Dec 10th, 12:00 AM

What do FinTechs actually do? A Taxonomy of FinTech Business Models

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Completed Research Paper[1]

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Abstract

FinTechs are companies that combine technological and financial attributes in their business models. In recent years, the rise of FinTechs has attracted much attention since they challenge incumbent financial service companies including the traditional banking model. In this paper, we aim to contribute to a better understanding of this phenomenon. Therefore, we develop a taxonomy of FinTech business models following a theoretically grounded and empirically validated approach for identifying and defining underlying business model elements. After developing our taxonomy, we use a clustering-based approach to identify business model archetypes on which to showcase our results, re-examine the assumptions made during taxonomy development, and validate the presented findings. Based on the gained insights, we discuss implications for research, practice and policy makers, as well as directions for future research.

Keywords: Taxonomy, E-finance, FinTech, digital business model, digital transformation, financial technology

Introduction

The financial services industry has always been characterized by a high affinity towards the use of information technology (IT). Eventually, this has led to an inextricable interlocking of the financial services industry and IT. However, in the past, IT was primarily a driver for cost-effectiveness and efficiency gains, like the automation of processes. Exemplarily, financial transactions are completed without any physical interaction (Puschmann 2017). More recently, the role of IT in general is undergoing a fundamental shift. Digital transformation of whole industries is brought about by pervasive digital technologies (El Sawy and Pereira 2013; Lucas Jr. et al. 2013). According to this new understanding of IT, companies create and capture "[…] business value that is embodied in or enabled by IT" (Fichman et al. 2014). This transformational impact can also be witnessed in the financial services industry via the emergence of new

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business models such as "robo-advisors", and an increasing cross-industry competition with formerly pure technology companies entering the financial market, such as Apple (Puschmann 2017). In sum, the emergence of pervasive digital technology (collectively referring to mobile technologies, cloud computing, big data analytics and social media) (Bharadwaj et al. 2013) triggered a shift in the role of technology, moving beyond process automation towards the enabling role of new innovative (digital) business models (Fichman et al. 2014; Teece 2010).

This development collectively refers to the movement of FinTechs. The term FinTech stems from the words financial and technology and clearly indicates the markets in which these companies do their business. Yet, due to the relatively recent emergence of FinTechs, there is no distinct agreement on or definition of what a FinTech actually is. Recent contributions describe FinTechs broadly as an entrepreneurial phenomenon in the financial services industry that leverages digital technologies. For example, Arner et al. (2015, p. 3) define FinTechs as companies that use "[…] *technology to deliver financial solutions*," and they are similarly described by Lee and Teo (2015, p. 2) as companies offering*"[…] innovative financial services or products delivered via technology."* FinTechs are also accounted for challenging established roles, business models and service offerings in the financial sector, which is particularly caused by the introduction of technology-based innovations (Gomber et al. 2017). These aspects are covered by the definition of Sia et al. (2016, p. 105) who define FinTechs as *"a new generation of financial technology start-ups that are revolutionizing the financial industry"* and by Puschmann (2017, p. 74), who define them as *"[…] incremental or disruptive innovations in or in the context of the financial services industry induced by IT developments resulting in new intra- or inter-organizational business models, products and services, organizations, processes and systems."* Against this background, we use the following definition in this paper: 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.

As digital technologies impact society at large and customers become increasingly technology-savvy, they can easily draw on ubiquitous, readily available information. As a result, customers are more informed, demand a higher level of transparency related to products and services, and are shifting their expectations towards more diverse yet personalized offerings (Alt and Puschmann 2012; Granados and Gupta 2013; Hansen and Sia 2015; Hedley et al. 2006). This development is a major driver of FinTech success and it explains why FinTechs hold the potential to disrupt whole branches of the financial services industry: FinTechs are often able to understand their customers better than incumbents and thus address their needs more effectively (Mackenzie 2015).

Incumbents' actions are often constrained by legacy systems, resulting in tension and the need to transform and adapt to digital technologies (Gregory et al. 2015) while also meeting institutional expectations from, e.g., regulators and analysts (Benner and Ranganathan 2012; Benner and Ranganathan 2013). In addition to a decline in customers' trust, many traditional financial services companies are affected by stricter regulations as a consequence of the financial and EURO crises (Alt and Puschmann 2012). In contrast, FinTechs are apparently less affected by these developments and the opposite seems to be the case: regulators seem to struggle to keep up with the ongoing increase in the diffusion and adoption of digital technologies alongside the creation of new innovative businesses (McGrath 2013; Rycroft 2006), resulting in a "pacing problem" (Marchant et al. 2011).

However, we also see that incumbents started to cooperate with FinTechs for value creation, leading to new ecosystem setups. In sum, the rise of FinTechs is an important and relatively new phenomenon, which addresses the changing role of IT, changing customer behavior, changing ecosystems, and changing regulation in the financial services industry (Puschmann 2017). Given this new enabling role of IT for business value creation in the financial industry, it is important to understand the similarities and differences among different business models in the FinTech field. The business model concept is useful for developing such an understanding as it provides *"[…] a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm" and "[…] a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams"* Osterwalder et al. (2005, p. 17). Against this background, we aim at providing a rigorous overview of FinTech business models. Thereby, this paper

contributes to a better understanding of FinTech business models by answering the following research question:

RQ1: What are the theoretically grounded and empirically validated elements of financial technology companies' (FinTech) business models?

RQ2: Which FinTech business model archetypes can be identified by an empirical examination of these elements?

To answer these questions, we first develop a taxonomy of FinTech business models (RQ1), before applying this taxonomy to our sample of FinTech companies using cluster analysis (RQ2), which yields a sample of companies, for which we investigate whether typical patterns (archetypes) of business model elements can be identified.

Theoretical Background

Classification Systems and Taxonomies

Maybe one of the earliest and best known publications of a classification system goes back to the botanist, physician, and zoologist Carl Linnaeus who, amongst other important classification schemes, published the "Systema Naturae" in 1758 providing a comprehensive classification of species of animals and plants (Linnæus 1735). Since then, the need for ordering or classification of objects and phenomenon of interest has been recognized as a fundamental form of science in most scientific disciplines as it aims at organizing concepts of knowledge (Carper and Snizek 1980). Classification systems put structure to a field of knowledge and can help researchers in further theory developing when hypothesizing and studying relationships among described objects. They are useful to e.g., explain differences and similarities of objects, as well as uncovering and classifying non-existent objects (Glass and Vessey 1995; Varshney et al. 2015). In the IS field, classification systems and taxonomies have themselves been classified as "theory for analyzing" describing characteristics of objects or phenomenon and relationships between them (Gregor 2006).

As reported by Nickerson et al. (2013), in IS research the term "taxonomy" is widespread, and the authors define it as a *"set of dimensions each consisting of a set of mutually exclusive and collective exhaustive characteristics"* (Nickerson et al. 2013, p. 340), or more formally as follows:

$$T = \{D_i, i = 1, \ldots, n \mid D_i = \{C_{ij}, j = 1, \ldots, k_i, k_i \geq 2\}\}$$

D_i (i=1, ..., n) defines the n dimensions and C_{ij} (j=1, ..., k_i) k_i ($k_i \geq 2$) the mutually exclusive and collectively exhaustive characteristics C_{ij} (j=1, ..., k_i) each dimension consists of. Here, "mutually exclusive" refers to the property that no object has two different characteristics in a dimension, while "collectively exhaustive" is used when each object has at least one characteristic in each dimension. Together, these two properties assure that each object has exactly one characteristic in each single dimension. We use this definition in the formal presentation of the developed taxonomy.

Conceptualizations of Business Models

In a recent review of the business model literature, Zott et al. (2011) found that the scholarly discourse is very heterogeneous in regard to the question of "what is a business model?". Generally, articles on business models refer to them as presentations of building blocks. However, they often lack a clear definition of the business model concept. Yet, Zott et al. (2011) show that the existing literature on business models can be classified according to three generic themes: 1) e-business models where organizations make use of information technology; 2) strategic issues, which address competitive advantage, value creation, and firm performance; and 3) the management of innovation and technology (Zott et al. 2011). For logic reasons, we focus on 1) e-business models, which suits our taxonomy development of FinTech business models and includes the following contributions (Alt and Zimmermann 2001; Osterwalder et al. 2005).

Another extensive review of the business model literature is presented by Alt and Zimmermann (2001), who find six common elements that business models consist of: *mission, structure, processes, revenues, legal issues,* and *technology*. The *mission* is described as one of the more important elements of a business

model. It encompasses an understanding ranging from corporate strategy down to products and services, including the value proposition. In addition, a convincing business model is often led by a vision and not just by the technology behind it. *Structure* highlights the actors and governance a company is engaging, i.e., its value network. Furthermore, it also describes the company's geographic and industry focus. *Processes* can be viewed as a more granular look at a business model's mission and structure, which provides detailed insight into the activities of value creation, i.e., customer orientation as well as coordination mechanisms. *Revenues* define the business' logic and sources of its revenue. *Legal issues* are an element that touches all dimensions: potentially influencing the vision, structure, value creation processes, and revenue model. Finally, *technology* can be an enabler of but also a constraint on a (technological) business model. Like legal issues, technological developments may influence the mission, structures, processes, and revenue model of a company.

Osterwalder et al. (2005, p. 12) identify nine common business model elements: *value proposition, target customer, distribution channel, relationship, value configuration, core competency, partner network, cost structure,* and *revenue model*. *Value propositions* provide information on what products and services a company is offering. *Target customer* describes to whom the company intends to offer its products and services, i.e., the value; *distribution channels* are the means and ways of how a company reaches out to its customers; and *relationship* refers to the links a company creates between its target customers and itself. These three elements (*target customer, distribution channel, relationship*) can also be subsumed under *customer interface*. *Value configuration* is how resources are arranged in relation to a company's activities; *core competencies* highlight the competencies that are needed to carry out the (desired) business model; and *partner networks* are the company's cooperation with other actors that are needed to create and offer the value. *Value configuration, core competency* and *partner network* can be categorized further as *infrastructure management*. Finally, the last two elements of a business model highlight financial aspects. The *cost structure* describes the "monetary consequences" for a business model to operate, and the *revenue model* is the way the company receives money from its revenue streams (Osterwalder et al. 2005).

Practically oriented contributions already capture the categorization schemes of FinTechs (Bajorat 2016; Levy 2015). However, they regularly lack a rigorous methodological foundation and fall short of describing more than one dimension (usually limited to the product/service offering). But also scientific literature on FinTechs in general and especially related to their business models are still scarce (Puschmann 2017).

Methodological Approach to Taxonomy Development

To address our first research question RQ1, we follow the method presented by Nickerson et al. (2013), which has also been adopted by a number of other IS studies, such as Prat et al. (2015) and Tan et al. (2016). The chosen method provides a structured process for developing taxonomies on the basis of existing theoretical foundations (deduction), as well as empirical evidence (induction) in an iterative manner. In so doing, we build upon the rich business model literature and conceptually derive the taxonomy's dimensions. Then, related characteristics are subsequently developed by empirically examining a large number of globally diverse FinTech companies. The development of taxonomies usually focusses on a specific phenomenon of interest, i.e., a *meta characteristic*, which is determined at the beginning of the process. All dimensions and characteristics are based on the meta characteristic.

As Nickerson et al. (2013) explain, a taxonomy can be viewed as useful when it meets the following five criteria, representing ending conditions during the iterative process of taxonomy development: (1) the number of dimensions and characteristics should be limited to obtain a *concise* taxonomy that is easy to apply and comprehend. (2) Yet, to make objects distinguishable from each other, there should be a sufficient number of dimensions and characteristics, making the taxonomy *robust*. (3) If all relevant dimensions of an object are identified, i.e., if all (or a random sample) can be classified, the taxonomy is c*omprehensive*. (4) The taxonomy's dimensions and characteristics should also be *extendable* to account for possible new objects in the future that may not fit in the existing taxonomy. (5) And finally, to understand the objects, the taxonomy should be *explanatory* and not just descriptive.

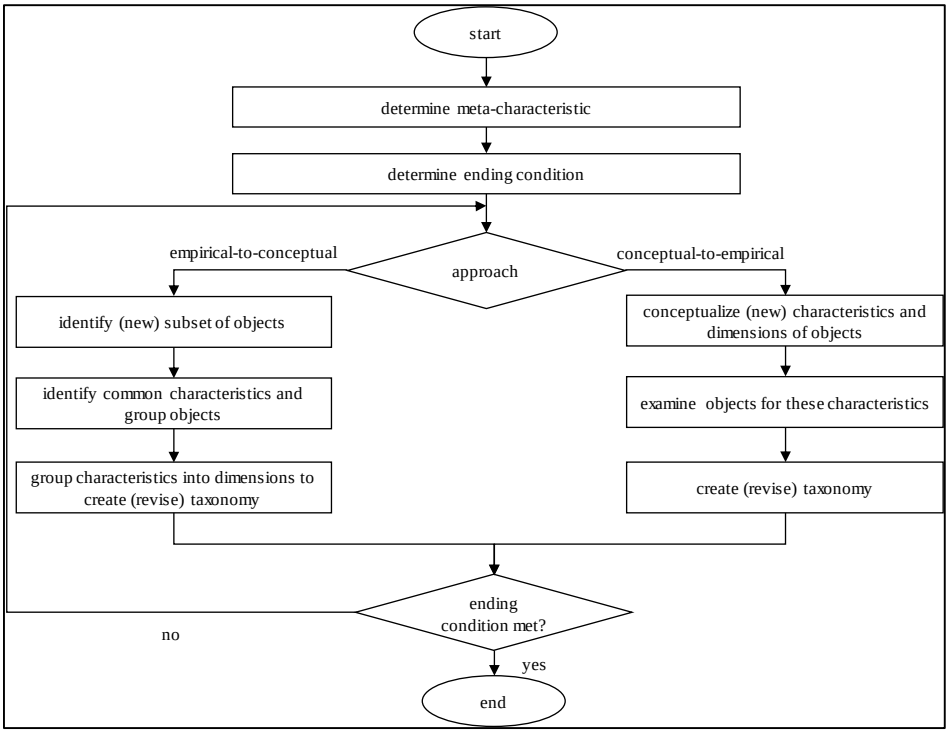

Figure 1. Taxonomy development method (Nickerson et al. 2013, p. 345)

These five attributes are also known as *subjective ending conditions* of a taxonomy development process. *Objective ending conditions* are as follows: there is no variation (merge, split or new additions) of objects, dimensions or characteristics in the last iteration; all objects (or a representative sample) are analyzed; every dimension, characteristic within the dimensions and combination of characteristics are unique; there is at least one object categorized for each characteristic under its dimension.

The final taxonomy should satisfy both subjective and objective ending conditions as well as the initial given definition of a taxonomy. During taxonomy development and after each iteration of revising dimensions and/or characteristics of the taxonomy, the satisfaction of all ending conditions is checked. Only if all ending conditions are satisfied, the process of taxonomy development is completed. Following and documenting this structured approach helps to cope with the complexity inherent to taxonomy development and to communicate the resulting taxonomy in a reproducible manner. During each iteration, dimensions and/or characteristics of the taxonomy are revised on the basis of either deductive (conceptual-to-empirical) or inductive (empirical-to-conceptual) reasoning.

Doing so allows to build upon existing theoretical foundations or, alternatively, empirical evidence. An overview of all steps of the method suggested by Nickerson et al. (2013) is depicted in Figure 1. In our process of taxonomy development presented in the following section it took four iterations (one conceptual-to-empirical and three empirical-to-conceptual) to arrive at a final taxonomy fulfilling the objective and subjective ending conditions.

Taxonomy Development

Dataset Description

During empirical-to-conceptual development iterations, we made use of the Crunchbase database (Crunchbase 2016). Crunchbase is a company information database with a focus on the start-up community. The database offers profiles of companies, investors and incubators, individuals, and events, as well as the relationships between these entities. There are two ways to browse the information available on Crunchbase. First, a web interface can be used to view information interactively. Second, an application programming interface (API) is available to perform structured requests against the database. We use the latter as our primary source of data.

Within the Crunchbase database, each company is assigned a number of attributes (tags), which help users to assess companies or find firms with specific characteristics. For our purposes, we use this tag attribute to request all firms in the database that have the "FinTech" tag. This results in a preliminary list of 2,340 companies. For each company, the database contains information such as name, country and city of origin, a hyperlink to the company website, social media links, a founding, date, and a textual description of the company.

We drop all companies for which no URL or textual description is available to exclude companies for which no meaningful information is readily available, resulting in 2,040 companies as the basis for our analysis. During the course of our analysis, more companies are dropped for similar reasons. As expected when looking at an industry dominated by startups, many FinTechs are quickly bought, or they cease operations, resulting in unreachable websites or redirects to new parent companies. When this is the case, the company is dropped from the sample. Table 1 provides an overview of the regional distribution of our initial sample. As shown, most companies are located in the United States or the European Union; however, we do not limit the analysis to these centers of activity.

Per Country FinTech No. in Dataset (Countries with at least 4 FinTechs)							
United States	942	Spain	15	Canada	28	Czech Republic	7
United Kingdom	192	Ireland	12	Mexico	28	Italy	7
Germany	50	Japan	12	Switzerland	25	Ukraine	7
India	40	South Africa	11	Netherlands	23	Thailand	6
Australia	38	Belgium	10	China	22	Latvia	5
Singapore	38	South Korea	10	Hong Kong	21	Luxembourg	5
France	33	Poland	9	Brazil	18	Philippines	6
Israel	29	Indonesia	8	Russia	16	Malta	4

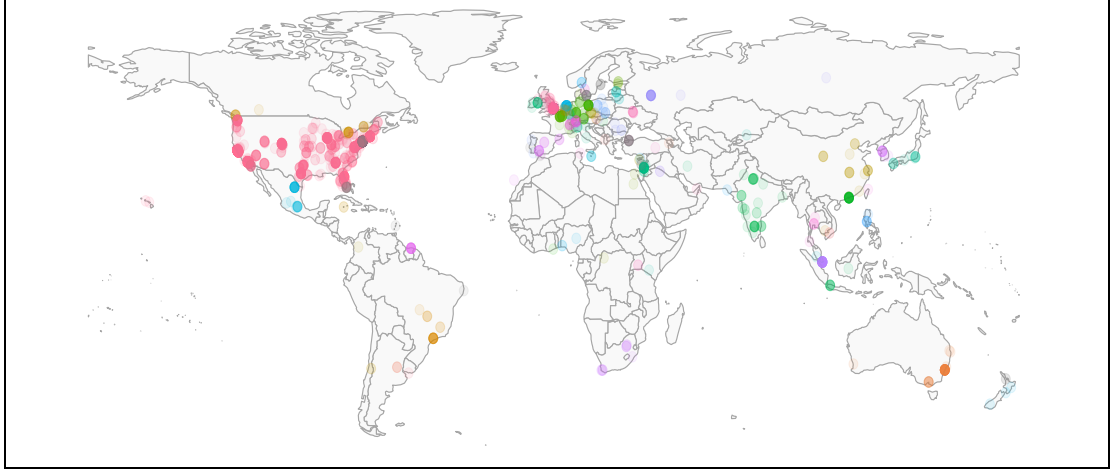

Table 1. Companies coded by country of origin. Only countries with >3 companies in the sample are reported in the table to save space, along with their color-coded (by country) global distribution (all observations).

Meta Characteristic

For our taxonomy, we are interested in the business models implemented by FinTechs. In line with (Nickerson et al. 2013, p. 343) the selection of our meta characteristic was guided by the purpose of the taxonomy and it was also based on existing (business model) theory. Consequently, we specify *elements of FinTech business models* as our meta-characteristic.

1st Iteration

Building upon the rich amount of literature on business models, our first iteration involved following the conceptual-to-empirical path of the applied method and, consequently, reviewing the existing knowledge and identifying relevant key concepts from the literature. In doing so, we purposefully selected dimensions that are useful for taxonomy development. We drop possible dimensions, in which many FinTechs are similar or regarding which information about individual companies can be obtained. Specifically, we draw on Zott et al. (2011) and, for the first iteration, we purposefully select D_1=*Dominant Technology Component* and D_5=*Revenue* from Alt and Zimmermann (2001) and D_2=*Value Proposition,* D_3=*Delivery Channel,* D_4=*Customer Segments,* and D_5=*Revenue Stream* from Osterwalder et al. (2005), which led to a preliminary taxonomy with the following formal notation:

$$
\begin{array}{lll}
T = \{ & D_1 \text{ Dominant Technology Component} & \mid D_1 = \{empty\} \\
 & D_2 \text{ Value Proposition} & \mid D_2 = \{empty\} \\
 & D_3 \text{ Delivery Channel} & \mid D_3 = \{empty\} \\
 & D_4 \text{ Customers} & \mid D_4 = \{empty\} \\
 & D_5 \text{ Revenue Stream} & \mid D_5 = \{empty\}\}
\end{array}
$$

Due to the purely conceptual nature of the first iteration, several ending conditions were not met, e.g., all objects (or a representative sample) are analyzed, as displayed in Table 2: Summary of the iterations and ending.

2nd Iteration

For our second iteration, we followed an empirical-to-conceptual approach and analyzed the data on FinTechs described in the previous section on "Dataset Description". We started by drawing a random sample of 150 companies that were labeled as FinTechs by the Crunchbase database. This sample was split, and each of the authors was assigned to analyze 50 companies. Thus, we were able to derive suitable characteristics for the dimensions obtained by the first iteration. The results of each author were discussed and integrated into a single taxonomy.

For example, characteristics with a very similar meaning but different names were summarized as a single characteristic, e.g., matching and intermediation to $C_{2,5}$ *Matching/Intermediation,* or unification and consolidation to $C_{2,10}$ *Unification/Consolidation*. Furthermore, during this empirical iteration, we identified the need for an additional dimension, D_6=*Product/Service Offering,* and added it to our taxonomy, which we did not include in the deductive first iteration. We added it as a new dimension in addition to the existing value proposition dimension. We did this because when looking at the FinTech companies in our sample, it becomes apparent that for many companies there is a clear distinction between what is being delivered to the customer and the use the customer is expected to gain from the service or product.

The newly added dimension and characteristics also indicated that our taxonomy has not yet reached all ending conditions and is still changing significantly. In sum, we developed the following taxonomy for the second iteration:

$T = \{$	D_1 *Dominant Technology Component*	$\mid D_1 =$	$\{C_{1,1}$ *Advisor System,* $C_{1,2}$ *Analytics,* $C_{1,3}$ *Payment System,* $C_{1,4}$ *Personal Assistant,* $C_{1,5}$ *Recommender System,* $C_{1,6}$ *Wallet,* $C_{1,7}$ *Blockchain,* $C_{1,8}$ *Digital Platform}*
	D_2 *Value Proposition*	$\mid D_2 =$	$\{C_{2,1}$ *Automation,* $C_{2,2}$ *Collaboration,* $C_{2,3}$ *Customization,* $C_{2,4}$ *Insight,* $C_{2,5}$ *Matching/Intermediation,* $C_{2,6}$ *Monetary,* $C_{2,7}$ *Financial Risk,* $C_{2,8}$ *Transparency,* $C_{2,9}$ *Trust,* $C_{2,10}$ *Unification/Consolidation,* $C_{2,11}$ *Usability,* $C_{2,12}$ *Convenience}*
	D_3 *Delivery Channel*	$\mid D_3 =$	$\{C_{3,1}$ *API,* $C_{3,2}$ *App,* $C_{3,3}$ *Physical,* $C_{3,4}$ *WWW,* $C_{3,5}$ *WWW+App}*
	D_4 *Customers*	$\mid D_4 =$	$\{C_{4,1}$ *B2B,* $C_{4,2}$ *B2C,* $C_{4,3}$ *B2B, B2C,* $C_{4,4}$ *B2B2C,* $C_{4,5}$ *B2C2B,* $C_{4,6}$ *B2CB}*
	D_5 *Revenue Stream*	$\mid D_5 =$	$\{C_{5,1}$ *Kickback,* $C_{5,2}$ *Pay Per Use,* $C_{5,3}$ *Revenue Share,* $C_{5,4}$ *Sales,* $C_{5,5}$ *Subscription,* $C_{5,6}$ *Unknown}*
	D_6 *Product/Service Offering*	$\mid D_6 =$	$\{C_{6,1}$ *Comparison,* $C_{6,2}$ *Data,* $C_{6,3}$ *Information,* $C_{6,4}$ *Lending}\}*

3rd Iteration

Next, we draw on a larger random sample of 600 companies, i.e., 200 per author, to test whether the dimensions and characteristics developed during iteration two are stable enough. During this iteration, we merged the characteristics $C_{1,1}$ *Advisor System,* $C_{1,2}$ *Analytics,* $C_{1,4}$ *Personal Assistant* and $C_{1,5}$ *Recommender System* with the newly added characteristic $C_{1,9}$ *Decision Support System*.

The reason was that $C_{1,1}$ *Advisor System,* $C_{1,4}$ *Personal Assistant* and $C_{1,5}$ *Recommender System* are very similar function-wise and they all encompass $C_{1,2}$ *Analytics* to some extent, which we subsumed to $C_{1,9}$ *Decision Support System*. In addition, we merged the characteristics $C_{1,3}$ *Payment System* and $C_{1,6}$ *Wallet* to the newly added overarching characteristic $C_{1,6}$ *Transaction Processing System*. Further changes within the Dimension D_1 *Dominant Technology Component* were the addition of the characteristics $C_{1,10}$ *Marketplace* and $C_{1,11}$ *Database*. Within D_4 *Customers* we condensed our taxonomy down to three characteristics, $C_{4,1}$ *B2B,* $C_{4,2}$ *B2C,* $C_{4,3}$ *B2B, B2C,* which makes the taxonomy more concise.

The most significant changes were in the dimension D_6 *Product/Service Offering*. The first three characteristics, $C_{6,1}$ *Comparison,* $C_{6,2}$ *Data* and $C_{6,3}$ *Information* were merged to $C_{6,3}$ *Information Aggregation*. In addition, we identified ten new characteristics, namely $C_{6,6}$ *Brokerage,* $C_{6,7}$ *Currency Exchange,* $C_{6,8}$ *Current Account,* $C_{6,9}$ *Device,* $C_{6,10}$ *Financial Education,* $C_{6,11}$ *Financing,* $C_{6,12}$ *Investments,* $C_{6,13}$ *Payment Service,* $C_{6,14}$ *Personal Assistant* and $C_{6,15}$ *Credit*. Similar to the 2nd iteration, our taxonomy still requires significant changes, indicating that the ending conditions have not been met. The taxonomy at the end of iteration three is notated as follows:

$T = \{$	D_1 *Dominant Technology Component*	$\mid D_1 =$	$\{C_{1,7}$ *Blockchain,* $C_{1,8}$ *Digital Platform,* $C_{1,9}$ *Decision Support System,* $C_{1,10}$ *Marketplace,* $C_{1,11}$ *Database,* $C_{1,12}$ *Transaction Processing System}*
	D_2 *Value Proposition*	$\mid D_2 =$	$\{C_{2,1}$ *Automation,* $C_{2,2}$ *Collaboration,* $C_{2,3}$ *Customization,* $C_{2,4}$ *Insight,* $C_{2,5}$ *Matching/Intermediation,* $C_{2,6}$ *Monetary,* $C_{2,7}$ *Financial Risk,* $C_{2,8}$ *Transparency,* $C_{2,10}$ *Unification/Consolidation,* $C_{2,13}$ *Security,* $C_{2,14}$ *Usability/Convenience}*
	D_3 *Delivery Channel*	$\mid D_3 =$	$\{C_{3,1}$ *API,* $C_{3,2}$ *App,* $C_{3,3}$ *Physical,* $C_{3,4}$ *WWW,* $C_{3,5}$ *WWW+App,* $C_{3,6}$ *Instant Message}*
	D_4 *Customers*	$\mid D_4 =$	$\{C_{4,1}$ *B2B,* $C_{4,2}$ *B2C,* $C_{4,3}$ *B2B, B2C}*
	D_5 *Revenue Stream*	$\mid D_5 =$	$\{C_{5,1}$ *Kickback,* $C_{5,2}$ *Pay Per Use,* $C_{5,3}$ *Revenue Share,* $C_{5,4}$ *Sales,* $C_{5,5}$ *Subscription,* $C_{5,6}$ *Unknown}*
	D_6 *Product/Service Offering*	$\mid D_6 =$	$\{C_{6,4}$ *Lending,* $C_{6,5}$ *Information Aggregation,* $C_{6,6}$ *Brokerage,* $C_{6,7}$ *Currency Exchange,* $C_{6,8}$ *Current Account,* $C_{6,9}$ *Device,* $C_{6,10}$ *Financial Education,* $C_{6,11}$ *Financing,* $C_{6,12}$ *Investments,* $C_{6,13}$ *Payment Service,* $C_{6,14}$ *Personal Assistant,* $C_{6,15}$ *Credit}\}*

4th Iteration

Last, we analyzed the remaining 1400 companies with a FinTech label. Within the dimension D_6 *Product/ Service Offering* we merged the characteristics $C_{6,4}$ *Lending* and $C_{6,15}$ *Credit* to $C_{6,16}$ *Credit/Lending* because they were identical in their meaning. Furthermore, we added two characteristics to this dimension, namely,

$C_{6,17}$ *Fraud Prevention* and $C_{6,18}$ *User Identification*. This led us to our final taxonomy. However, the last iteration did not meet two objective ending conditions from Nickerson et al. (2013), i.e., "no dimensions or characteristics were merged or split," and "no new dimensions or characteristics were added." Nevertheless, we stopped the development process because, after this iteration, we analyzed the largest and remaining proportion of the FinTech sample, yet our taxonomy experienced only marginal changes. The final taxonomy is visualized in Table 3 "FinTech Business Model Taxonomy" with the following formal notation:

$T = \{$	D_1 *Dominant Technology Component*	$\mid D_1 =$	$\{C_{1,7}$ *Blockchain,* $C_{1,8}$ *Digital Platform,* $C_{1,9}$ *Decision Support System,* $C_{1,10}$ *Marketplace,* $C_{1,11}$ *Database,* $C_{1,12}$ *Transaction Processing System}*
	D_2 *Value Proposition*	$\mid D_2 =$	$\{C_{2,1}$ *Automation,* $C_{2,2}$ *Collaboration,* $C_{2,3}$ *Customization,* $C_{2,4}$ *Insight,* $C_{2,5}$ *Matching/Intermediation,* $C_{2,6}$ *Monetary,* $C_{2,7}$ *Financial Risk,* $C_{2,8}$ *Transparency,* $C_{2,10}$ *Unification/Consolidation,* $C_{2,13}$ *Security,* $C_{2,14}$ *Usability/Convenience}*
	D_3 *Delivery Channel*	$\mid D_3 =$	$\{C_{3,1}$ *API,* $C_{3,2}$ *App,* $C_{3,3}$ *Physical,* $C_{3,4}$ *WWW,* $C_{3,5}$ *WWW+App,* $C_{3,6}$ *Instant Message}*
	D_4 *Customers*	$\mid D_4 =$	$\{C_{4,1}$ *B2B,* $C_{4,2}$ *B2C,* $C_{4,3}$ *B2B, B2C}*
	D_5 *Revenue Stream*	$\mid D_5 =$	$\{C_{5,1}$ *Kickback,* $C_{5,2}$ *Pay Per Use,* $C_{5,3}$ *Revenue Share,* $C_{5,4}$ *Sales,* $C_{5,5}$ *Subscription,* $C_{5,6}$ *Unknown}*
	D_6 *Product/Service Offering*	$\mid D_6 =$	$\{C_{6,5}$ *Information Aggregation,* $C_{6,6}$ *Brokerage,* $C_{6,7}$ *Currency Exchange,* $C_{6,8}$ *Current Account,* $C_{6,9}$ *Device,* $C_{6,10}$ *Financial Education,* $C_{6,11}$ *Financing,* $C_{6,12}$ *Investments,* $C_{6,13}$ *Payment Service,* $C_{6,14}$ *Personal Assistant,* $C_{6,16}$ *Lending/Credit,* $C_{6,17}$ *Fraud Prevention,* $C_{6,18}$ *User Identification }}*

Finally, and in order to demonstrate the necessity of each iteration, Table 2 provides a summary of the four iterations and to which extent each of them contributes to fulfilling the required ending conditions. As shown, the first iteration (conceptual-to-empirical) only satisfied three ending conditions, while the subsequent three iterations (empirical-to-conceptual) contributed to the satisfaction of the remaining ending conditions. As all ending conditions are satisfied for our company sample after the four conducted iterations, we consider the developed taxonomy finalized at this point. However, as the FinTech field keeps evolving, which may lead to a future violation of an ending condition, the developed taxonomy may be extended to reflect such changes by conducting additional development iterations.

Iteration				Ending Condition
1 conceptual	**2 empirical**	**3 empirical**	**4 empirical**	**Taxonomy definition restrictions**
	●		●	Mutually exclusive: no object has two different characteristics in a dimension
	●	●	●	Collectively exhaustive: each object has at least one characteristic in each dimension
	●	●	●	Concise: dimensions and characteristics are limited
	●	●	●	Robust: sufficient number of dimensions and characteristics
	●	●	●	Comprehensive: identification of all (relevant) dimensions of an object
●	●	●	●	Extendable: possibility to easily add dimensions and characteristics in the future
			●	Explanatory: dimensions and characteristics sufficiently explain the object
	(50)	● (600)	● (all)	All objects (or a representative sample) were analyzed
●	●	●	●	No object was merged or split
	●	●	●	At least one object assigned to each characteristic
			●*	No new dimensions or characteristics were added
			●*	No dimensions or characteristics were merged or split
●	●	●	●	Every dimension is unique
			●	Every characteristic within the dimension is unique
	●		●	Every combination of characteristics is unique

Table 2. Summary of the iterations and ending conditions. * In these cases there is a minor change, which we consider insignificant due to the size of our sample.

FinTech Business Model Taxonomy

Dimensions D_i					
D_1 Dominant Technology Component	D_2 Value Proposition	D_3 Delivery Channel	D_4 Customers	D_5 Revenue Stream	D_6 Product/Service Offering
Characteristics C_{ij}					
$C_{1,7}$ Blockchain	$C_{2,1}$ Automation	$C_{3,1}$ API	$C_{4,1}$ B2B	$C_{5,1}$ Kickback	$C_{6,5}$ Inform. Aggregation
$C_{1,8}$ Digital Platform	$C_{2,2}$ Collaboration	$C_{3,2}$ App	$C_{4,2}$ B2C	$C_{5,2}$ Pay Per Use	$C_{6,6}$ Brokerage
$C_{1,9}$ Decision Support System	$C_{2,3}$ Customization	$C_{3,3}$ Physical	$C_{4,3}$ B2B, B2C	$C_{5,3}$ Revenue Share	$C_{6,7}$ Currency Exchange
$C_{1,10}$ Marketplace	$C_{2,4}$ Insight	$C_{3,4}$ WWW		C5,4 Sales	$C_{6,8}$ Current Account
$C_{1,11}$ Database	$C_{2,5}$ Matching/Intermediation	$C_{3,5}$ WWW + App		$C_{5,5}$ Subscription	$C_{6,9}$ Device
$C_{1,12}$ Transaction Processing System	$C_{2,6}$ Monetary	$C_{3,6}$ Instant Message		$C_{5,6}$ Unknown	$C_{6,10}$ Financial Education
	$C_{2,7}$ Financial Risk			$C_{5,7}$ Free	$C_{6,11}$ Financing
	$C_{2,8}$ Transparency			$C_{5,8}$ Hybrid	$C_{6,12}$ Investments
	$C_{2,10}$ Unification/Consolidation				$C_{6,13}$ Payment Service
	$C_{2,13}$ Security				$C_{6,14}$ Personal Assistant
	$C_{2,14}$ Convenience/Usability				$C_{6,16}$ Lending/Credit
					$C_{6,17}$ Fraud Prevention
					$C_{6,18}$ User Identification

Table 3. FinTech Business Model Taxonomy. Overview of all Dimensions (D_i) and Characteristics ($C_{i,j}$). State after the conclusion of the development process following Nickerson et al. (2013).

After the development iterations discussed above, we provide an answer to our first research question RQ1 and arrive at the final taxonomy presented in Table 3. As shown, the taxonomy of FinTech business models contains six dimensions, each of which is composed of several characteristics. As discussed, this taxonomy satisfies the formal requirements and ending conditions required by Nickerson et al. (2013). Of course, as the developed taxonomy represents the state of the FinTech industry to-date, future additional development iterations may uncover additional relevant dimensions and/or characteristics.

Because a useful taxonomy is *explanatory*, not just descriptive, and to make interpreting the taxonomy easier, we elaborate on our definitions of critical characteristics that we do not consider self-explanatory. To this end, the definitions of all dimensions are shown in Table 4. As shown, each dimension refers to extant business model literature. Likewise, Table 6 (appendix) details the descriptions of each characteristic contained in the product or service dimension, in the dominant technology dimension, and in the value proposition dimension. We consider the characteristics of the other dimensions to be self-explanatory.

Dimension	Definition
D_1 Dominant Technology Component	Dominant IT artifact that is the driver for the IT-based business model (Alt and Zimmermann 2001; Power 2004).
D_2 Value Proposition	Describes the value the company creates for its ecosystem (customers, partners etc.) (Osterwalder et al. 2005).
D_3 Delivery Channel	Describes how the products and services are distributed to the customers (Osterwalder et al. 2005).
D_4 Customers	Describes to whom the company intends to offer its products and services (Osterwalder et al. 2005).
D_5 Revenue Stream	Describes how the company generates revenue from its products or services (Alt and Zimmermann 2001; Osterwalder et al. 2005).
D_6 Product/Service Offering	Describes what the company offers to its Customers (Osterwalder et al. 2005).

Table 4. Definitions of taxonomy dimensions.

Archetypes of FinTech Business Models

In order to address our second research question RQ2, we build upon our developed taxonomy of FinTech business models in order to identify typical patterns (archetypes) of business model elements from a large collection of FinTech companies, which we also extracted from the Crunchbase database. The database includes a set of business sector and technology tags for each firm.

We use these tags for a cluster-based validation of the previously identified dimensions and their characteristics. The developed taxonomy should be able to identify a representative firm archetype for each cluster, determined on the basis of the Crunchbase tags. This is also done to ensure that the most important *company-archetypes* are represented in the presentation of our results. The clustering is based on the entire company sample and is consequently unbiased by our prior taxonomy development, which did not use these tags in order to preserve them for this demonstration, which can also serve as a check as to whether the developed taxonomy can be applied to the raw data.

In particular, we use the multiscale bootstrap resampling approach implemented in the PVClust R-package (Shimodaira 2004; Suzuki and Shimodaira 2006). In contrast to traditional approaches, this yields nearly unbiased *p*-values for each cluster (Shimodaira 2004), allowing us to assess which clusters are significantly different from their peers. This provides us with additional information when assessing whether clusters are of interest to our analysis. Figure 2 shows the resulting cluster-dendrogram. As shown, the clustering results in several sensible categories, such as a "Blockchain" (7) or "Cyber Security" (32) cluster. Still, to develop these clusters into dimensions and their characteristics, further processing is needed, as not every cluster is likely to yield informative distinctions according to our initial FinTech definition (see Introduction).

Accordingly, the resulting tag clusters are examined in a two-stage analysis. First, we identify cluster-nodes in the cluster-dendrogram, which seem like promising candidates for company archetypes. Second, the companies in each cluster are re-examined manually, and the cluster is thus checked for coherence regarding the business model of the firms contained therein to assess the usefulness of each cluster beyond its quantitative presence. For the first step, a company is considered a member of a cluster if it has > 0 tags in common with the cluster and not as many matches with another cluster.

As shown in Figure 3, the first step yields 24 candidates for relevant clusters, while 14 clusters remain after the manual coherence check and are reported in Figure 3. Cluster candidates for step 1 are determined using two criteria, the first of which serves as a sanity barrier, while the second serves as a focus check towards taxonomy development:

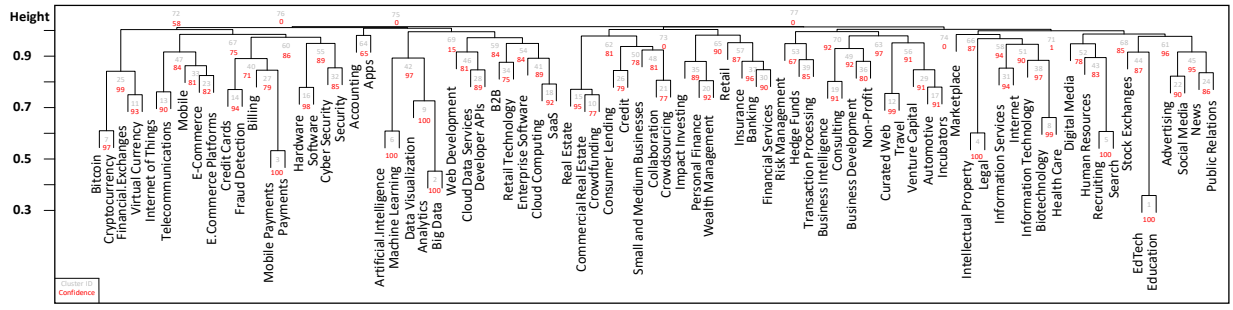

Figure 2. Cluster dendrogram of firm tags as included in the Crunchbase database. Red numbers represent approximately unbiased p-values (confidence) indicating cluster significance (note: > .9 is equivalent to <.1 for normal p-values). Grey numbers represent cluster IDs counted from the branches of the tree upwards. The difference in height between clusters can be interpreted as a distance measure between clusters.

1. The chosen category should satisfy the discussed definition of a FinTech, i.e., it should describe companies seeking to take part in areas of business traditionally covered by banks or the financial services industry or establish novel business models relevant to these sectors.
2. The chosen categories should be sufficiently distinct from one another to be able to serve as a basis for taxonomy development.

The result of step 1 is presented by cluster candidates **A** to **X**, shown in Figure 3. As described, each of these clusters is consequently examined in more detail by checking the companies contained therein for coherence and discarding a cluster if the contained companies are not FinTechs as defined in the context of this paper. Additionally, we discard a cluster if it does not contain firms with business models that are coherent regarding the tags the cluster contains or if a cluster does not contain firms.[2] The clusters violating these conditions are marked with a red dot in Figure 3 below.

As noted, 14 clusters remain after these two steps. However, examining these clusters in detail, we noticed, that some clusters are also close to each other in terms of their manifestations (Figure 3). Namely, **B**, and **E**, **I** and **J** as well as **Q**, **R**, and **W**, which then were grouped to **B+E**, **I+J** and **Q+R+W**. In doing so, we obtained ten partially grouped clusters, which we select by traveling upwards in the cluster hierarchy until a unified cluster results that passes manual introspection. Next, and in order to provide an answer to our second research question RQ2, the actual identification of FinTech business model archetypes is achieved. This is done by reporting the dominant characteristic for the firms contained in these clusters for each dimension of the developed taxonomy (see Table 6). The first column of Table 6 represents the manually labeled different FinTech business model archetypes. The label is obtained by examining the most dominant characteristics of each cluster and the cluster tags. For example, the FinTech business model archetype "Payment Service" is described by cluster B+E with a dominant technology component of a transaction processing system, the value proposition is mostly convenience/usability, which is usually delivered by an app for B2B customers. Meanwhile, the revenue stream is unknown and the product/service offering is logically a payment service.

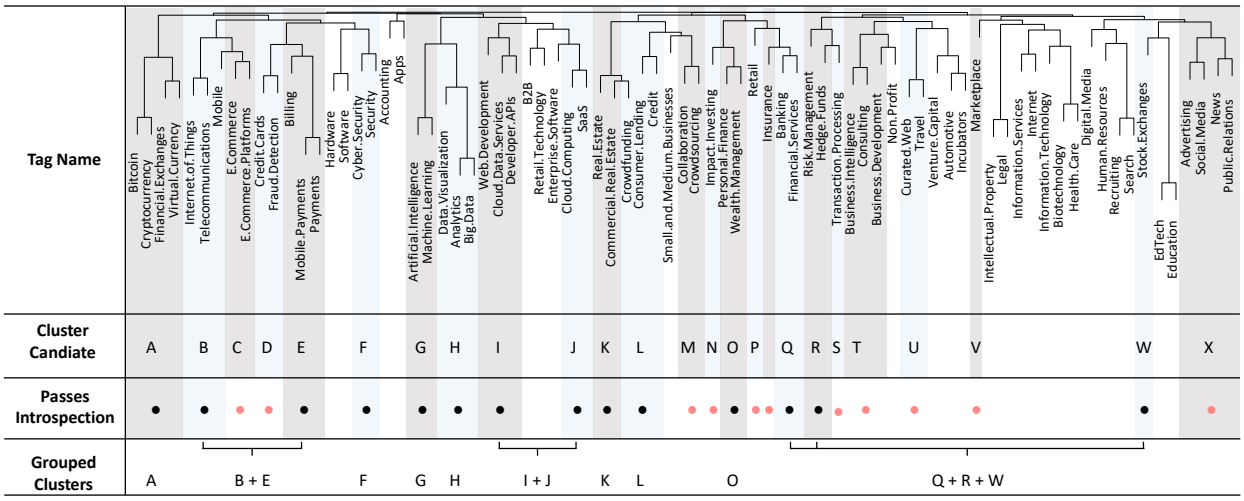

Figure 3. Coding (three coder's consensus) of clusters. To technological and entrepreneurial categories. Colored columns only serve to emphasize the clusters. Red dots indicate clusters that do not contain companies in line with the FinTech definition used here.

[2] No-firm clusters are possible because of the requirement that a firm is only assigned to a cluster if it has more tags in common with this cluster than with any other, which makes the cluster assignment very strict. As shown, this strict criterion still results in a variety of clusters.

Archetype Label	Cluster	Dominant Technology Component	Value Proposition	Delivery Channel	Customers	Revenue Stream	Product/ Service Offering
Cryptocurrency	*A*	Blockchain	Convenience/ Usability	API	B2C	Unknown	Currency Exchange
Payment Service	*B_E*	Transaction Processing System	Convenience/ Usability	App	B2B	Unknown	Payment Service
Financial Markets Intermediary	*F*	Marketplace; Transaction Processing System	Matching/ Intermediation; Security	Physical / WWW	B2B	Sales, Unknown	Brokerage; Device
Information Aggregator	*G*	Decision Support System	Convenience/Usability	App	B2B, B2C	Unknown	Inform. Aggregation
Information Extractor	*H*	Decision Support System	Insight	App	B2B	Unknown	Inform. Aggregation
Insourcer of Sub-Processes	*I_J*	Decision Support System	Automation	App	B2B	Unknown	Inform. Aggregation
Lending Community	*K*	Marketplace	Monetary; Transparency	WWW	B2C	Revenue Share; Unknown	Lending/ Credit; Financing
Alternative Trading Venue	*L*	Marketplace	Matching/ Intermediation	WWW+ App	B2B, B2C	Unknown	Investments; Lending/ Credit
Robo Advisor	*O*	Decision Support System	Monetary	App	B2C	Revenue Share; Unknown	Personal Assistant
Co-Creator of Financial Analysis	*Q_R_ W*	Decision Support System	Convenience/Usability	App	B2B	Unknown	Inform. Aggregation

Table 5. FinTech business model archetypes coded from dominant (most common occurrence) characteristic for firms within each cluster resulting from coding in Figure 3.

As shown in the table, cluster **A** relates to cryptocurrency based business models, which typically relate to consumer based convenience offerings. Cluster **B + E** contains firms offering payment services. The prime example of firms contained in this cluster is given by PayPal, and many firms contained therein offer similar but more specialized services. The companies contained in Cluster **F** focus on offering device based security offerings that support other firms' business processes. One example of this is supplying biometric authentication for brokerage offerings.

Firms that are part of cluster **G** offer their customer information aggregation services, which focusses on the supplying of information. Going further, firms in cluster **H** focus on extracting information from such data. Cluster **I + J** offers similar services but the business offerings of firms in this cluster tend to be more cloud-centric and revolve around hosting the entire service on the FinTechs servers. Cluster **K** contains lending communities, which are marketplaces for lending or financing, and often focus on providing micro funding or aim at providing a form of disintermediation. Similarly, cluster **L** contains firms that focus on providing alternative trading venues.

Cluster **O** relates to financial "robo" advisors, which perform actions such as user specific portfolio suggestions or credit scoring. Cluster **Q+R+W** offers co-creation of financial analysis, which involves tasks such as credit risk assessment but also reaches into educational offerings in this area. These archetypes present the answer to RQ2 by using the developed taxonomy to examine groups of firms regarding the commonalities in their business models, and shows how the taxonomy can be applied to specific companies.

Implications

Implications for Research

The first implication of this paper is its contribution toward developing a consensus on the question of what a FinTech actually is and upon what elements their business models are built. As discussed, due to the rapidly changing landscape of FinTech companies and the relative youth of the "FinTech phenomenon", the lines are not distinct. Furthermore, the lines are blurred between traditional tech firms selling their products to banks and the new phenomenon of FinTech, in which firms challenge the established banking industry by providing either what was traditionally considered a banking service or entirely new related services. To this end, the presented taxonomy of business models can be interpreted in terms of what it does not include. Considered in conjunction with the above-mentioned existing definitions of FinTech firms, this enables researchers to focus on the new phenomenon. Additionally, like all taxonomies, ours provides an overview of the studied phenomenon. Thus, the dimensions and characteristics of FinTech business models included in the taxonomy presented here help to identify different types of FinTech business models by abstraction beyond the business model of individual firms. In conjunction with the presented clustering of firm attributes, this allows for the identification of firms that are especially unlike each other, each of which represents a different facet of the FinTech landscape. In addition, the developed taxonomy and archetypes will assist researchers to find and position future contributions. Furthermore, the presented dimensions and characteristics provide a basis for further theory development and theory testing related to the FinTech phenomenon (Varshney et al. 2015). Finally, the iterative taxonomy development process described by Nickerson et al. (2013) allows other researchers to extend the presented taxonomy by adding further iterations if new FinTech business models are observed in the future.

Implications for Practice

For practitioners, business model taxonomies may at first appear very "academic" in the negative sense of the word. However, they allow for the necessary abstraction needed to identify unoccupied business models, as reflected by combinations of characteristics currently not offered by competing firms. While, naturally, not every such combination is likely to be sensible, spotting what is not being done by others is an inherently difficult problem for which academia can provide support by delivering abstractions, such as the presented taxonomy. Additionally, incumbents can use the taxonomy to gain an overview of which traditional business models are threatened by new competition and which new business models are being developed. Overall, as the industry is still developing and highly dynamic, this is a critical feature to ensure the usefulness of any taxonomy in this industry.

Policy Implications

The dynamic nature of the FinTech movement presents policy makers with a number of challenges, such as the identification of whether or which FinTech firms need to be subject to regulation. The presented taxonomy can provide information regarding this question. The banking sector is a highly regulated industry, in which incumbents comply with regulations regarding problems such as fraud prevention, identity theft, organized crime, and sanctions against nation states. While regulators have established processes to address these and many other concerns with incumbent firms, FinTechs have not been subject to the same level of scrutiny if they themselves have not been classified as banks or providers of financial services. This pacing problem (Marchant et al. 2011) has yet to be fully addressed by regulators. However, the nature of FinTech business models implies that these firms face many of the same risks as traditional banks. For example, they handle similarly sensitive customer information and may be targeted by illegal activity, such as fraud. Thus, it is imperative for regulators to gain an overview of what business models are being created in this new sector of the financial industry to identify FinTechs that may play a crucial role in the financial industry, which may become relevant when considering market stability. While certainly not every FinTech needs to face the same scrutiny as traditional banks, parts of this new industry may create a need for new forms of regulation or an extension of the applicability of existing rules. Therefore, a taxonomy of business models is needed to enable judgment, on a case by case basis, whether any regulatory consequences should apply.

Limitations and Future Research

Limitations

The presented taxonomy should be used while keeping in mind several assumptions and decisions made during its development. First, regarding the development of dimensions, the selection of dimensions based on the business model literature is inherently selective. For other researchers, other dimensions may be of more interest. As discussed, this may be addressed by adding new dimensions to the taxonomy and performing additional development iterations when such extensions are desired. Due to the dynamic nature of business and the FinTech movement in particular, we cannot exclude the possibility that, for a given company, multiple possible characteristics exist, which contradicts the definition of Nickerson et al. (2013) of mutually exclusive characteristics. In this research, we opted to map each company based on its dominant characteristic if firms presented insurmountable challenges in this regard. Still, we developed the characteristics of the taxonomy with this goal in mind.

Second, regarding the development of characteristics during our empirical-to-conceptual development iterations, we were inherently limited to the companies contained in our sample. While this sample is quite large, not every company has an inherent need to be listed in such a database. This is especially true for non-US or non-EU firms.

Future Research

In this paper, we developed a taxonomy of FinTech business models. However, the aspiration to generality limits the granularity of both the dimensions and characteristics developed to fit different types of FinTechs. Thus, future research focusing on more specialized taxonomies may provide further insights. Additionally, the developed taxonomy can be used to analyze the landscape of FinTech companies more directly. For example, clustering can be performed on the characteristics assigned to each company, as opposed to the approach chosen here, namely to cluster the tags not used during taxonomy development as a confirmatory effort. Such clustering could help to identify which combinations of characteristics are common and show patterns across different types of business models, identifying which roles are already being filled by companies and which are not.

Additionally, the taxonomy can be used to analyze companies based on other data points available on Crunchbase, such as funding success or the likelihood of long-term success, or which types of investors favor particular types of FinTechs. As noted, the dynamic development of the FinTech field creates a need for future investigation. New companies may follow entirely different business models than the ones included in our dataset. Thus, future research may focus on exploring whether our taxonomy still holds.

Appendix A: Description of Characteristics

Definitions of Characteristics in selected Dimensions	
Product or Service	
Brokerage	The service acts as an intermediary between market participants and markets (Reuters 2016).
Credit/Lending	The product enables the customer to enter credit contracts as either lender or borrower (Oxford-Dictionaries 2016).
Currency Exchange	"An exchange, or market, is a physical location or an electronic system in which securities are traded in an orderly, regulated way [...]" (Reuters 2016).
Current Account	"An account with a bank or building society from which money may be withdrawn without notice, typically an active account catering for frequent deposits and withdrawals by cheque." (Oxford-Dictionaries 2016).
Device	"A thing made or adapted for a particular purpose, especially a piece of mechanical or electronic equipment." (Oxford-Dictionaries 2016).
Financial Education	Improves the understanding of financial concepts or products (OECD Directorate for Financial and Enterprise Affairs 2005).
Fraud Prevention or Detection	The product intends to either prevent fraud from happening (fraud prevention) or detect fraud after the fact (fraud detection) (Bolton and Hand 2002).
Information Aggregation	The product collects information from multiple sources and provides the user with an aggregated information basis.
Investments	Investing money for profit beyond lending money, e.g., real estate investments (Oxford-Dictionaries 2016).
Payment Service	A service that enables users to send and receive payments.
Personal Assistant	The system provides the user with recommendations on which the user may choose to act, e.g., the recommendation of a portfolio structure (Resnick and Varian 1997), e.g., routing information.
User Identification	The system authenticates user identity (Todorov 2007).
Dominant Technology Component	
Blockchain	„[...] is a distributed database in digital form maintaining a continuously-growing list of records which are grouped into blocks and protected against malicious alteration through being encrypted and grouped into blocks“ (Cohen et al. 2016).
DSS	„[...] are interactive computer-based systems, which help decision- makers interactive computer-based systems to solve unstructured problems“ (Morton 1971).
Marketplace	„[...] facilitating the exchange of information, goods, services, and payments. In the process, they create economic value for buyers, sellers, market intermediaries, and for society at large“ (Bakos 1998).
Platform	"[...] a building block, providing an essential function to a technological system—which acts as a foundation upon which other firms can develop complementary products, technologies or services" (Gawer 2011).
Database System	„[...] is basically a computerized record-keeping system; in other words, it is a computerized system whose overall purpose is to store information and to allow users to retrieve and update that information on demand“ (Date 2004).
Transaction Processing System	„[...] is a collection of transaction programs designed to do the functions necessary to automate a given business activity“ (Bernstein and Newcomer 2009).
Value Proposition	
Automation	A machine agent (computerized system) that executes a function previously carried out by a human (Parasuraman and Riley 1997; Parasuraman et al. 2000).
Collaboration	"The action of working with someone to produce something" (Oxford-Dictionaries 2016).
Convenience/ Usability	„The ease of use and the degree to which it is easy for the user to understand the system in order to use it for its intended purpose“ (ISO 2010).
Customization	The ability to either customize a product according to the user's wishes or letting the customer accomplish such customization (Hart 1995; Pine et al. 1993).
Financial Risk	The product is intended to make financial risks, i.e., uncertainty about future returns due to market developments, more manageable (Reuters 2016).
Insight	Provides the user with the means to advance his or her knowledge (Chang et al. 2009).
Matching/ Intermediation	The products make it easier for buyers and sellers to align their transaction intentions by providing them with the means of discovering each other (Spulber 1996).
Monetary	The product promises financial gains.
Security	We follow the CIA-Triangle definition of security, i.e., the product intends to improve users' perceived or actual security by addressing systems' [C]onfidentiality, [I]ntegrity or [A]vailability (Avizienis et al. 2004).
Transparency	Increasing market fairness by enabling market participants to act on more timely or comprehensive information (Madhavan 2000).
Unification/ Consolidation	"The action or process of combining a number of things into a single more effective or coherent whole." (Oxford-Dictionaries 2016).

Table 6. Definitions of characteristics. For each characteristic, a reference to a description or our own understanding of what is contained therein is provided.

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