; Diamond 1984; Holmstrom and Tirole 1997). Intermediaries can create value by facilitating one or multiple of these cost-incurring activities or by reducing informational discrepancies.

FIs also take on another function: they transform assets' maturity, denomination, liquidity, or risk profile in order to allow for greater participation in the respective markets (Bhattacharya and Thakor 1993; Diamond and Dybvig 1983; Hasman et al. 2014; Krasa and Villamil 1992). Traditionally, the role of intermediaries in financial markets was understood primarily as entities connecting individual lenders and borrowers with different preferences and possibilities regarding the amount of money invested or borrowed, as well as the duration of the financial commitment made. In addition, individual lenders might not be willing to accept the full credit default risk in an entirely undiversified, one-to-one relationship with borrowers. Such risks can be transformed with a number of measures, e.g. through intertemporal smoothing, cross-sectional risk sharing, or by hedging against non-diversifiable risks (Allen and Santomero 2001). With entities acting as an intermediate layer between borrowers and lenders at larger scale, all of the above discrepancies in requirements can be overcome by offering loans and deposits with characteristics suitable to many market participants, e.g. by financing relatively risky, high-volume, long-term loans through many smaller-volume deposits with varying maturity on the lending side. Bhattacharya's contemporary banking theory concisely describes asset-transforming (AT) activities, which also accommodate for Allen and Santomero's risk management functions, as follows (Allen and Santomero 1998, 2001; Bhattacharya and Thakor 1993): FIs can transform assets' term to maturity, divisibility, liquidity, and credit risk.

Due to the complexity of financial markets and instruments, individuals' de-facto access is sometimes limited, either because they don't possess the necessary knowledge, due to inviable financial circumstances (i.e. expensive initial setup required, high transaction costs, impractical asset characteristics such as very large lot size requirements in trading or high minimum investment), or even due to regulatory constraints: As per the respective regulations, several financial instruments may only be traded by qualified investors like investment banks. In summary, FIs have a raison d'être in an environment where imperfect market conditions prevail. They act as agents who help mitigate asymmetrically distributed information, they reduce transaction costs in different activities, and they transform assets in ways that ultimately allow individual investors to efficiently participate in markets otherwise unavailable to them (Allen and Santomero 1998; Diamond 1984; Haas et al. 2014).

FinTechs as Financial Intermediaries

While FinTechs are sometimes said to decrease the level of intermediation by carving out middlemen from processes, such as eliminating traditional banks as a vital intermediary to connect capital-seekers and –givers, such statements usually refer to specific FinTech business models such as P2P payments and crowdfunding (Emmerson 2015; Lamacraft 2016; McWaters et al. 2016; Riasanow et al. 2018). However, while FinTechs do indeed sometimes eliminate existing FIs, they often also act as a new type of intermediary, which is aligned with previous research (Domowitz 2002); they may offer a more competitive pricing, better user experience, or otherwise superior offering, but they routinely act as middlemen themselves and therefore do not eliminate intermediaries as a whole. It should be noted that FinTechs with business cases based on distributed ledgers like blockchain potentially decrease the level of intermediation. Researchers and practitioners speculate that they might, one day, manage to cut out middlemen from several use cases, but currently it is still virtually impossible to participate in such networks without services like exchanges, which, again, act as FIs (Moore and Christin 2013). In the better-researched FinTech areas such as peer-to-peer lending or crowdfunding, prior work consequently stated that those platforms act as FIs (Bachmann et al. 2011; Belleflamme et al. 2012; Lin et al. 2013).

To verify this assumption, this chapter will examine whether FinTechs do indeed fulfil the functions of FIs as discussed in the previous section. We thus investigate whether each intermediation function is implemented by FinTechs. Note that not each FinTech necessarily needs to fulfil every function, just like there exist incumbents that do not fulfil all functions simultaneously.

On a more abstract level, when considering any form of financial exchange between market participants, the absence of any third parties involved in such transactions would represent a truly peer-to-peer, intermediation-free world. The very existence of a service provider in these exchanges, whether incumbent or innovator, adds an extra layer, which we know as FIs. In fact, since FinTechs frequently make use of existing infrastructures and in many cases even rely on established custodian banks (e.g. for regulatory purposes), they routinely intensify the level of intermediation, instead of reducing it. In this case, profits might have to be shared between even more entities in the value chain, which would potentially pose an additional financial burden on the end customers. Intermediaries obviously need to create an added value, or else they could not justify adding indirections in transactions and imposing fees for their services. For instance, as highlighted in the previous section, many transactions might never even take place without the facilitation offered by intermediaries. How exactly do FinTechs provide such a strong added value that explains their existence? To answer this question, the three categories of value creation in financial intermediation, i.e. reduction in transaction costs, alleviation of information asymmetries, and transformation of assets, will represent the basis of this analysis.

Table 1. FinTech's implementation of financial intermediation functions

Category	Examples for Implementation by FinTechs
Transaction Costs (TC)	• Investment advice by a robo-advisor, based on the user's risk profile • Assessment of crowdfunding projects' likelihood for success through manual vetting • Continuous, automated checks of a customers' asset portfolio, with alerts for critical events and rebalancing suggestions. • Crowdfunding or peer-to-peer lending platforms that legally pursue participants who fail to honour their part of agreements • Aggregation of multiple bank accounts and stock portfolios in a unified dashboard • Automated provision of personalized investment advice through computerized recommendation systems to customer segments previously excluded from such services
Information Asymmetry (IA)	• Investment advice provided by market experts whose interests are fully aligned with those of their customers, e.g. by advice-neutral and / or directly performance-dependent compensation of advisors
Asset Transformation (AT)	• Lending marketplaces that allow borrowers and lenders to independently specify the timeframe of their loans / investments • Crowdfunding platforms that split up project goals into smaller chunks, thus allowing investors to participate to a much larger project with a small investment • Crowd-investing platforms that enable third parties to invest in early-stage startups, which is otherwise a hardly accessible and tradeable type of asset • Real-estate investment companies that allow for a multitude of small investments into properties with a variety of different risk-reward profiles

Methodology

To truly comprehend to what extent FinTechs act as FIs and possibly affect financial intermediation, we follow the proven approach of Nickerson et al. to first systematically develop a taxonomy, and then we perform a cluster analysis to identify archetypes of the intermediating functions that FinTechs fulfil (Eickhoff et al. 2017; Gimpel et al. 2017; Haas et al. 2014; Malhotra et al. 2005; Nickerson et al. 2013).

Taxonomy Development

The first step is the definition of a meta-characteristic, which then informs the remainder of the iterative taxonomy development process (Nickerson et al. 2013). For this paper, we thus define "financial intermediation functions" as the meta characteristic of interest. Due to the iterative nature of this approach (see Figure 1), there need to be conditions under which the process is considered completed. Following prior work, we thus chose multiple objective ending conditions from the list proposed by Nickerson et. al, in particular i) no variations of the taxonomy in the current iteration (i.e. no new dimensions or characteristics were added, merged, split, or removed), ii) every dimension and characteristic is unique, iii) all objects are analysed, and iv) there is at least one object categorized for each characteristic (Nickerson et al. 2013). In addition, the taxonomy needs to be concise, robust, comprehensive, extendible and explanatory in order to meet the subjective ending conditions.

We then proceeded with a first, conceptual-to-empirical iteration: We built on the theory of financial intermediation to derive dimensions. The previous chapter discussed the main value-adding functions

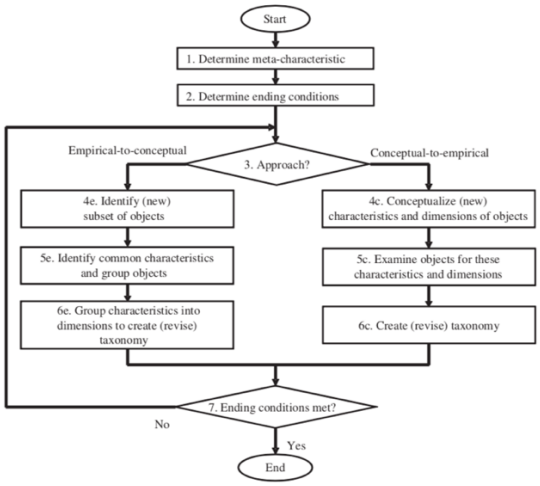

Figure 1. Taxonomy development method (Nickerson et al. 2013)

of intermediaries: reduction of transaction costs (TC) and information asymmetries (IA), as well as asset transformation (AT), which formed the basis for defining the taxonomy dimensions. As outlined in the previous chapter, TC can be decreased across several functions, such as search, verification, monitoring and enforcement activities related to financial transactions (Dahlman 1979; Ferguson and Keen 1996). Using a sample of 30 FinTechs from CrunchBase, we found that each TC type was indeed applicable, and thus added the first four dimensions, i.e. *reduction of search cost*, *reduction of verification cost*, and so on, to our taxonomy. These dimensions would each contain the binary characteristics *true* and *false*, indicating e.g. whether a particular FinTech does reduce search cost, or not. Although more fine-granular or even quantifiable characteristics would have been desirable, an objective data collection across a large sample of rather early-stage companies would have been impossible, hence we decided for accuracy at the cost of additional precision. Further, IA can lead to inefficiencies in markets, and even market failure, e.g. due to adverse selection. Popular counter-measures are *screening* and *signalling*, which were added as additional dimensions in the IA category. In addition, there are four different types of AT, i.e. by *maturity*, *denomination*, *liquidity*, and *risk*, each of which was also added as a new dimension (Bhattacharya and Thakor 1993; Brealey et al. 1977; Hasman et al. 2014; Holmstrom and Tirole 1997).

We then proceeded with a second conceptual-to-empirical iteration. In order to be able to describe the clusters better later, we also incorporated the main business function (BF), customer group (CG), and value chain focus (VC) in the taxonomy. Please note that these merely serve descriptive purposes, and are not used in the cluster analysis, since they are not directly related to the functions of financial intermediation. In line with Gimpel et. al (2017), we argue that an abstraction from the functional level of the business model is required to build a useful taxonomy. For example, an insurance broker as well as loan or bank account comparison websites operate in different functional areas (insurance, lending, banking), but they all add the same fundamental value: They help customers select a fitting product, thus decreasing search TC. Nonetheless, we found the taxonomy development methodology helpful in adding descriptive aspects in a structured way. For example, for the purpose of this work, if two FinTechs were to reduce search cost, this would indicate similarity between the two. The fact that they may cater to different customer groups (e.g. one might be a business-facing, the other a consumer-facing FinTech), is secondary. However, after a cluster analysis has identified clusters of FinTech intermediaries (purely based on the intermediating functions, TC, IA, and AT), we may then observe that some cluster predominantly hosts business-facing FinTechs, for instance. In the BF category, we referred to a report developed by a number of industry experts, which classifies financial services into six main functions: *payments, investment & wealth management, deposits & lending, capital raising, market provisioning, insurance* (McWaters et al. 2015). As for the CG, we simply followed the common convention of distinguishing between customers into *business-to-consumer (B2C)* and *business-to-business (B2B)*. Finally, based on the financial services value chain (VC) developed by Nelson (2015), the dimensions *front office*, *back office*, and *infrastructure* were added.

In a third, empirical-to-conceptual iteration, we examined another random sample of 30 FinTechs. In doing so, we decided to split *deposits & lending* in two dimensions, and expand *payments* into *payments*

& everyday banking. In addition, we merged the two IA-related dimensions, *signalling* and *screening* into a broader dimension *alleviation of IA*, which also includes other measures such as a financial incentivisation scheme that aligns the interests of principals and agents. Finally, we found that many FinTechs facilitate processes through (partial) automation or an improved user experience, which allows users to perform a desired action quicker, more conveniently, or with less friction. Similarly, automation allows financial services providers to offer previously manual services like investment advisory to a broader audience. In some cases, this may, for instance, lead to a reduction in search TC or monitoring TC. However, in other cases such as payment API providers (see Table 1 for more examples), we found that the existing TC types were not exhaustive. Thus, *process automation* was added as a further dimension in the TC category.

After this iteration, we found all ending conditions to be met. The complete classification scheme is summarized in Table 2. Instead of repeating the dichotomous characteristics for every dimension, we provided examples for each dimension in the same table.

Data Collection and Classification of FinTechs

This section describes the database development, the random selection of companies followed by an eligibility check, and the data collection using the above taxonomy. The final 190 companies served as the basis for the following cluster analysis. The number of companies is in line with requirements for taxonomy validation and similar to or higher than in comparable studies (Gimpel et al. 2017; Haas et al. 2014; Malhotra et al. 2005).

First, we built up the database consolidating sources for over 4159 FinTechs with a total of 120262 individual attributes. The primary data sources were CrunchBase and AngelList, which were queried with terms derived from a list of relevant categories and markets in each database (AngelList 2018; CrunchBase 2018). Search queries included the CrunchBase categories “FinTech”, “Cryptocurrency”, “Bitcoin”, as well as the AngelList markets “Fin Tech”, “Finance Technology”, “Insurance”, “Personal Finance”, and “Virtual Currency”. Other terms, such as “Financial Services” on CrunchBase resulted in a suboptimal signal-to-noise ratio for the identification of FinTechs. For companies to be included, their primary business purpose had to fall directly in the financial services or insurance industries. In addition, companies who provide technologies and services that are very commonly and primarily used by financial service providers were also included (e.g. several companies in the DLT space). The sizeable volume of automatically collected attributes of these companies were used only for the purpose of checking for possible selection biases. For example, a geo-location attribute was available for 3077 (74%) of the companies in the database. Most FinTechs with a known location were geographically based in the US (56%), followed by the UK (10%), which is well-aligned with the distribution of investment volume and number of market entrants in the financial services area from other sources (e.g. Skan, Dickerson and Masood, 2015; Statista, 2015b; Widmer, Schneider and Hucker, 2016).

Second, we randomly picked 300 companies from the database and put them through an eligibility check. To ensure that only FinTechs were included, we defined a cut-off for companies older than ten years prior to making the selection. During our analysis, we found a rather sizeable number of companies who appeared to be inactive (50 companies), i.e. those who either apparently ceased to operate, or did not (yet) provide any substantial information on their website, which can be explained by the nature of the databases used as data source: Founders are often eager to quickly spread the word about their company, even though they might not be operational yet. In addition, they might be less diligent when it comes to marking a startup as obsolete in such databases in case they cease operation. Furthermore, 59 companies could not be confirmed as actual FinTechs. Many of them turned out to be advisors or consultants, accountants, FinTech incubators, or software providers in areas such as accounting or taxation. Such companies were excluded from the analysis, since they either miss the technology component for them to qualify as a FinTech innovator, or because their services could be described as marginally touching financial services at best. Finally, one of the 300 companies was acquired and integrated in the buyer’s organization in such a way that the original offering appeared to no longer exist. The remaining 190 FinTechs were then analysed for this work.

Third, for the remaining 190 companies, we manually collected the data used for our cluster analysis and data description, i.e. 22 taxonomy dimensions with binary characteristics (as discussed in the previous chapter) per FinTech, resulting in 4180 data points in total. For the selected FinTechs, we conducted desk research, i.e. consulted company websites and media articles to collect data. Where

necessary, we signed up for trial accounts in order to learn more about a company's offering. The data collection took place within a two-month timeframe. We created a coding schema for each of the dimensions, which determined when a particular FinTech exhibited the characteristic (true) or not (false). To ensure coding validity of our data collection, an additional researcher was tasked with blindly re-coding a randomly selected subset of 40 of the original 190 FinTechs using the same coding schema. Both raters have gathered extensive work experience in the financial services industry and have made multiple related academic publications. Interrater agreement was calculated with Cohen's kappa, a metric that accounts for the possibility of random agreement between multiple raters, which is better suited for the data at hand than simple proportional agreement measures. This is a crucial detail, since in our case, simple proportional agreement metrics would overestimate the agreement between raters, because the values for our 22 taxonomy dimensions are quite asymmetrically distributed, i.e. only a minority of the 4180 values were marked as *true*. With Cohen's kappa values ranging from -1.0 to +1.0, our kappa result of 0.69 indicates substantial intercoder agreement (Landis and Koch 1977).

Cluster Analysis

To identify different archetypes of FinTechs' intermediating functions, we conducted a cluster analysis using the first ten dimensions (TC, IA, AT, as mentioned above), which seeks to minimize the within-cluster variance as compared to the variance across the entire dataset, i.e. it groups the most similar items together. We used an agglomerative hierarchical clustering analysis using Ward's linkage method and the Jaccard similarity metric (Chandrasekharan and Rajagopalan 1989; Haas et al. 2014; Malhotra et al. 2005). This exact configuration of a clustering analysis is best-suited for asymmetrically-distributed (μ=30.5% dimensions per FinTech exhibited the characteristic *true*), binary dimensions, where true-true matches are a greater indicator of similarity between entities than false-false matches (Chandrasekharan and Rajagopalan 1989). For instance, if two companies alleviate IA, it is reasonable to assume that there is some similarity between them, at least regarding this one aspect. If, on the other hand, two companies do not alleviate IA, it would be highly questionable to infer similarity from the common absence of said aspect.

Table 2. Final taxonomy (each dimension has the binary characteristics true/false)

Cat.	Dimension	Example
TC	Reduced search cost	Matching lenders with borrowers in lending marketplaces; providing information for investment opportunities
	Reduced verification cost	Assessment of borrowers' credit default risks in lending marketplaces
	Reduced monitoring cost	Investment portfolio dashboard with alerts for relevant changes
	Reduced enforcement cost	Collection of overdue loan payments
	Process automation	Aggregation of data from multiple sources in a unified dashboard
IA	Alleviated info. asymmetries	Pre-vetting of startups through experts on crowd-investment platforms
AT	Maturity transformation	Financing of long-term loans through short-term deposits
	Denomination transformation	Financing of large investments through smaller contributions
	Liquidity transformation	Financing of mortgage loans with more easily tradable bonds
	Risk transformation	Investment into diversified assets, e.g. crowd-investing into a variety of real estate objects
BF	Payments & Everyday banking	Payments at point-of-sale
	Investment & Wealth mgmt.	Trading of stocks or other financial instruments
	Deposits	Low-risk and low-return deposit of money
	Lending	Acquiring extra short-term liquidity for projects
	Capital raising	Acquiring extra liquidity as a company
	Market Provisioning	Real-time analysis of market events for traders
	Insurance	Services around health or car insurance
CG	Consumers (B2C)	Individual customers
	Businesses (B2B)	Institutional investors
VC	Front office	Mobile application used by end customers
	Back office	Calculation of credit scores invisible to customers
	Infrastructure	Setup of payment network

Hierarchical clustering algorithms do not require a pre-defined number of clusters. Instead, the resulting, tree-shaped dendrogram illustrates the similarities between individual FinTechs, and groups of FinTechs. As a final step, the ideal number of clusters has to be identified. In the work at hand, a visual inspection of both the dendrogram and scree plot showed six to be an appropriate value. In addition, a Mojena test was conducted, with a critical value of 2.0, as advocated by Mojena, which also proposes the existence of six stable groups (Milligan and Cooper 1985; Mojena 1977). The same test was repeated with different parameters, whereas critical values ranging from 1.75 to 2.25 each suggest a six-cluster solution. Higher critical values, such as 3.0 would lead to a four-cluster solution, in which our clusters 1 and 6 would have been merged into one, as well as 2 and 4, and we found that the six-cluster solution had a greater explanatory value than one with fewer clusters. Finally, the cluster assignments were manually checked for plausibility. For the resulting six clusters, we then calculated the frequencies with which the characteristic *true* occurred per cluster (see Table 3), e.g. 25 out of 27 companies in Cluster 1 (92.6%) reduced search-related TC. While using the number of FinTechs

Table 3. Cluster Analysis Results (n=190, significance levels: * p<.05; ** p<.01; *** p<.001)

Dimension		Clusters						Significance Tests	
		C1 *n=27*	**C2** *n=56*	**C3** *n=37*	**C4** *n=28*	**C5** *n=30*	**C6** *n=12*	χ^2	**Significant cluster differences**
TC	Reduced search cost	**92.6%**	35.7%	0.0%	**92.9%**	0.0%	0.0%	119.2***	1-2***, 1-3***, 1-5***, 1-6***, 2-3***, 2-4***, 2-5***, 2-6***, 3-4***, 4-5***, 4-6***
	Reduced verification cost	37.0%	32.1%	0.0%	14.3%	0.0%	0.0%	33.4***	1-3***, 1-5***, 1-6***, 2-3***, 2-5***, 2-6***, 3-4*, 4-5*, 4-6*
	Reduced monitoring cost	**59.3%**	**62.5%**	0.0%	**60.7%**	**100.0%**	0.0%	84.6***	1-3***, 1-5***, 1-6***, 2-3***, 2-5***, 2-6***, 3-4***, 4-5***, 4-6***
	Reduced enforcement cost	29.6%	16.1%	0.0%	0.0%	0.0%	41.7%	32.7***	1-3**, 1-4**, 1-5**, 2-3**, 2-4**, 2-5**, 3-6*, 4-6*, 5-6*
	Process automation	25.9%	**57.1%**	**100.0%**	**60.7%**	**100.0%**	33.3%	62.6***	1-2**, 1-3***, 1-4**, 1-5***, 2-3***, 2-5***, 3-4***, 3-6***, 4-5***, 5-6***
IA	Reduced information asymmetries	25.9%	3.6%	0.0%	**60.7%**	0.0%	0.0%	73.2***	1-2*, 1-3**, 1-4**, 1-5**, 1-6**, 2-4***, 3-4***, 4-5***, 4-6***
AT	Maturity transformation	0.0%	10.7%	0.0%	0.0%	0.0%	0.0%	14.8*	1-2*, 2-3*, 2-4*, 2-5*, 2-6*
	Denomination transformation	**100.0%**	0.0%	0.0%	0.0%	0.0%	0.0%	190***	1-2***,1-3***,1-4***,1-5***, 1-6***
	Liquidity transformation	**85.2%**	5.4%	0.0%	0.0%	0.0%	**100.0%**	151***	1-2***, 1-3***, 1-4***, 1-5***, 1-6*, 2-6***
	Risk transformation	**100.0%**	0.0%	0.0%	7.1%	3.3%	0.0%	168.8***	1-4***, 1-5***
BF	Payments & Everyday banking	0.0%	23.2%	**59.5%**	0.0%	**70.0%**	0.0%	68.8***	1-2***, 1-3***, 1-5***, 2-3***, 2-4***, 2-5***, 2-6***, 3-4***, 3-6***, 4-5***, 5-6***
	Investment & Wealth management	**96.3%**	42.9%	10.8%	**75.0%**	**26.7%**	0.0%	70.6***	1-2***, 1-3***, 1-4*, 1-5***, 1-6***, 2-3***, 2-4**, 2-6***, 3-4***, 3-6*, 4-5***, 4-6***, 5-6**
	Deposits	0.0%	1.8%	5.4%	7.1%	3.3%	0.0%	(n.s.)	-
	Lending	55.6%	21.4%	21.6%	17.9%	0.0%	**100.0%**	56.8***	1-2**, 1-3**, 1-4**, 1-5***, 1-6***, 2-5***, 2-6***, 3-5**, 3-6***, 4-5*, 4-6***
	Capital raising	37.0%	5.4%	0.0%	7.1%	0.0%	0.0%	38.8***	1-2**, 1-3***, 1-4**, 1-5***, 1-6***
	Market Provisioning	14.8%	**66.1%**	0.0%	3.6%	0.0%	0.0%	91.7***	1-2***, 1-3*, 1-5*, 1-6*, 2-3***, 2-4***, 2-5***, 2-6***
	Insurance	0.0%	7.1%	2.7%	7.1%	0.0%	0.0%	(n.s.)	-
CG	Individuals (B2C)	74.1%	26.8%	67.6%	**82.1%**	60.0%	25.0%	37.3***	1-2***, 1-6**, 2-3***, 2-4***, 2-5**, 3-6*, 4-6**, 5-6*
	Businesses (B2B)	77.8%	**89.3%**	48.6%	28.6%	46.7%	75.0%	40.9***	1-3*, 1-4***, 1-5*, 2-3***, 2-4***, 2-5***, 4-6**
VC	Front office	96.3%	76.8%	**89.2%**	**100.0%**	**90.0%**	100.0%	14.9*	1-2**, 2-4***, 2-6***, 3-4*, 3-6*
	Back office	81.5%	73.2%	83.8%	**67.9%**	60.0%	75.0%	(n.s.)	-
	Infrastructure	0.0%	5.4%	2.7%	0.0%	0.0%	0.0%	(n.s.)	-

engaging in an intermediating activity as an estimator for their intermediating effect may not be the perfect metric, it is the best available one. Using success metrics such as FinTechs' market share as weights may be an interesting extension to this research. However, note that we investigate early-stage companies in a highly dynamic environment, thus such success metrics are not reliably available, and, in contrast to the mere number of FinTechs, they are subject to significant change. Therefore, we opted for accuracy at the cost of additional precision. Finally, we ran χ^2 tests and follow-up pairwise t-tests to check for significant differences between the clusters for each dimension included in the clustering, as well as the twelve additional, more descriptive dimensions (BF, CG, VC).

Results

As Table 3 illustrates, the cluster analysis identified six distinctive clusters, with significant between-cluster differences for 18 of the 22 dimensions. The clusters represent six archetypes of FIs as observed amongst FinTechs. We first describe how FinTechs in each cluster act as intermediaries, before discussing their impact on financial intermediation in the next chapter.

Cluster 1–Asset Transformers

FinTechs in the first cluster identified by our analysis are active either in the investment and wealth management space, as well as either in lending or capital raising. They add value by reducing TC, in particular search and monitoring costs of financial instruments (93% and 59%, respectively), thus almost always have direct customer interaction through some user interface (96%), and they serve both consumers (74%) as well as businesses (78%). Prototypical companies of this cluster operate crowdfunding or crowd-investing platforms, or are active in peer-to-peer or marketplace lending. Since many of the cluster-1 companies act as a marketplace platform that facilitates the interaction between third parties, it is not surprising that at least a minority of them also implements measures to enforce contracts such as debt collection and reduces IA (30% and 26%, respectively). An outstanding feature of cluster-1 FinTechs is that they frequently also transform assets in terms of denomination (100%), liquidity (85%), and risk (100%). For example, several peer-to-peer lending platforms in this cluster split up loans requested by borrowers into notes, so that investors can diversify by buying different quantities of notes representing different default risks according to their preferences. Interestingly, however, this cluster did not include any example where assets' maturity was also transformed, i.e. peer-to-peer lenders and similar platforms appear to always finance loans with investments of equal lifetimes. Cluster 1 includes companies such as marketplace lender Lending Club, real-estate investing marketplace LendInvest, or crowdfunding platform Youstart.me. As already pointed out by prior work focusing on some of the business functions represented in this cluster (e.g. crowdfunding), cluster-1 FinTechs engage in many intermediating activities, and thus clearly are to be considered intermediaries.

Cluster 2–Market Provisioning for Businesses

FinTechs in the second cluster support their business clients (89%) in market provisioning, in trading (43%) and other activities. They reduce all types of TC, but only rarely transform assets or decrease IA. Addepar, for instance, offers an investment analysis and monitoring platform; QuantConnect allows professional traders to computationally back-test their strategies on a large historical market database, an otherwise highly labour-intensive process. Other companies in this cluster offer services resolving around back office processes such debt collection (TrueAccord), or offer a B2B solution that allows merchants to flexibly offer payment plans to their clients (Financeit). Due to the many ways in which TC are reduced, it is obvious that cluster-2 FinTechs also routinely act as intermediaries, e.g. by reducing friction in transactions between multiple financial service providers, or by allowing finance professionals to more efficiently test investment strategies and monitor their portfolios.

Cluster 3–Process Automation in Payments & Everyday-Banking

The third cluster with 37 companies is a very clear-cut one: 100% of the FinTechs in this category exhibit only one intermediating function – process automation. Most of them (60%) offer services in the Payments & Everyday-Banking or Lending (22%) business functions, and they cater to consumers more often (68%) than to businesses (49%). Examples are information aggregators for credit scores and loan reports such as Borrowell, payment and bank account API providers such as Plaid, as well as cross-currency payment providers like RemitBee or CurrencyCloud. With each of them merely automating existing processes, for this cluster it is the most debatable whether the FinTechs in it can be regarded as

full FIs, i.e. if offering only this one TC-reducing function is enough to qualify as such. Based on the definition of intermediaries (entities that facilitate or enable economic transactions, see above), we argue that they can, and should be regarded as such. For example, making cross-currency payments traditionally was a cumbersome endeavour, which has been facilitated by FinTechs.

Cluster 4–Investment & Wealth Management Facilitators for Consumers

The fourth cluster revealed through our cluster analysis is best described as novel, digital advisors or robo-advisors across all business functions, and especially investment & wealth management (75%). They predominantly target consumers (82%), and set on top of existing infrastructures and products more often than other clusters. Accordingly, all cluster-4 firms have direct user interaction, and create value by helping customers with choosing appropriate financial products, thus reducing search TC (93%). They also frequently help alleviate IA (61%), e.g. by implementing measures to reduce agency costs (Jensen and Meckling 1976). This is achieved, for example, by refraining from employing provision-based internal incentive schemes, which might cause agents to have conflicting interests with their principals, i.e. the end customers. They also reduce monitoring TC (61%) and facilitate steps such as the purchase of stocks or rebalancing asset portfolios (61%). Digital wealth management firms in this category also reduce the market entry barriers, since they can serve customers with investment sums much smaller than what would be required with traditional wealth managers or private banks. This is enabled through leaner cost structures due to the utilization of computerized recommendation systems, or through human-generated advice, without having to maintain physical bank branches. US-based investment and wealth manager SigFig is a prominent case of cluster 4, with other examples including Simply Wall Street and InstaVest, who seek to support their clients with investment decisions by proving high-quality market data, or by replicating the actions of expert traders.

Cluster 5–Information Aggregators for Everyday-Banking and Investment & Wealth Mgmt.

The fifth cluster is comparatively similar to cluster 3 in that all FinTechs in it reduce friction through process automation; in addition, they all reduce monitoring TC. Most FinTechs in this cluster either offers services regarding payment & everyday-banking (70%) or investment & wealth management (27%). This cluster includes what popular literature has dubbed “neobanks” such as Simple Bank. Neobanks usually provide customers with an initial offering that includes everyday accounts and payment cards, and then gradually expand their service portfolio towards saving, investment and trading as well as other banking features. This cluster also contains B2C personal finance managers, such as Level Money and Gullak, which help customers keep track of their monetary in- and outflows. Another member of this cluster, Cleo, offers similar added-value through a chat bot interface.

Cluster 6–Liquidity-Transforming Lenders

The final and smallest cluster is comprised of twelve FinTechs in the lending space, all of which offer AT in terms of liquidity, and sometimes reduce enforcement TC (42%) or automate processes (33%), and they predominantly serve businesses (75%). Examples include Plum Lending, who offer bridge financing and refinancing services for commercial real estate. Other FinTechs in this cluster, like Payability and Konfio, offer the short-term financing of their business customers’ receivables to increase liquidity. Like in the two previous clusters, these FinTechs clearly fulfil the definition of FIs.

Discussion

Our analysis resulted in six robust groups with distinct archetypes of intermediating functions amongst FinTechs, and it has revealed commonalities between FinTechs of multiple business functions, which becomes evident in the fact that many of our clusters include companies from different FinTech verticals. It has also shown that FinTechs in each of the six clusters act as FIs, even though clusters 3 and 5 do so in very focused ways, e.g. by reducing friction through automation by leveraging new technological possibilities. We argue that even those archetypes significantly remove friction in (i.e. facilitate and enable) financial transactions, and thus are to be considered intermediaries. With the remaining four archetypes, the situation is even clearer. Without the asset-transforming intermediaries in cluster 1, for instance, the matching of capital-seekers and -givers amongst peers (P2P lending) would be a lot harder, if not impossible. The clusters are robust in the sense that during data collection, we observed that value propositions repeated after a while. For example, we found a number of B2B lending providers for bridge-financing receivables through short-term loans to increase working capital,

which are now grouped together in the sixth cluster. They might be located in different geographical markets, or specialize even further on customers from different industries, such as mobile app developers or media agencies, but their business models are comparable. This observation holds true for many of the companies included in our random sample, with only a minority of exceptions with unique value propositions within the investigated dataset.

Regarding the intermediation functions, we found that not many of the companies offer maturity-transforming services (only 6 cases in total, or 3.2%). Possible explanations for this could lie either the complexity that arises from accommodating for temporal transformation between market participants, or the decreased likelihood that marketplace-type offerings would find enough participants for transactions to actualize if, for example, the capital-giving side could specify not only the amount that they wish to invest, but also a customized timeframe during which they expect to be paid back. Another activity that is not (yet) frequently offered by FinTechs, is the alleviation of IA (13.7%). Most exceptions to this statement can be found in the first and fourth clusters, in the realm of investment and wealth management, where FinTechs sometimes implement measures to ensure their own interests are not conflicting those of their customers. All the different types of TC, on the other hand, are tackled quite frequently, most notably through automation, as well as reduction of search- and monitoring-related costs. This is true for all clusters and across all business functions, such as wealth managers, personal finance managers, neo-banks, or lending platforms, all of which, for instance, frequently offer some sort of monitoring of invested assets, personal expenses, or loans.

Some archetypes (e.g. Asset Transformers) are clearly taking on more intermediating functions than others. This observation may be in parts due to the sensible market-entry strategy of assessing product-market fit with the smallest resource input possible, which is also reflected in the fact that FinTechs initially focus on building better front office applications (e.g. improved usability, enriched data or more advanced data analysis) than incumbents, while relying on existing infrastructure (Niederkorn et al. 2015). Many back-office activities, such as the market-making of exchange-traded financial instruments, require a more intimate domain knowledge and are thus accessible to fewer challengers, and they often require time- and capital-intensive approval by the respective financial regulatory authority. Similarly, the number of intermediating functions may also be lifecycle-dependent, i.e. FinTechs may go to market with a very focused, technology-driven value proposition with relatively light intermediating functions (e.g. process automation, search & monitoring TC reduction – which can often be done without regulatory approval and while using existing infrastructure and financial products), and over time expand their product and service portfolio, in the course of which they might then also engage in more intermediating activities such as asset transformation. An example for this is the Germany-based neobank N26, which initially appeared to operate a bank without a banking license, by building a mobile banking app around bank accounts held by the B2B whitelabel bank Wirecard. After a few years, they then acquired their own banking license, migrated bank accounts in-house, and expanded the product portfolio from a simple main bank account with a payment card to also include investment, saving and insurance products, and also engaged in more intermediating functions.

But how do FinTechs in general affect financial intermediation and the financial services value chain? Do they really cut out middlemen? Three basic options exist: i) FinTechs cut out existing middlemen without replacement, ii) FinTechs replace existing intermediaries, and iii) FinTechs simply add an intermediation layer, without replacing an existing one.

Based on the observations made in this work, the first option is currently, by far, the least common one. An example would be to make peer-to-peer money transfers through DLT (e.g. using Bitcoin), as opposed to using the traditional banking system. Bitcoin provides a purely technological solution and renders existing intermediaries obsolete for this particular function. However, fiat-to-fiat transactions (e.g. transferring US dollars) still require the exchange of USD into Bitcoin, and Bitcoin back to USD, for which intermediaries like crypto-currency exchanges are still needed. Nonetheless, the exchange happens in close-to-realtime and tends to be cheaper than when using the traditional system. Similarly, DLT-based smart contracts may cut out middlemen entirely even for more complex business functions like lending or insurance. If and when they become more prevalent, DLT-based FinTechs might thus have a more profound disintermediating effect on various financial services (McWaters et al. 2016).

More commonly though, FinTechs follow the second option, i.e. they replace existing intermediaries and act as intermediaries themselves. Examples include when neobanks replace incumbent banks, or

when non-DLT-based P2P business models replace their conventional analogue, e.g. a P2P-lending FinTech replacing banks as the middlemen connecting capital-seekers and -givers, or a P2P-insurance FinTech replacing a traditional insurer. The FinTech versions of comparable business models often have reduced operational overhead and leverage technology to a greater degree, which allows them to differentiate from their incumbent competitors. Moreover, in P2P business models, market participants suddenly become more visible for each other. For example, in the P2P-lending case, capital-seekers and -givers become more aware of where their money is coming from or going to, compared to the traditional model with large banks in the middle. In some cases, it might not even be necessary for the funds to actually flow through the P2P-lending platform but be transferred directly from givers to seekers. Still, the economic transaction of lending money still would not have happened without the match-making platform in the middle. P2P-lending platforms thus clearly follow the definition of FIs, as has also been acknowledged in previous research (e.g. Bachmann et al. 2011). Such FinTech intermediaries might offer a leaner, more frictionless user experience with better pricing than the intermediaries they replace, but they still are FIs.

Finally, many FinTechs choose the third and final option, i.e. they build on top of existing intermediaries while also acting as intermediaries themselves. An example are cross-currency money transfers as offered by FinTech such as Transferwise. The company keeps bank accounts with sufficient liquidity in different currencies (e.g. USD and EUR), and ask consumers to transfer money to their internal account in the source currency while paying out to the recipient from their target currency account; only occasionally do they have to actually move money across currencies–if accounts in a particular currency run low–, thus saving bank fees themselves. Because they use this clever setup to work around the traditional banking infrastructure, money transfers happen much quicker and with less friction. In addition, Transferwise is able to offer better pricing to their customers. Even though in consumers' perception, the banks become partly invisible. However, the existing infrastructure (in particular bank accounts) are still required for every single transaction – senders need to transfer their funds to an existing bank account. Transferwise thus built on top of the existing payment and banking infrastructure. Still, they reduce friction, transaction speeds and thus clearly act as an intermediary themselves. Other examples include FinTech offerings that help consumers manage their bank accounts and budgets, or facilitate investments by suggesting a particular asset (e.g. an ETF) to invest in (e.g. using robo-advisory). Again, the existing infrastructure and financial products are required for these FinTechs to operate; yet, they facilitate economic transactions, thus act as FIs. As discussed before, such FinTechs may choose to capture greater parts of the value chain by themselves over time. In this case they would remain intermediaries, but the underlying existing layer would be removed, i.e. they would transition from the third option to the one discussed before.

FinTechs therefore generally act as FIs, and by and large also do not cut middlemen out of financial transactions. Therefore, the popular notion of them disintermediating financial services cannot be supported. Instead, when consistently following the definition of FIs, it becomes obvious that by and large, FinTechs leverage technology better to reduce friction while either replacing incumbent intermediaries, or even adding additional layers of intermediation.

Conclusion

This work first built upon financial intermediation theory and real-world observations to develop a taxonomy of financial intermediation functions amongst FinTechs. Then, the taxonomy was applied to a large dataset of 190 FinTechs by independent raters with substantial intercoder agreement (Cohen's kappa 0.69), based on which six archetypes of FIs could be identified. This work thus demonstrates that many FinTechs indeed act as new types of FIs that fulfil the same or similar functions as incumbent intermediaries. The identified archetypes describe in greater detail how exactly most FinTechs challenge existing intermediaries, and on which parts of the financial services value chain they focus. This study also contributes to our understanding of how FinTechs impact financial intermediation itself: Popular and academic literature sometimes suggest that FinTechs cut out middlemen and thus decrease the level of intermediation (e.g. Arner et al. 2015; Xu 2015). Our research has found that currently, this is not (yet) the case. In fact, while some FinTechs may indeed have a disintermediating effect (e.g. DLT-based business models), by and large, they leverage technology better than their incumbent competitors to remove friction, while either replacing incumbent intermediaries, or even adding additional layers of intermediation.

This work thus contributes to the scientific body of knowledge by shedding light on how FinTechs impact intermediation in the financial services industry. While some areas like crowdfunding and crypto-currencies have been well-researched before (e.g. Agrawal et al. 2011; Belleflamme et al. 2012; Nakamoto 2008), and some research has shed light on the business functions and service offerings that the FinTech revolution brought upon us (e.g. Eickhoff et al. 2017; Gimpel et al. 2017), little prior research investigated how FinTechs across business functions fit in the financial services value chain, and to what extent they truly act as FIs. In addition, this work disentangles the popular notion that FinTechs have a disintermediating effect on the financial services value chain.

However, this work is not free of limitations. Although we have analysed a large dataset of relevant FinTechs from around the world, extending the sample to conduct geographic sub-analyses might be a worthwhile endeavour. While we believe that the archetypes identified in this work are representative on a global level, the intermediating functions might still vary across geographies depending on factors such as regulatory environment and developmental status of the economy and financial infrastructure. Finally, our dataset included only a limited number of companies built on top of DLT, which may have a truly disintermediating effect on the financial services industry. Once such companies reach a slightly more mature status, it would certainly be compelling to conduct a similar study investigating the proposition regarding whether distributed ledgers help eliminate FIs altogether.

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