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The impact of digitization in the banking sector -An analysis of leading European universal banks-

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To my family especially to my wife

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To *Mariola* my beloved significant other. Without her structural understanding, profound knowledge of quantitative methods and her strict view, this work would not have been realised this way. She was the one who had the idea for this project and who pioneered the way at the CEU San Pablo in 1998 - 2006, together with the director of her thesis, Don Antonio Sainz Fuertes.

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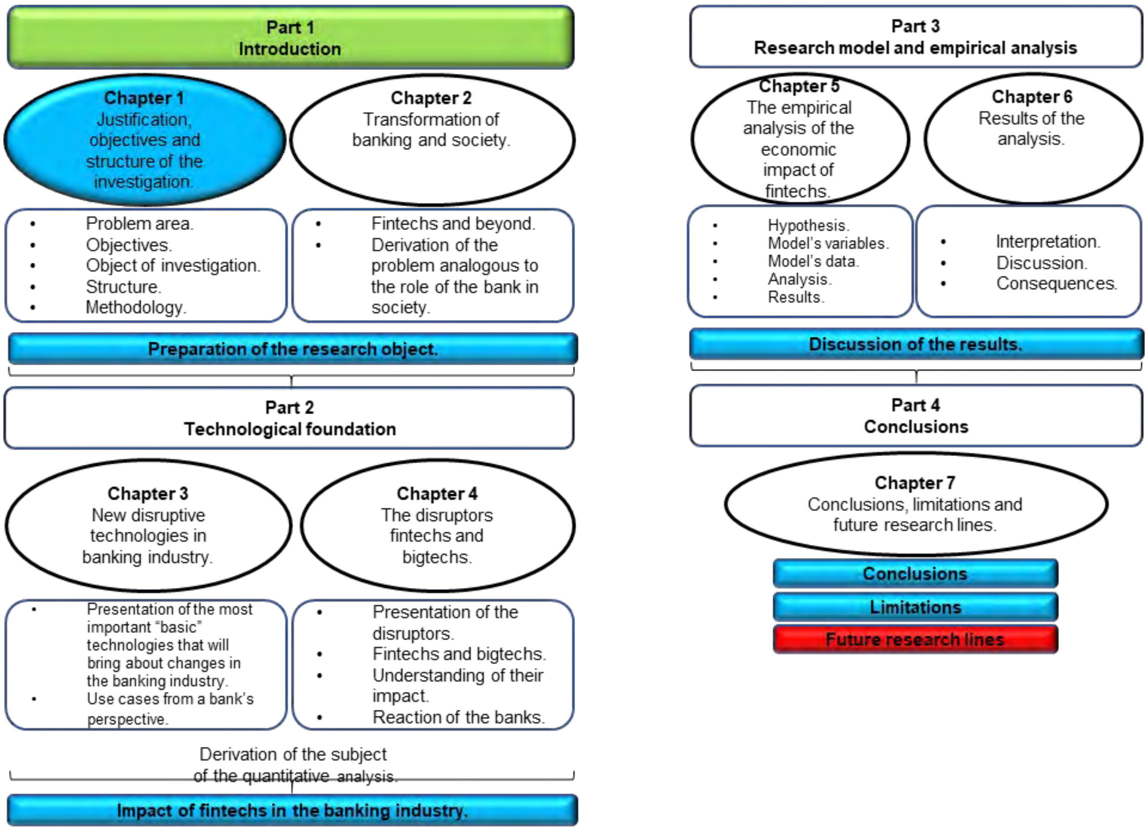


The definitions of the technical terms (printed in italics) used frequently in this dissertation are contained in the glossary of definitions (on page xliv).

Most terms are not clearly defined by law, but often have a historically evolved range of meanings. Thus, the definition is chosen as used in this thesis.

1.1 Introduction.

The task of this sub-chapter is to lay the foundation stone for the analyse of the impact of digitization on the *business models* of incumbent European listed *universal banks*.

The End of Banking (Mcmillan, 2014) is increasingly proclaimed in contemporary literature. A verbatim search in Google of the terms "The end of banking as we know it" results (as of 20th October 2019) in an outcome of 165 million entries in the world wide web. Accelerated by the consequences of the subprime crisis, a process began which Bill Gates already predicted in 1994 (Haley, 1994). This results in the interest to investigate which influencing factors affect in what way banks' change and its possible future shape. A further aspect of interest is, whether the changes are of *evolutive*, *disruptive* or *revolutionary* nature.

The news of diverse information media shows different and simultaneously acting factors, as triggers of the current process of the financial industry’s change:

Table 1: Changes in the banks’ operating environment.

Factor	Origin	Impact
• macro financial environment	external	margin
• regulation and supervision	external	*business model*
• stakeholder scrutiny	external	funding
• development of the non-bank sector	external	competition
• technological change	internal	efficiency

Source: Own elaboration based on (Buch, 2018).

In a study 2017 commissioned by the Committee on the Global Financial Stability (CFGS, BIS Basle) to analyse structural changes in the international post-crisis banking sector (Buch, 2018), the changes shown in Table 1 have been identified.

Macro financial environment refers to the phase of historically low (Wiebe, 2019) and in some European states even negative benchmark interest rates. This reduces continuously the classic banks’ margins. Due to their intermediaries’ role in lot size-, maturity-, cross-border- and risk transformation they depend on promising yield curves.

Regulation and supervision consequently became much stricter and more complex. Even post subprime, requirements for higher-quality capital and liquidity are still increasing. The transformation of the *business models* (e.g. reducing proprietary trading[1]) is a result initiated by the assessment of the European Supervisory Review and Evaluation Process (SREP) (Beau, 2014).

Stakeholder scrutiny expresses doubts of the capital market concerning the banks' sustainable profitability affecting the funding costs.

Development of the non-bank sector relates to the growing competition of non-bank financial institutions in financing economic activities as well as activities of private households. In addition to the global expansion of insurance and pension funds, the growth of the *bigtechs* (GAFA[2]) should be mentioned.

A transformation is enabled by the *technological change*, the fifth and last modification of the post-crisis operating environment for banks identified by the CFGS working group (Committee on the Global Financial System, BIS Basle). For the purposes of this thesis, the technological change is the most important modification. In contrast to the four other factors of external origin, technological development is the only factor that *universal banks* can independently manage through their own project resources.

As the credit industry is traditionally highly information intensive (Stijn Claessens et al., 2018) it is thus of high degree susceptible to technological change. The internet in its fourth stage of evolution (IoT[3]) is the driving basic technology that allows massive changes in the data processing (Dhasarathan, 2019). The DLT (Distributed Ledger Technology) as well as the access to the account over different mobile devices are among others a result of this technological evolution.

Fintechs[4] adapt more quickly to these technological changes than the classical *universal banks*. They work either as a supplement or as a competitor to traditional banks or bank-lines (Fernández Torres et al., 2019).

The technological changes are bearing potential for traditional banks to improve their CIR (Cost Income Ratio) despite steady or decreasing performance. The emergence of new risk classes that are allocable to the family of operational risks, such as the risk of data security

[1] Banks' trading in its own name and for own account.
[2] GAFA: Google, Apple, Facebook, Amazon.
[3] IoT: Internet of Things.
[4] Fintech is an acronym standing for a combination of the words finance and technology.

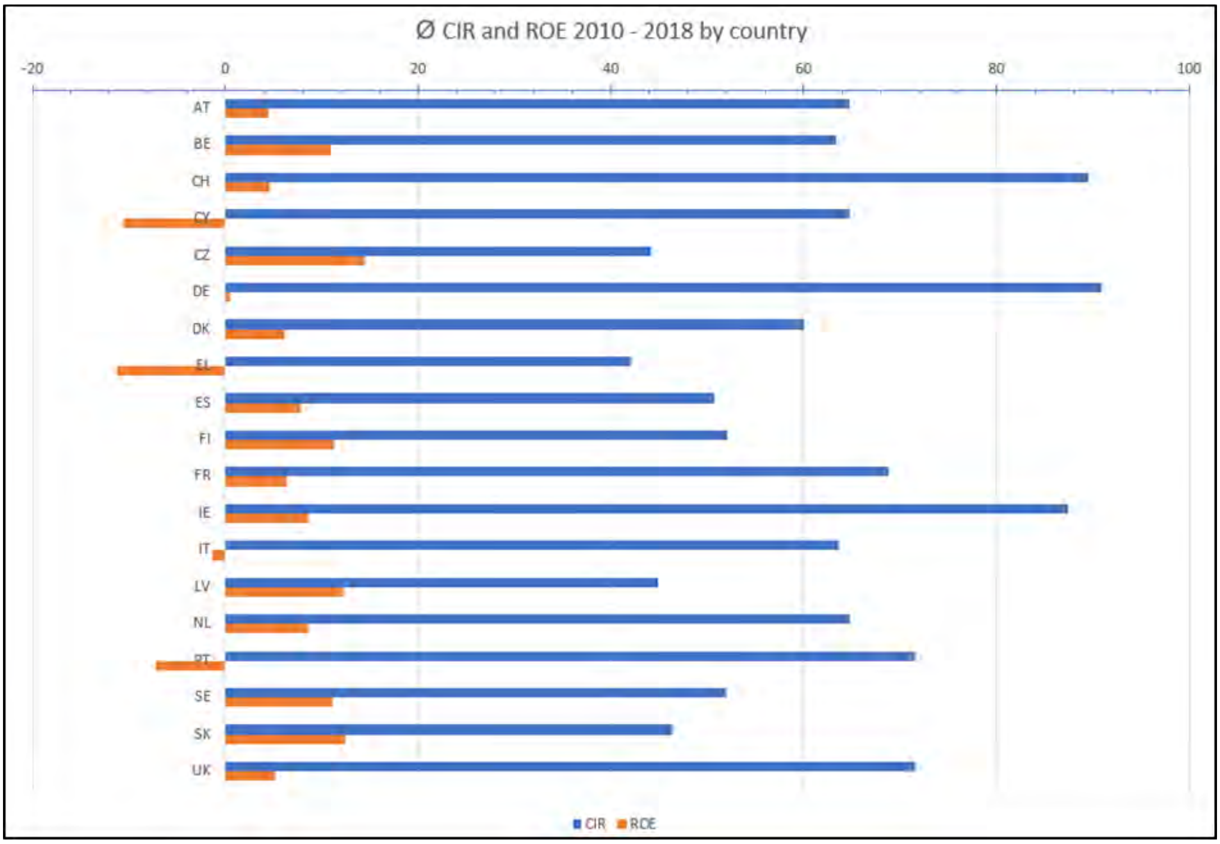
or cyber risks, is the price of the development of new digital technologies (BCBS 2018). Even an ECB cyber risk stress test is conceivable (ECB Cyber resilience oversight n.a., 2018).

In this regard, the Global Financial Crisis (GFC) acted as a catalyst that accelerated the change in the banking environment and hence its revenue opportunities as well as their *business models* (Buch, 2018).

The following figure demonstrates the comparison of two key performance indicators RoE (Return on Equity) and CIR (Cost Income Ratio) of European *universal banks* at an average over the years 2010 to 2018, compared by country. The x-axis contains the percentages of the two ratios CIR (blue) and RoE (orange), the-y axis the compared listed *universal banks* in relation to the European countries.

This cumulative overview based on Bloomberg data confirms the already gained insights. The revenues compared to costs of European *universal banks* nearly over the last ten years in the post subprime crisis period can be described as alarming low or even negative!

Figure 1: CIR and RoE of the post subprime European *universal banks*.



Source: Own elaboration based on data provided by Bloomberg.

An unevaluated explanatory approach could be the degree of digitization of the respective EU member states (cf. DESI[5] Report 2019).

Nordic countries (FI, SE, NL, DK)[6] have reached the highest level of digitization in the EU, according to this report (as of 2019).

Their banks are revealing a proper relation between CIR and RoE. In countries that only recently experienced a development spurt (CZ, LV, SK)[7], digital technologies could be used without having to replace old and established technologies and ways of thinking (Bode et al., 2017).

Since the Global Financial Crisis (GFC) in 2006/2007 the banks' *business models* were subject to several modifications. To stabilize the earning capacity and thus the ability to pay dividends, both the asset side and the liability side of the balance were adjusted.

On the *asset side*, easing margins could be counteracted in two ways, without changing the *business model*. First, depending on the price elasticity of loan demand, loan interest rates could be adapted slowly unlike the interest rates of the deposit supply. Second, low interest rates use to generate high bond prices and rising share prices (Filipovii et al., 2017). As a result, the assets could be reallocated away from the interest-dependent lending business to the more risk-intensive trading business within the framework of regulatory requirements.

On the *liability side* the treasury could be stimulated by low interest rates to rebalance the companies' funding structure. Due to decreasing refinancing costs, a redistribution could take place, away from short-term variable funding to long-term debt and even to new issues of low-yielding corporate bonds[8] (Brei et al., 2019).

Through a combination of assets and liabilities, the treasury of a bank is still able to generate interest margins, albeit small ones, despite the current negative interest rates. On the assets side, short-term liquid funds are deposited with the European Central Bank (ECB), for which interest is now to be paid (by deduction on repayment). This deposit rate is sometimes a few basis points lower than the interest the bank receives for a loan.

However, these measures are based on the traditional role of the intermediary between loan demand and deposit supply. Banks are also confronted with growing financial activities in the non-banking sector (e.g. *big techs*) (FSB, 2019b). Overall, the value of the listed banks on

[5] Digital Economy and Society Index (DESI) of the EU Commission.
[6] FI Finland, SE Sweden, NL The Netherlands, DK Danmark
[7] CZ Czech Republic, LV Latvia, SK Slovakia.
[8] See USD AT1 Emission of Commerzbank as of 02 July 2019.

the capital market decreases. Banks are therefore more than ever forced to look for yield alternatives.

In the short term, the solution consists of modifying existing *business models*. This solution instead is still vulnerable to changes in the yield structure. For example, a sudden rise in central bank rates would be accompanied by asset and bond impairments on the banks' assets side and rising opportunity costs on the liability side (Landier et al., 2013). Focusing on fee income could only partially offset falling interest margins. A comprehensive involvement in proprietary trading is hardly possible due to regulatory requirements.

For these reasons, it is remarkably interesting to portray the paradigm shift that banks are currently having to execute to their *business models* to remain profitable in the long run.

To be able to correctly assess this upcoming transformation, it is first necessary to rise the banks' environmental changes more structured. The following graphic should comprehensively outline the exogenous influence factors on a bank's *business model*. It is based on the operation of a planetary gear.

From the outer to the inner wheel, the driver of the change (planetary gears) should act on the object under investigation (*universal bank* as a sun gear).

As a result, the sun gear is constantly forced to rotate in accordance with adjustments. From the outside to the inside in a clockwise direction, the triggering factors that led to the changes apart from 2006/2007 are presented first. This refers to the transformation of the banks' *business model* (role of the intermediary), which had proven itself since the Middle Ages until today.

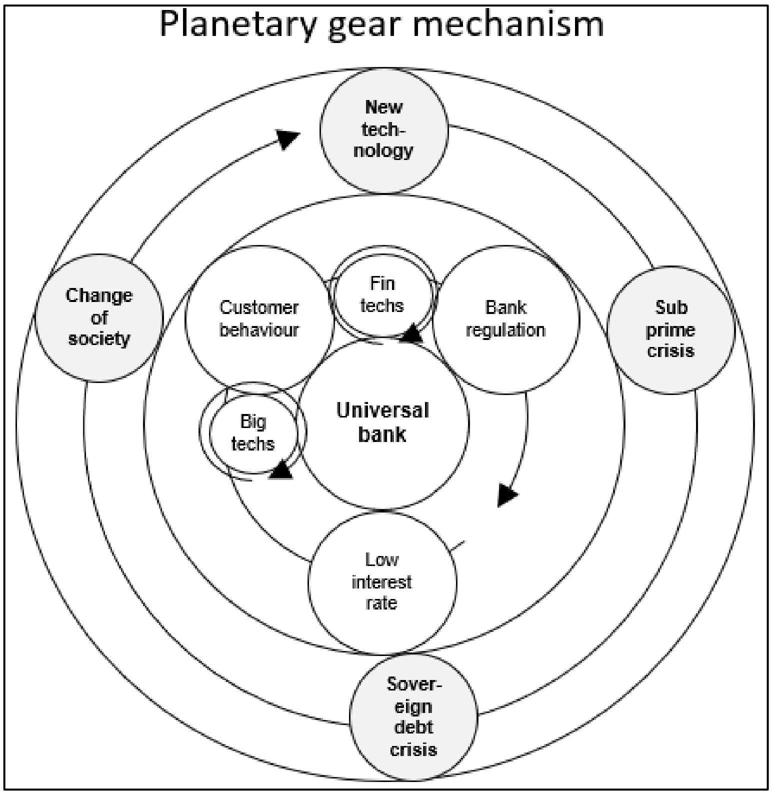
The *US subprime mortgage crisis* in 2006/2007 (leading to the GFC) was triggered by the increase of the Federal Open Market Committee (FOMC) in the Fed funds rate from 1.00% to $5^{1/4}$% p.a in the years 2004 to 2006 (Bernake, 2007). Consequently, homeowners were no longer able to service their variable-rate mortgages. An oversupply on the market followed, which provoked a price decline. This left millions of US proprietors with homes worth less than the face value of their mortgages (Barbara and et al., 2008).

Sovereign debt crisis arose due the widespread US funding of subprime mortgages via Asset Backed Securities (ABS) and Collateralized Debt Obligations (CDO) around the globe. Financial institutions seeking for higher yields invested in these financial instruments which became toxic after the Great Financial Crisis (GFC). Banks around the world have been obliged to impair these financial instruments which at the very beginning promised a high interest rate supported by proper ratings (Zorgati et al., 2019).

As sovereign states in the eurozone rescued banks with billions of Euro, the euro crisis followed in 2010. This crisis was overly complex and, in addition to the sovereign debt crisis, includes a banking crisis and an economic crisis.

Iceland was the first sovereign state nearly to suffer bankruptcy, as the simultaneous support of three banks (Glitnir Bank, Kaupthing, Landsbanki) by far exceeded the possibilities of public funds.

Figure 2: Current *ecosystem* of *universal banks*.



Source: Own elaboration based on (BIS, 2019b).

Change of society includes 2 aspects in this paper (cf. chapter 2). On the one hand investors' behaviour has changed with respect to current *business models* of banks. Investors' pressure on banks has increased due to the prolonged earnings weakness and changing risk appetite. This automatically leads to higher refinancing costs for the banks. On the other hand, society is increasingly evolving from a short-term, return-oriented, egoistic viewpoint to a sustainability-oriented perspective (Gladwin et al., 1995). Due to the crises of the recent past, the social acceptance of the banking industry has fallen (Kuna, 2019).

New disruptive technologies not only enable a change in customer behaviour, but also create completely different competitive situations. For example, non-banks are increasingly involved in traditional banking domains, such as lending in the private customer sector and small to medium-sized corporate clients (FSB, 2019b)(cf. chapter 4).

On the other hand, these technologies offer the opportunity to operate the banking business more efficiently and cost-effectively in the future.

The *inner planetary wheel*, which symbolizes the direct influences, represent the low-interest-rate phase, changed customer behaviour and stricter post subprime crisis bank regulation. These factors provoke steadily eroding profits (Dombret et al., 2019).

During a meeting of the Governing Council of the ECB on 12th September 2019, another historical monetary decision was reached. The *interest rate* on the deposit facility was reduced from -0.40% to -0.50%. The *interest rate* on the main refinancing operations and the rate on the marginal lending facility remained unchanged at their levels of 0.00% and 0.25% (see ECB press release on Monetary Policy Decisions as of 24th September 2019). Thus, the ECB *key interest rates* continue to be on a historical low since 2011.

Customers' Behaviour is currently showing 5 occurrences, according to a study by Accenture (Global Financial Services Customer Study 2019). Customers no longer want traditional, homogenous banking products but integrated, comprehensive products. For example, the bank can offer potential home buyers not just the loan but also the associated real estate. In addition, individual cyberrisk insurance (identity theft, psychological care in cyberbullying) could be offered[9]. Customers are interested in personalized advice on how to handle money. Customers are also willing to share data to receive a better range of services. Customers are wishing true and fast omnichannel access across electronical devices with no data loss as well as physical experiences. Customers loyalty is shrinking especially among the younger generation.

Bank regulation has been described since the subprime crisis, on the one hand, as the precursor of a more economically stable banking landscape than before. On the other hand, the aggregated annual regulatory costs of 13 global banks surveyed were already estimated at $ 37 billion in 2016. This represented 39% of capital market-based expenses (Lewis, 2018). This development led already in the circle of supervision itself to the discussion of the proportionality (Castro Carvalho et al., 2017).

Financial institutions today can no longer afford to ignore these sometimes-disruptive influences and continue a low paced evolutive process ("business as usual"). The following tabular overview shows trends that are recognizable in the current specialist literature. The originators were selected from the multitude of search results for their intuitive reliability. Furthermore, the way of legislation was chosen as an analogy and authority argument.

[9] see product range of Allianz AG as of 11/2019.

The following characteristics of dealing with the topic are identifiable in current literature:

Table 2: Literature review on disruptive changes in banking.

Key words			disruption of banking		
Results			33.300.000		
Originator	**Study**	**Publication**	**Content**	**Focus**	**Conclusion**
OECD	Financial Markets, Insurance and Pensions: Digitalisation and Finance	2018	5 articles with key aspects fintech, robo-advice, API.	Focus on the impact of digitalisation and technology in the areas of financial markets, insurance, and private pensions.	Will make banking accessible to a wider range of market.
IOSCO	IOSCO Research Report on Financial Technologies (Fintech)	2017	Global Fintech landscape.	Risks of fintechs.	Fintechs are developping at an increasing faster pace. They are an opportunity for the financial sector.
Worldbank	Worldbank: FINTECH: THE EXPERIENCE SO FAR	2019	Comprehension of the development, Reference to the Bali Fintech Agenda.	Stock of country fintech experiences and identifies key fintech-related issues that merit further attention.	Fintechs at the moment, their risks and future aspects.
IMF	The Bali Fintech Agenda	2018	Response to a call of member countries for a better understanding of the global finech landscape.	Framework for National Authorities and standard setting bodies.	Fintechs their risks and upcoming regulation.
BIS	Implications of fintech developments for banks and bank supervisors	2017	Description and solutions of the extend of Fintechs.	Impact of Fintechs to traditional financial intermediation.	Fintechs as a challenge and as a catalyst.
BIS	BigTech and the changing structure offinancial intermediation	2019	Description of the potential extend of Bigtechs to financial services.	Bigtechs and their rapid market entry.	Impact of Bigtechs to traditional financial intermediation.
FSB	Outline of G20 report on implementation and effects of reforms	2017	Inventory of progress since G20 lauched a comprehensive program of reforms in 2009.	regulation, market liquidity, safer derivatives markets, shadow banking.	providing the "status quo" with an adequate set of rules.
European Commission	FinTech Action plan: For a more competitive and innovative European financial sector	2018	Enabling innovative business models. Chances and risks of the new players on the financial market.	Fintechs; merging of different initiatives: Commission's Digital Single Market Strategy, EU's cybersecurity strategy, eIDAS Regulation, financial services initiatives such as the Consumer Financial Services Action Plan and the Capital Markets Union (CMU) mid-term Review.	provide better access to finance and to improve financial inclusion for digitally connected citizens.
EBA	EBA REPORT ON THE IMPACT OF FINTECH ON INCUMBENT CREDIT INSTITUTIONS' BUSINESSMODELS	2018	Position of traditional banks.	Rethinking of incumbents' business models.	Change of society as one of the main drivers. Fintechs. Bigtechs.
ECB	Financial Stability Review	2019	Providing a fincial-system wide assessment of ist vulnerabilities.	European financial stability environment.	Status quo and micro- and macro-prudential developments.
EIB	Blockchain, FinTechs and their relevance for international financial institutions	2019	Provide a primer on financial technology.	Fintechs and Blockchain.	Facilitating the functioning of an international financial institution (IFI).
BDE	FINANCIAL INNOVATION IN THE DIGITAL AGE: CHALLENGES FOR REGULATION AND SUPERVISION	2016	analyzing the potential benefits of the digitisation of finance, the new risks that digital infrastructures, business and distribution models and customer solutions may pose, the expected regulatory and supervisory response.	Understatement of the new technologies, change in customers' behavior, regulatory impact.	3 key guiding principles: - customer in the center - future developments - collaboration among stakeholders chances and new risks.
Buba	Digitalization, Competition, and Financial Stability	2019	FinTechs and BigTechs potentially have comparative advantages over banks in deploying big data techniques, artificial intelligence, machine learning, or social media data for credit scoring or risk assessments.	Fintechs, Bigtechs, Regulatory Response, improvement of surveillance.	technological innovation as chance to improve eficiency and catalyse structural change, but there are new challenges for the supervisor

Source: Own elaboration based on internet research Google as of 08th December 2019.

In the examined literature two lines of argumentation are recognizable. The first focuses on preserving existing and proven *business models* (FSB, 2017). The second line of argumentation is forward-looking and brings, albeit modestly, the change in *business models* into play (OECD, 2018). However, none of the sources calls for a radical new beginning, based on the core competencies gained in the past. Added value through product innovation is not mentioned in the selected sources.

All sources agree to a large extent that disruptive changes are already taking place (Vives, 2019b). There is also agreement on the causes of these changes. It constantly mentions changes in customer behaviour, coupled with new technologies whose roots date back to the last decades of the last century (González-Páramo, 2016; EBA, 2018).

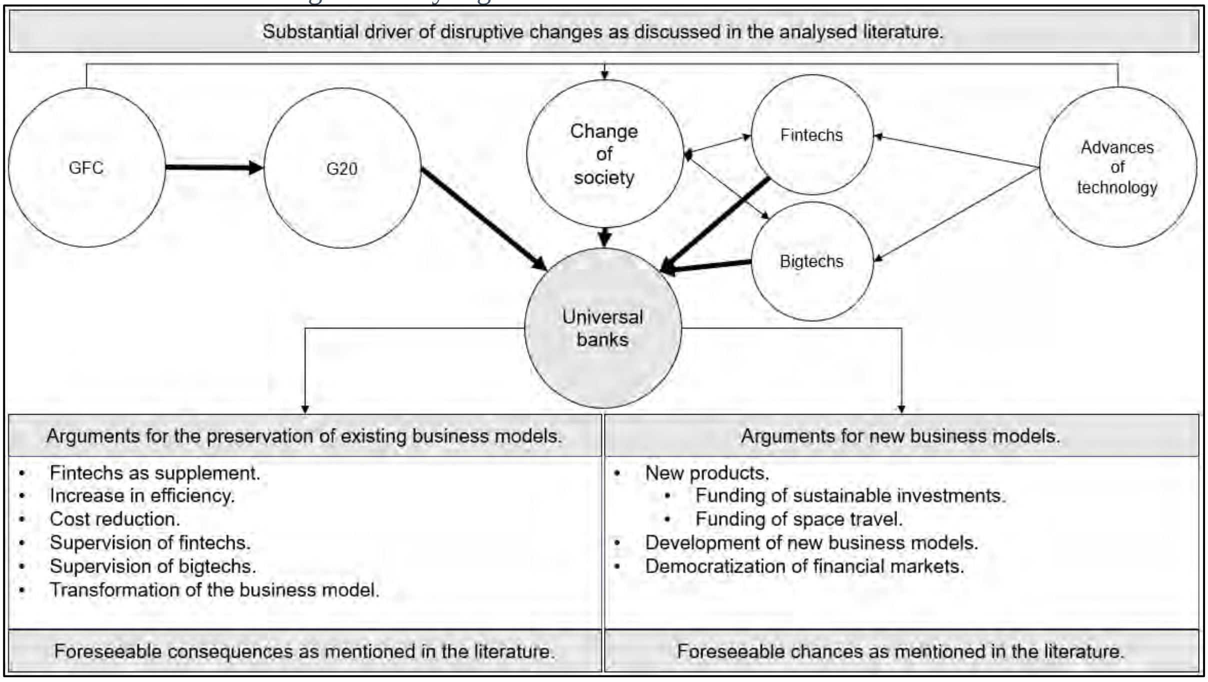
The conservative sources acknowledge the changes but focus mainly on *fintechs*. They are credited with an innovative power in both positive and negative terms. On the one hand, *fintechs* seems to be the innovative forces that help the financial industry to increase its efficiency and, if necessary, to change existing *business models*.

On the other hand, the call for their regulation gets louder. Here, *fintechs* seem to be on the top of the agenda (2018). Only sources from the year 2019 identify the disruptive nature of *bigtechs*, which have greater efficiency than *fintechs* due to their core competencies and organization (EBA, 2018; Buch, 2019). One of the main focuses of conservatively arguing sources is the regulatory challenge of *fintechs*.

The cautiously positive future-oriented sources see technological development as an opportunity for existing financial intermediaries. At a higher level, these developments also see an opportunity to promote liberalization and democratization of the financial market. The aim is to enable broader market access through innovative digital technologies (OECD, 2018).

Already at this point it becomes apparent that no source covers the entirety of the changes of the next decade. Moreover, none of the sources comment on concrete proposals on how the bank of the future could be modelled. The authors rather tended to take stock of existing changes. The following graphic shows an overview of the key arguments of the literature review.

Figure 3: Key arguments of the review of the literature.



Source: Own elaboration based on the literature review (cf. Table 2 on page 12).

The graphic is explained clockwise from left to right and from top to bottom.

The global financial crisis (GFC) followed by the sovereign debt crisis and the euro crisis (2008-2009) triggered an immediate reaction by the G20 member states in 2009. At their 2009 G20 meeting in Pittsburgh (USA), leaders adopted a landmark declaration of intent to stabilize the global financial system. From now on, the "Framework for Strong, Sustainable and Balanced Growth [SSB]" provided the basis for far-reaching regulatory reforms and developments that continue to these days (see Basel IV).

The social standing of the banks as the trigger of the crisis changed considerably. From now on, the variable remuneration systems of the banks were the focus of public discussion. This culminated at the European level with directive *2010/76/EU*, which had to be incorporated into national legislation (e.g. Spain: legislation through two laws (Law 2/2011 and Law 6/2011) and the Royal Decree 1642/200819, Germany: InstitutsVergV).

The most important technological drivers of digitization include the military-driven development of the Internet (Leiner et al., 2009) and the supply of households worldwide with affordable PCs (Apple 1977). Through Samuel Finley Breese Morse in 1837 mankind learned to transmit standardized codes. These technological developments, among many others, have allowed the emergence of new *business models*, today known as *fintechs* and *bigtechs*. It can also be assumed that the GFC released highly trained personnel in the investment bank environment. Subsequently, they had to reorient themselves. Technological development also changed social behaviour of demand. Services must be available 7 days a week, 24 hours via electronic devices (Buch, 2019).

The banks are now at the parting of the ways. On the one hand, they can try to conserve the historically proven *business model* that has existed for centuries through investment. On the other hand, they can venture completely new *business models* based on their experience. Only few players will have enough resources to try both.

Arguments in the sense of conservative business models.

The evaluated literature shows a concentration on the importance of *fintechs*. It provides them the opportunity to increase efficiency and, if necessary, to reduce costs. However, they also see the risk of independently assuming traditional banking services unattended. *Bigtechs* find subordinate attention. It is becoming apparent that these are only at the beginning of their financial market-specific development. In them, a risk tends to be an opportunity. Proof has already been furnished at the current stage that *bigtechs* are willing to invest in countries that serve classic banks to a lesser extent (BIS, 2019a).

Arguments in the sense of innovative business models.

In this regard, it is only stated that an adaptation and a change of traditional *business models* must take place. About the way, only new product ideas, such as the investment in sustainable projects or funding of space travelling (Concini et al., 2019), are mentioned. It has already been noted positively in terms of social change that digitization has made opened access to the financial market.

Considering the objectives of this paper, the study will focus on the impact of *fintechs* and *bigtechs* on the classic banks' *business model* as a conceptual basis suitable for carrying out the empirical analysis. But this work wants to analyse more than focus on *fintechs* or *bigtechs*. The objective is to present a holistic picture of the impact of current change on banks. Furthermore, the last chapter (cf. chapter 7) deals with the question of which solutions could exist for the future.

The coming decade will be marked by disruptive changes triggered by technological developments (Manyika et al., 2013). This not only related to banks, but also how society lives and works and relates to other industries and economies.

The arguments identified above are taken up again in the context of the presentation of the objectives of this thesis.

1.2 Justification of the investigation.

Problem investigated.

At the time this thesis was drafted, between 2016 and 2020, the profitability of *universal banks* is sometimes compared to the Bermuda Triangle (van Steenis, 2014), where profits are steadily eroding. The cornerstones of the triangle represent the low-interest-rate phase, changed customer behaviour and stricter post subprime crisis (post GFC) bank regulation.

Already these circumstances represent a threatening scenario for the future of the banks. For example, it is predicted for the German banking market that in 2030 it will be shared by 150 instead of currently 1900 credit institutions (Birkholz, 2018).

The aspects mentioned at the beginning consider important extrinsic factors of influence. However, the manifestation and impact of the greatest extrinsic primary influence, the technological change, should first and foremost be considered (cf. chapter 3). This change will only allow for growing competitive development on both the supply and demand side.

This is particularly important for an industry that produces almost exclusively intangible financial instruments and other financial services. Here, dependence on data processing is among the highest.

For this reason, the focus of this dissertation is the impact of digitization on the banking sector. Although the disruptive changes do not respect national borders, this work focuses geographically on Europe. Thus, the analysed banks at majority seem to share the same characteristics (ECB, 2018a).

Importance and achievement of this thesis

The decision makers of the *universal banks* surveyed currently have at their disposal the following alternatives of resource allocation (Kaplan et al., 2016):

Table 3: Alternatives of resource allocation.

Alternative	Notation	Description	Assumed risk	
			Short term	**Long term**
A	Conservation of the old *business model*.	Occupation of niches.	➔	🡅
B	Evolutionary opening of the old *business model*.	Admixture of digitization.	➔	🡅
C	Disruptive new *business model*.	Development of new digital *business models*.	🡅	➔
D	Laissez-faire	Uncoordinated development.	🡅	🡅

Source: Own elaboration.

In an increasingly competitive economic environment, *alternative A* will only be possible for a few niche players in the short to medium term (e.g. classic wealth management).

In the long term, too, even this *business model* must be adjusted, possibly due to the changing customer behaviour (e.g. of wealthy digital affine younger generations). Choosing the wrong niche can also quickly lead to a market exit[10].

Alternative C represents the other extreme, which is highly risky. One large volume malinvestment could lead to a market exit in the short term. Nevertheless, this is the alternative that best shows the way to the future (Kliesen, 2017).

However, if the right model is found, the risk should fall in the medium to long term. Currently the most frequently observed is the often-late work on the *alternative B*.

Often-late work in this context means *alternative D* observed in German banks for too many years (Nestler, 2020).

[10] e.g. Maple Bank Frankfurt am Main in insolvency since 06th February 2016 due to cum ex deals.

The scientific contribution of this work comprises the following aspects:

1) to draw a holistic picture of digital influences on European listed *universal banks*.

2) to quantify by an empirical study the impact of *fintechs* and *bigtechs* on banks.

3) generally, outline an approach to a new *business model* strategy as an exit.

In this way, with a combination of qualitative (1 and 3) and quantitative elements (2) the reader is offered a theory-practice reflection.

Benefit. Currently, hardly any empirical studies are disposal neither literature-oriented-investigative nor quantitatively empirically analytically analysing comprehensively the impact of digitization on *universal banks*.

Some authors have already dealt with the impact of individual components on *universal banks* (Santos et al., 2019). Other authors examine parts of the entire picture (González-Páramo, 2016). The most comprehensive surveys of the current situation have so far been carried out from a regulatory perspective (BIS, 2019a) (FSB, 2019a).

From an individual entrepreneur's perspective, this is also necessary for sustainable livelihood. For this, it is indispensable to explore forward-looking strategies.

This dissertation attempts to fill this gap by focusing on the *business model's* transformation process from a banking perspective.

The added value of this research is to provide new and recent information about the importance and trajectory that digitalization processes have had and will have in banks and banking in Europe.

Negative repercussion. If at the beginning of this decade, the right investment and transformation decisions are not taken. If only too hesitant, highly iterative half-hearted decisions are reached, then at the level of individual companies, effects such as mergers are to be expected.

Bankruptcies should be avoided by the constantly growing bank regulation. Should such a case nevertheless occur, the SRB[11] in Brussels is already dealing with either rapid settlement or the modified continuation of the defaulted European credit institution because of the EBA's SREP[12]. Industry-specific, it could prove the often-cited statement of Bill Gates that bank services are needed, but banks will not (Haley, 1994).

[11] SRB Single Resolution Board (Brussels).
[12] SREP Supervisory Review and Evaluation Process.

1.3 Objectives of the investigation.

This dissertation researches the impact of digitalization on selected European listed *universal banks* (cf. chapter 2). The project is based on the fixed assumption that from a macroeconomic perspective the banking function is necessary even in the future.

It is aiming to develop a statement about the degree of transformation of the traditional banks' *business model* that has already been achieved and implemented.

To simplify matters, the objectives of this research are presented in the following table.

Table 4: Objectives of the investigation.

Overarching question
The banking function is from a macroeconomic perspective necessary even in the future.
General objectives
• Holistic approach: Draw a picture comprising all influencing factors of digitization on *universal banks*' *business models* by this research. • Status quo: Statement of the degree of transformation of the incumbent banks' *business models*. • Solution: Which transformation must the *business model* undergo to remain sustainable in the future.
Special objectives
• Changes in demand: Social transformation as driver (cf. chapter 2). • Changes in demand and supply: Technological foundation (basis innovations) as driver (cf. chapter 3). • Impact of *fintechs* on incumbent banks' *business models* (cf. chapter 5). • Impact of *bigtechs* on incumbent banks' *business models* (cf. chapter 5).

Source: Own elaboration.

To these ends, on the one hand, a complete picture of the social transformation (demand side) and technological modifications surrounding the banks is outlined.

On the other hand, the quantitative part of the thesis examines the effects of a subset of the influencing factors. In special, the impact of *fintechs* and *bigtechs* on the *business models* of banks is analysed. This should provide an outlook on the ambivalent future of the current banks' revenue opportunity.

This study should convey deeper knowledge about a topic that has already been the subject of numerous general and specialised researches (Manaa et al., 2019) (Arnaboldi, 2019). However, due to the high degree of complexity, no holistic pattern has been worked out so far.

This will allow to analyse if there are differences or similarities with respect to other contexts regarding the causes and the effects that these disruptive changes have on the transformation of the *business models*.

In this thesis, the question is examined which transformation the *business models* of *universal banks* must undergo to be future-oriented. Alternatively: will banks in their classic role as intermediaries be necessary at all in the future or can this role be taken on by other market players (e.g. by *bigtechs*)?

To answer this question, a holistic understanding of all factors influencing European banks as investigated companies is necessary. In this context, holistic means that a view beyond the actual impact of digitization should be outlined.

The investigation is carried out from the risk perspective of listed European *universal banks*. The risk perspective in this context is the own counterparty risk, which is accelerated by a lack of strategic orientation (ECB SSM Report, 2018).

The outcome of the investigation is a strategy recommendation based on the Blue Ocean Strategy Tool (Kim et al., 2015) (cf. chapter 7). It is expected that massive changes to the classic *business model* are necessary, based on core competencies that have been established and confirmed over centuries. Only in this way will banks be able to secure their future (Anand et al., 2019).

In the current transformation process, questions arise as to which options are available to banks for a strategic realignment and how far the changes are already having an effect.

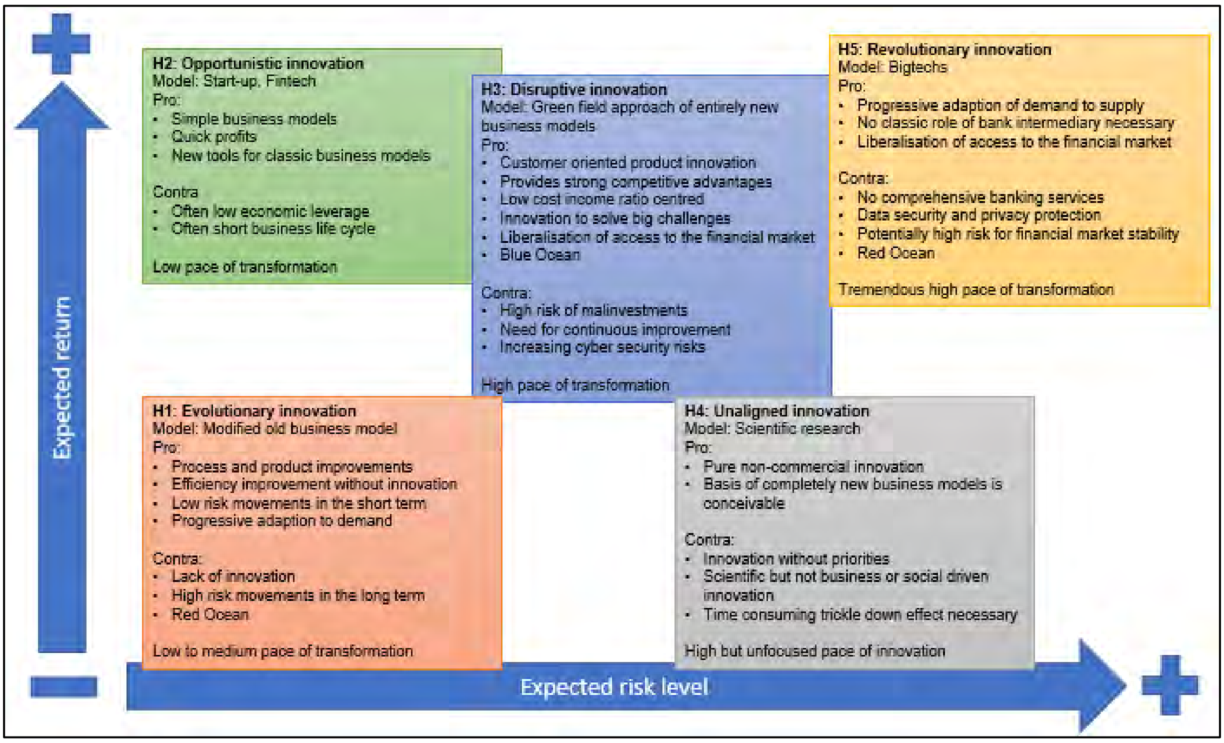
This dissertation analyses the five modalities of innovation (Ferras, 2020) shown in the graphic below. The five individual modalities represent the superordinate qualitative hypotheses to be researched.

They are presented in the graphic as alternative courses of action and overarching hypotheses of this dissertation in the figurative sense of a portfolio selection (Markowitz, 1952).

The unscaled x-axis represents the intuitively expected risk (banks' own counterparty risk) from the perspective of the analysed banks and the unscaled y-axis represents the intuitively expected return (revenues in general).

In this context, the five hypotheses to be analysed are presented in the sense of risk-bearing assets. A combination of the assets could lead to a risk diversification (e.g. combination of H2 and H3). The presentation is supplemented by a brief pro-contra assessment and an indication of the pace with which the traditional *business models* might be transformed.

Figure 4: Modalities of innovation and overarching hypotheses.



Source: Own elaboration based on (Ferras, 2020)(Palomo 2020).

The following Table 5 shows an overview of the combination of the actively controllable resource allocation alternatives listed in Table 3 on page 17 and the superordinate hypotheses shown in Figure 4. In the last column of the table, an intuitive statement on the risk-benefit ratio is made.

Table 5: Combination of hypothesis and resource allocation.

Hypothesis	Alternatives of resource allocation	Description	Strategy occurrence	Assumed risk-benefit ratio
Out of the scope of this dissertation due to the underlying banks' *business model* (often *special banks*).	**A Conservation**	Occupation of niches.	Blue ocean	low
H1: Evolutionary innovation.	**B Evolution**	Admixture of digitization.	Red ocean	low
H2: Opportunistic innovation.	**B and C Evolution and Disruption**	Observation, incubation, and implementation of current developments.	Red ocean	low
H3: Disruptive innovation.	**C Disruption**	Development of new digital *business models*.	Blue Ocean	medium to high
H4: Unaligned innovation	**Out of scope**	Not directly influenceable by banks.	Blue Ocean	low
H5: Revolutionary innovation.	**D Laissez-faire**	Uncoordinated development.	Red ocean	high

Source: Own elaboration based on (Ferras, 2020)(Palomo 2020).

To review the above-mentioned overarching hypotheses (reinforcement or rejection), approximately 50 measuring points are currently installed over the entire work at a suitable point (usually interim conclusion at the end of a subchapter).

The assessment of the strategic occurrence already refers to the development of a forward-looking strategy. This should lead to a so-called blue ocean, far from cost-intensive competition, characterized by high earnings opportunities.

In this dissertation, the initially intuitive assumption is made that H3 is the most sustainable form of innovation. Furthermore, a priori the supposition is made that a combination of H3 and H2 is created based on H1 to be able to counter H5.

However, H4 will play a subordinate role since the banks are not able to influence in a direct way the development of the innovations. Indirectly, banking industry can influence university research through sponsorship or cooperation (Fabbri et al., 2018).

The price is that the innovation that opens completely new perspectives may not be discovered. Nevertheless, technologies can emerge from university developments that form the basis of completely new *business models* (Nambisan et al., 2019).

In preparation for this analysis, the *second chapter* on first describes the current situation of the banks' *ecosystem*. A basic structure of the *business models* of the banks is worked out, which is used for the further investigation.

A complementary goal of this dissertation is to think beyond just taking stock of the banks' current situation. To this end, the *second chapter* analyses also the correlation between social change and the role of banks as intermediary.

This investigation is based on the phases of industrialization. In this way, the transformation of the demand behaviour for banking services is worked out in the individual phases as a trigger of modified offers of banking products.

The *third and fourth chapters* act as a supplement to the presentation of the current state of the banking *ecosystem*, commenced in the second chapter. Their objectives are the presentation of the new technologies that affect the banks and of the aggressors in the form of *fintechs* and *bigtechs*. To this end, the objective of *chapter three* is the presentation and derivation of use cases of disruptive technological innovations.

In addition, in *chapter four* landscapes of the company types (*fintech* and *bigtech*) are shown that already use these new technologies successfully. This enables them to undermine the traditional earnings pillars of banks to a greater or lower extent.

Subordinate quantitative hypotheses will be analysed in the *fifth chapter*, the quantitative approach of the interaction between *fintechs*, *bigtechs* and banks. This quantitative approach considers the basic assumption that the hypotheses H3 in combination with H2 are the most sustainable.

The objective of the *sixth chapter* is the reflection of the quantitative knowledge extracted in the previous chapter. These insights are interpreted and discussed.

In the *seventh chapter*, conclusions are drawn. Furthermore, insights are derived from this for a sustainable strategic realignment of the banks' *business model*, focussed on the customers' needs.

1.4 Methods and sources of the investigation.

The *business models* of European SI (Significant Institutions) were assessed by the ECB in 2018. As a result, a shortcoming in strategic and risk management was identified. This is an important determining factor for their sustainable profitability.

For successful strategic management under bad conditions, a networked thinking between the scientific disciplines is necessary, which are shown in the following illustration Figure 5.

This work structurally follows the risk control cycle (PASTOR, 1999), which is represented as an outer circle. The risk purpose of this investigation is to avoid an extremely specific counterparty risk, namely that of the companies' own insolvency due to a lack in sustainable strategies. To be able to control the risks to which the *business models* of classic *universal banks* are exposed, these must first be identified, analysed, and quantified. The major challenge from an external perspective is to quantify this particular risk.

Chapter five represents a quantitative attempt to make a statement about the impact of *fintechs* and *bigtechs* on the classic *universal banks' business model*. The analyse is based on externally available data from the IAS/IFRS annual reports and data providers (Refinitiv, Bloomberg) of the companies examined from 2010 to 2018.

A strategic realignment is only possible in the sum of all knowledge in order to manage the identified risk (Yeow et al., 2018). The risk control circle for strategic alignment will have to be thought through continuously (Kaplan et al., 2012), like the banks' internal multi-year planning process (Hitz et al., 2018).

In order to cope with the complexity of this management task, a networked thinking between the scientific disciplines shown in the Figure 5 below is necessary (Smith, 2020). The disciplines highlighted in grey are taken up in this dissertation. The other scientific disciplines are only mentioned once in this context in this subchapter.

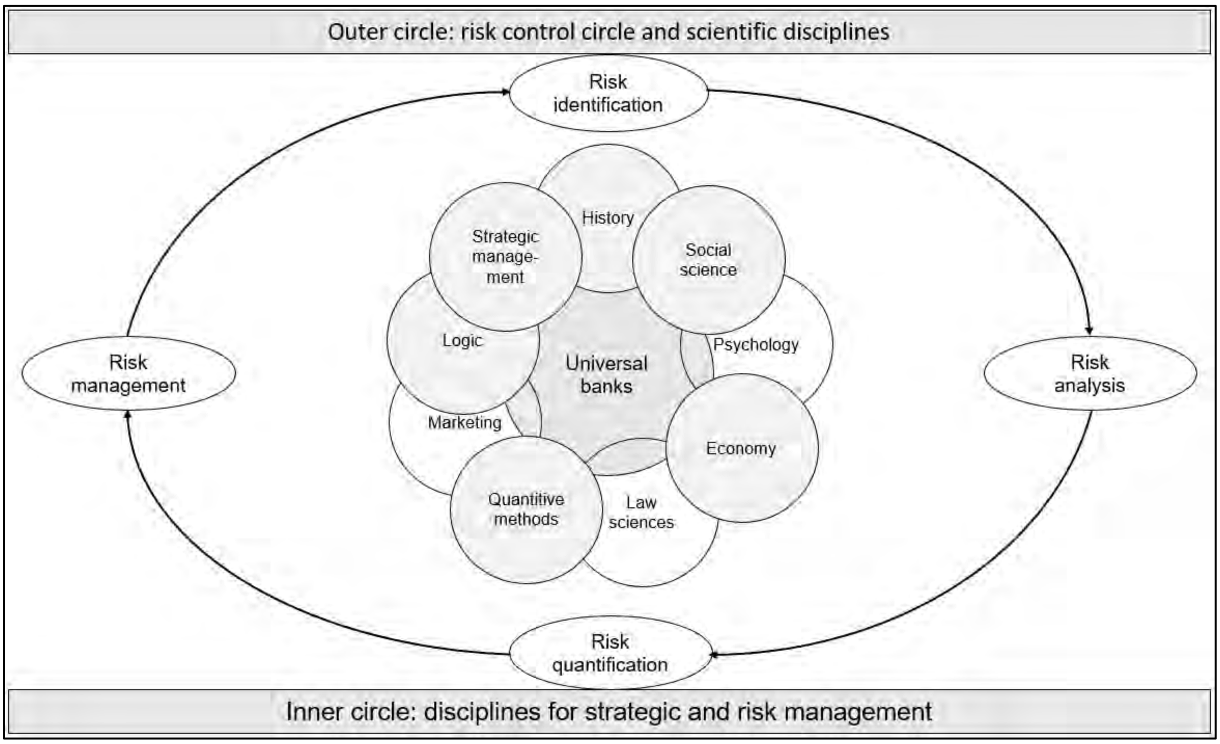
Risk identification and risk analysis take place in chapters two to four. First, the banks to be examined are identified. The current *ecosystem* in which the banks operate is then presented. Knowledge of recent industrial history, social sciences, business administration, economics and information technology are required for this. These will be used in this dissertation.

In addition, the scientific discipline of psychology should be endeavoured to gain a deeper understanding of customers' behaviour (e.g. shape of demand), such as understanding the strategic decisions of risk takers in banks. Law sciences will play an increasing role in terms of data protection, providers protection and the protection of consumers (e.g. privacy). Psychological knowledge such as that of law sciences is used in this dissertation, if only superficially.

Chapter five presents an attempt at *risk quantification*. Using descriptive stochastic methods and graphic demonstrations, the effects of *fintechs* and, in the form of a litmus test, the effects of *bigtechs* on classic *universal banks* are analysed. Knowledge of business administration and economic aspects are used to design the modelling.

The derivation of the findings is shaped by the disciplines of logic and strategic management. These should be used to control the named own counterparty risk. The potential own default should be continuously managed (Härle et al., 2015). The business discipline of marketing should also play a role in establishing new strategies on the market. However, marketing will not be mentioned in this dissertation. Marketing is nevertheless an important bridge to future revenues. The internet based social media presence and the forms of interaction with potential and current customers of different ages are becoming increasingly necessary for survival (Hudson et al., 2016).

Figure 5: Risk control circle and scientific disciplines.



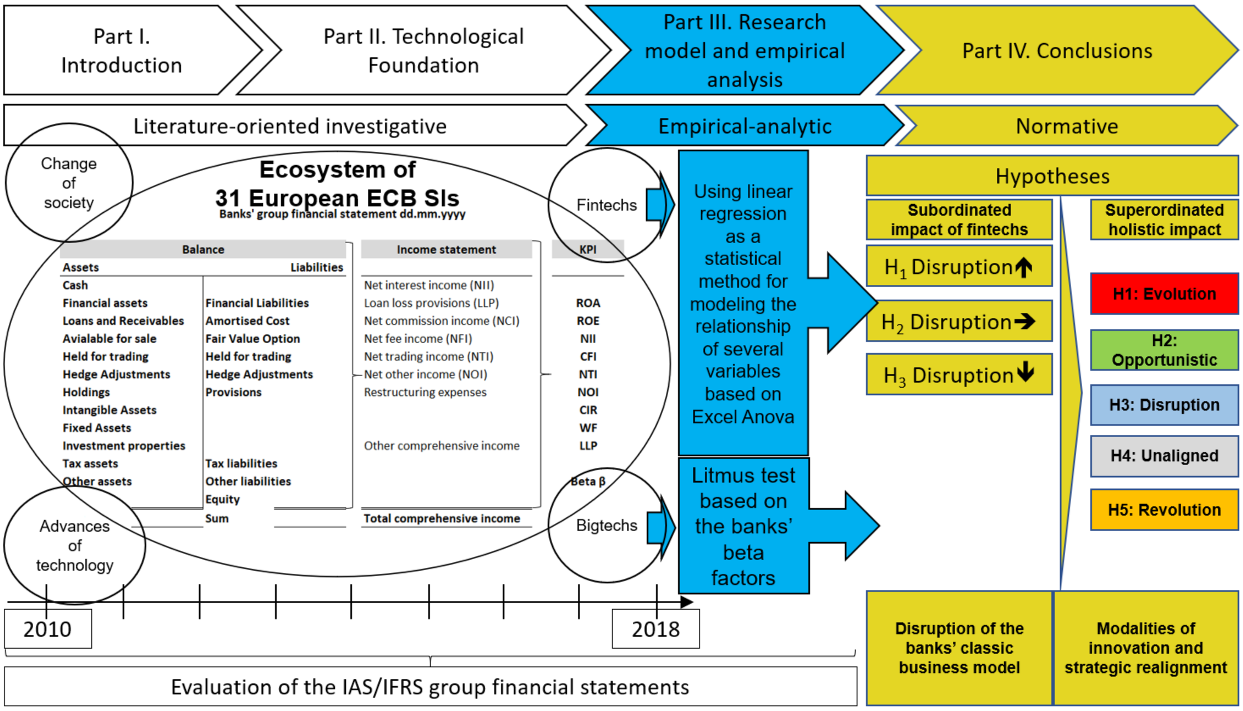
Source: Own elaboration.

The leitmotiv of the impact of digitalisation running like a thread through this dissertation is spanned from general questions to special questions to general questions.

This dissertation comprises from the research idea to the conclusion a mixed-methods approach (Smith, 2020). Figure 6 below illustrates the structure of this work and the scientific methods used in the context of its main parts.

The four main parts of this work pursue three different leading scientific approaches to gain reliable knowledge. These are supplemented in the individual main parts by further projections. Parts one and two are designed qualitatively. Part three comprises a dominant quantitative approach and a qualitative-quantitative mixed one in the form of a questionnaire. The work is closed by the normative completed fourth part.

Figure 6: Structure and methodology of the dissertation.



Source: Own elaboration.

In detail, the four main parts include the following scientific approaches to gain knowledge:

Parts I and II (qualitative approach).

These parts are essentially designed to be literature-oriented and investigative. When selecting the sources, emphasis was placed on using highly quotable and worth quoting literature. Essentially, articles from internationally recognized scientific journals were used. Monographs as well as collected editions and professional journals were only used to a lesser extent. Articles in the business press were used only to an extremely limited extent as sources. The websites and document servers of google scholar, EBSCO, JSTOR, ResearchGate, SSRN and WoS were used for literature research[13]. The selection of valid sources is supported by bibliometrics.

Wherever possible, sources from bank regulation were used to validate definitions or overarching framework concepts (e.g. *business model*).

A qualitative content analysis (Smith, 2020) was used to identify the relevant technologies that have an impact on the banks' *ecosystem*. For this purpose, advertising brochures of leading international consulting companies were evaluated, which apply to technology drivers.

Part III (quantitative and qualitative approach).

In this empirical-analytical part of the work, the impact of two populations on the selected *universal banks* is analysed. The effect of *fintechs* on the *business models* of traditional banks is examined with the help of modelling using a multivariate regression. The calculations and diagnostics were carried out with the Excel ANOVA toolkit.

The effects of the *bigtechs* on the *business models* of classic banks were researched with the help of a simple time series analysis of sensitivity values (event analysis). Due to the simplified, quick approach, this test is referred to as litmus test.

The acquisition of the data basis for this part uses archival research (Smith, 2020). The modelling of dependent and independent variables of the multivariate linear regression goes back to the evaluation of 248 IAS/IFRS group financial statements of 31 European listed *Universal banks* over the period of eight years (from 2010 to 2017). In addition to this, as well as to the analysis of the time series, data from the news services Bloomberg and Refinitiv (formerly Thompson Reuters Eikon) were used.

As *fintechs'* data are difficult to access (McKinsey Panorama Fintech), the study is based on the population *universal banks*, focusing on *fintechs* and focusing on *bigtechs*.

Part IV (normative approach).

At the finishing point, an attempt is made to answer the question of what should be sketched, possibly even to some extent (Weber, 1968; Habermas, 1973). The preceding parts of the dissertation are intended to ensure that the arguments are comprehensible. With a view to a theory-practice reflection, the presentation of a solution for the current economic challenges of risk takers is also being considered.

[13] EBSCO (Elton B. Stephens Company), JSTOR (Journal STORage), SSRN (Social Science Research Network), WoS (Web of Sciences).

In principle, the empirically analytical economic sciences dominate in this work. Components from formal sciences (statistics) and approaches from humanities (jurisprudence) are borrowed. The latter, however, without further depth.

Finally, the scientifically recognized methods (Döring et al., 2016) of empirical analytical research used in this work are listed at this point.

Table 6: Scientifically recognized methods used in this work.

Methods used	Chapter
Quantitative research	
Investigation of the impact of *fintechs* on the *business model* of European *universal banks*. Use of a descriptive statistical procedure, the linear multivariate panel regression.	Chapter 5.1 – 5.5
Investigation of the impact of *bigtechs* on the *business model* of European *universal banks*. Use of a simple graphical comparative event analysis without further statistical evaluation methods.	Chapter 5.6
Qualitative research	
During the five-year research phase, rather spontaneous, unstructured interviews were conducted with older colleagues and colleagues from other banks. Their findings were incorporated into this work, but they were not transcribed.	Chapter 7.3
The insights from fintech events in Frankfurt am Main also flowed into this work.	
Mixed approach	
A structured questionnaire was prepared to research the banks' view of the positive and negative effects of *fintechs* and *bigtechs* on the *business models* of *universal banks*. This questionnaire (Likert scale system) could have been statistically evaluated descriptively.	Chapter 5.7
Evaluation of contemporary literature (e.g. whitepapers from management consultancies) to evaluate the respective research focus.	Chapter 3.1 and other chapters
Research project	
The research project took place in the winter semester 08/2018 to 02/2019 with the aim of launching the questionnaire. It is to evaluate the quantitative research results.	Chapter 5.7

Source: Own elaboration based on (Döring et al., 2016).

1.5 Structure of the investigation.

To achieve the objectives in the previous section, the work has been structured in four parts (see Figure 7 and Figure 8 on pages 31 and 32). The first part consists of an introduction and a deep identification of the problem. The second part contains the technical foundations and the third part deals with the empirical content, its results, and their analysis. The last part includes the conclusions obtained from the study as well as an outlook to the future shape of a *universal bank's* sustainable *business model*.

First part.

The first part contains two components to capture the problem in depth.

Chapter one contains an introduction that situates the problem to be treated and presents the objectives, methodology and structure pursued with the realization of this study. This will provide the reader with an understanding of the depth of the problem, approach and objective. Furthermore, the reader gets a clear guide through the thesis. This in the form of the graphic representation of the structure repeatedly shown at the beginning of each main chapter (see Figure 7 and Figure 8 on pages 31 and 32).

In the *second chapter*, the mechanics of the *universal bank* as an object of investigation are first presented. Furthermore, the reasoned selection of the objects of analysis for the quantitative analysis in the third part is made. For further analysis purposes, based on the comparison of the segment reports of the study objects, the current *business model* of most European *universal banks* is drawn. This to illustrate the connection between the change of the society and the role of the bank. By this, the background of the quantitative analysis in chapter 5 is also prepared.

The first part is also intended to convey the perspective of a banks' classic group structuring department whose role is, among other things, identifying changes in the bank's environment to align them. This should include the observation of social conduct. A direct influence on the behaviour of customers should be derived, who ultimately represent the source of revenue.

These insights are summarized in Chapter 7. The basis for this is the comparative analysis of the change in the *business model* of the banks and the company (as present and future customers).

Second part.

The second part constitutes the theory of the research framework and has been divided into three chapters.

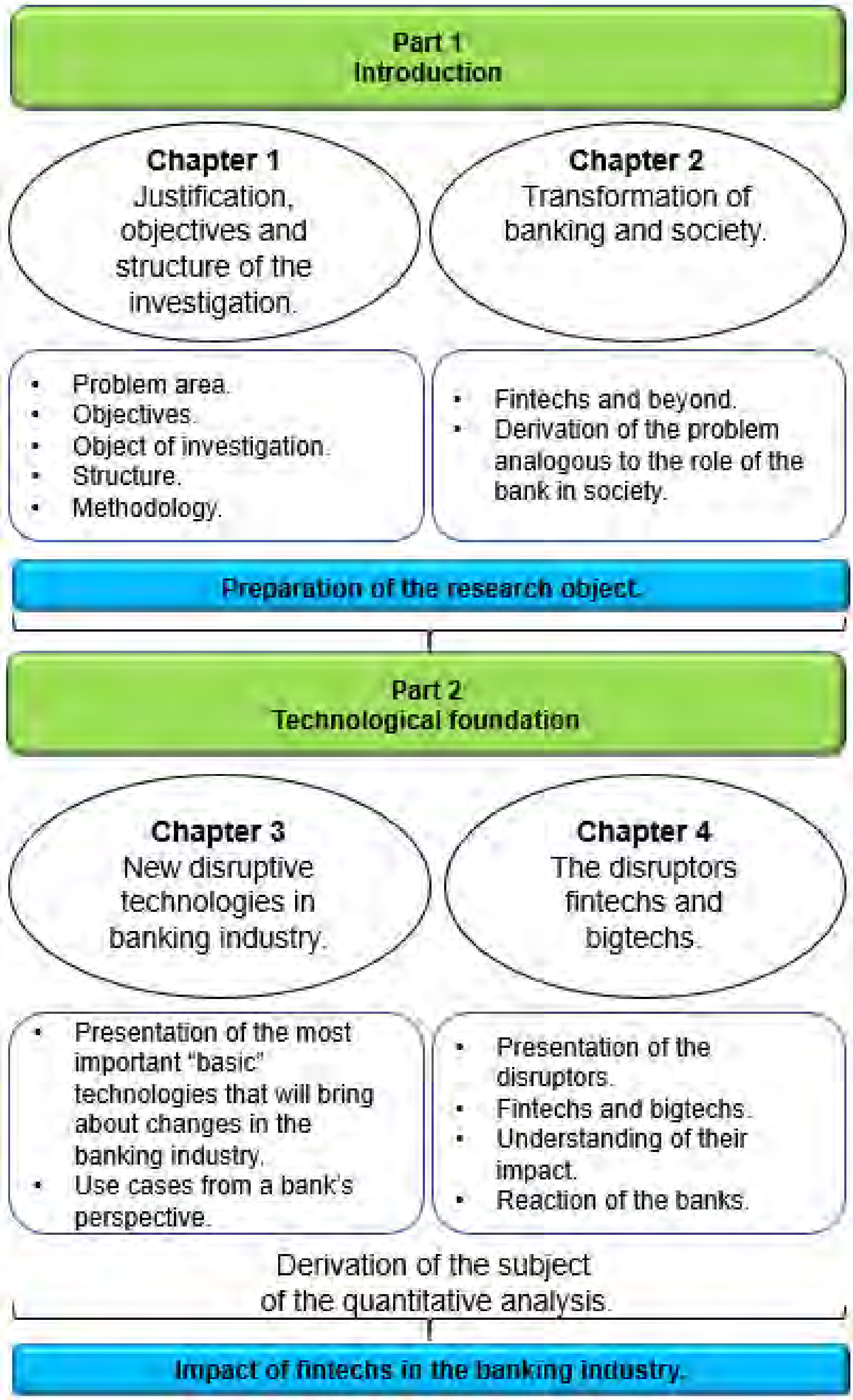
Third part.

The third part of the research includes the definitive quantitative approach of the model, the methodology used, the empirical analysis and the main conclusions.

Fourth part.

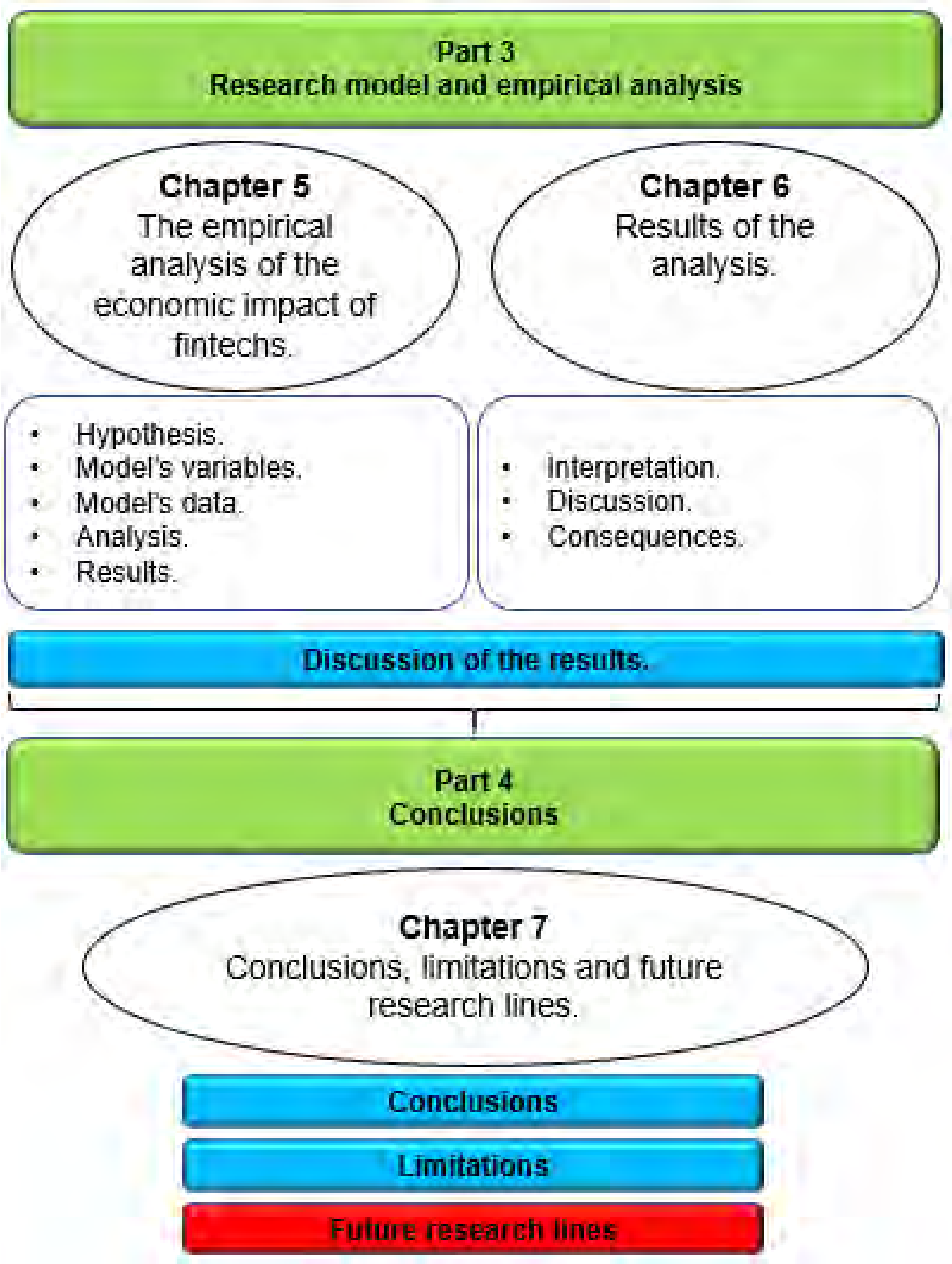
In the fourth part (chapter seven), the main conclusions of the research that seek to clarify the validity of the variables to determine the impact of digitization in banking are presented. This not only from a theoretical point of view, but according to the results obtained in the empirical test that is presented here. The main obstacles and limitations are also analysed, concluding with the exposition of the main lines of future research that would be interesting for the continuation of this investigation.

Figure 7: Structure of the dissertation -part 1-.



Source: own elaboration.

Figure 8: Structure of the dissertation -part 2-.



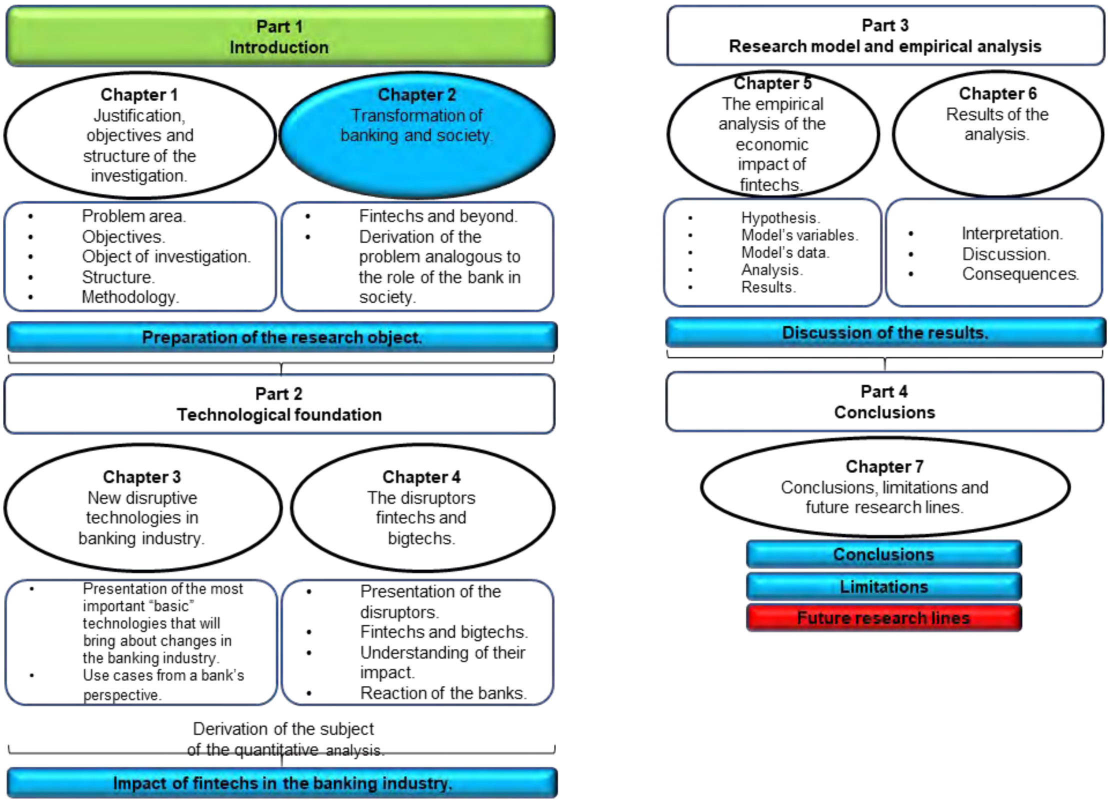
Source: own elaboration.

Chapter 2. Transformation of banking and society.

2.1 Transformation of banks and society.

2.2 General view on *universal banks*.

2.3 Driver of the changes.



The second chapter on the one hand is devoted to analysing the transformation of the banks' traditional intermediary role. This reflection should be set in connection with social change acting as driver (Cajaiba-Santana, 2014).

On the other hand, the 31 European listed *universal banks* to be analysed in this dissertation will be selected. The research focuses on their *business models* (Oordt et al., 2019) and to explore their nuances.

The aim is to identify a *business model* standardized for further investigation in this dissertation. As basis for this serves the design of the segment reports in accordance with IFRS 8 (Operating Segment) of the companies analysed.

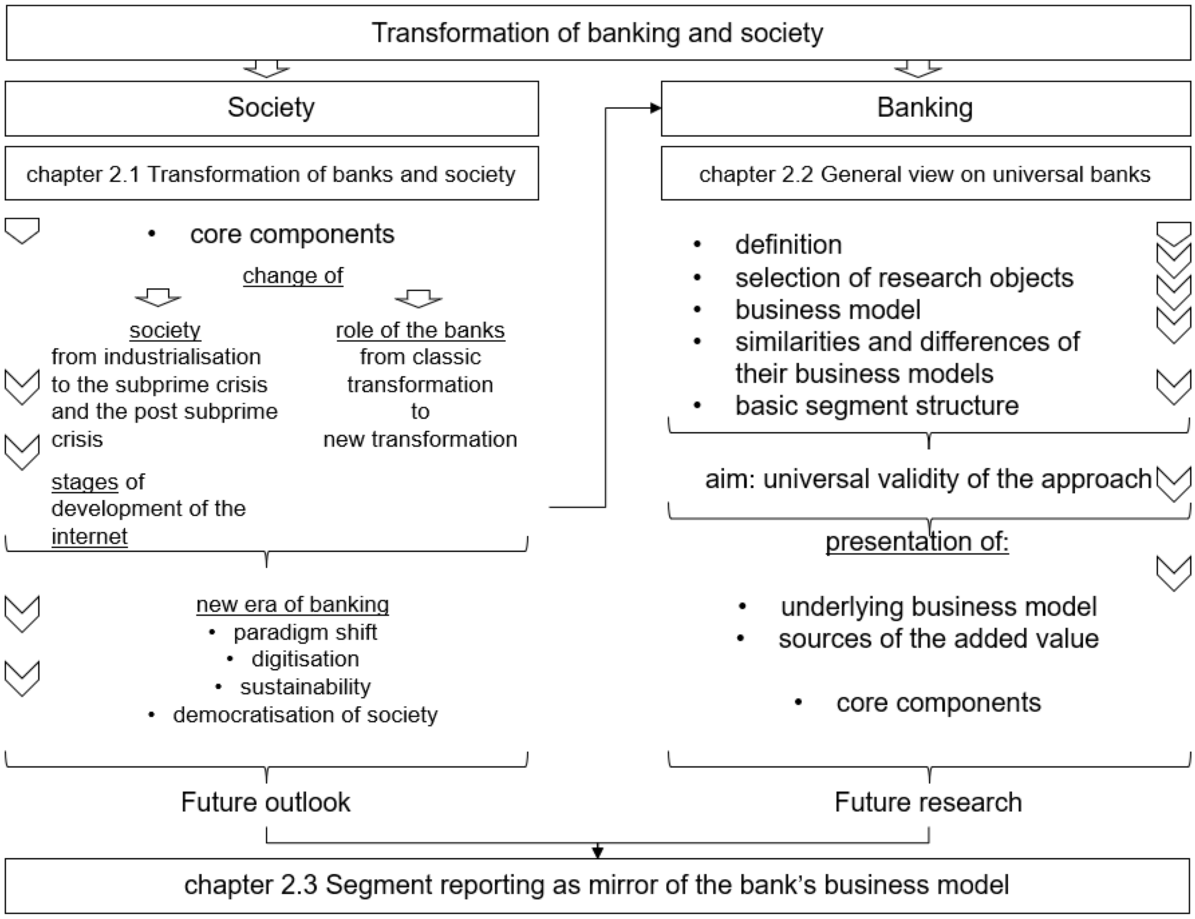
The knowledge gained in this way is needed in view of the further course of the dissertation, for example for modelling the quantitative approach. Then again, these insights are also included in the final normative part of the dissertation. A solution to the challenge is there developed in the form of an innovative strategy.

The following points will be worked out step by step after definition of essential terms:

- Comparative presentation of social change and the role of banks.
- Describe the pillars of classical banks' revenues from pre-industrialization to the present age.
- Selection decision of the objects of interest.
- Understand their core elements of value creation.
- Evidence of the importance of segment reporting for the purposes of this research.
- Presentation of the current post-sub-prime structure of common *business models* of classic European *universal banks*.

The following graphic shows the structure of the second chapter.

Figure 9: Structure of chapter 2.



Source: Own elaboration.

Two lines of investigation are tracked in this chapter. The first line is not only intended to allow a view into the future of banking business. Also, the understanding of one of the main drivers of the disruptive transformation is to be promoted.

Secondly, the selection of the research objects is taken and justified. This selection represents the basis of modelling the empirical analysis in part three of the work. To reflect the vulnerability and attack surface of the two populations fintech and *bigtech*, the *business models* of the analysed banks are attributed to a unified representation of value added according to Porter (Porter, 1981).

In summary, this chapter concludes with a first reflection of the insights gained regarding the overarching hypotheses.

2.1 Transformation of banks and society.

The term *civil society* can be traced back to the works of the Roman speaker, philosopher and statesman Cicero (Cicero, 2013) and before him of other Greek philosophers (Sulek, 2010). They equated civil society with the state (Zetzel, 2017). Through the centuries, the term was further developed by political intellectuals and philosophers such as Thomas Paine (Kaye, 2006) and Georg Hegel (Rosenzweig et al., 2010).

Civil society was understood to be a domain parallel to the state but separated from it (Carothers et al., 1999). In this work, the term is defined as a kind of limited area of protection in which citizens can pursue their individual interests and wishes. This view, which has been distorted several times in the recent history of modern times, only made possible private ownership and a market economy. Calvinist influences contributed to this understanding (McGrath et al., 1991). Banks and customers representing civil society can reach each other worldwide (24 h/7 days) via digital channels. For this reason, no geographical limitation is made regarding this term. Nevertheless, the term *civil society* is always used in this thesis in relation to banks.

Present and future customers are in this dissertation understood as the link between society and the banks' *ecosystem* (ACCENTURE, 2019). Other important links between both are the trust of customers as (usually) representative of the demand side and the reputation of banks as (usually) representatives of the supply (Aramburu et al., 2019; Merton et al., 2019).

Banks have a specific, firmly assigned role in the lining of the offer function of banking services since the beginning of their existence. Namely, it is the role of an intermediary of liquidity in different forms and characteristics (Sgambati, 2016).

The banking products offered to satisfy demand are on top all characterized by a lack of storage-life and a high degree of homogeneity (Howcroft, 1991). These characteristics make it difficult to carve out unique selling points of a single market participant (Baye et al., 2001).

The role of the intermediary between liquidity demand and liquidity supply is at the heart of the bank's revenue generation (Gobat, 2018). The changes in the form of this role are presented below based on social change.

The change in society can certainly be represented in many ways in social science and fixed at many points (Diesing, 2017) (e.g. by wars). In this way, the main consensus-building interests, from the capitalistic egocentric orientation to the sustainability efforts of the present, could be put in the centre (Urry, 2015). For further analyse, the change of society is initially in Table 7 directed towards the phases of industrialization.

Table 7: Coherence between industrialization and banking.

Phase of development	Years	Industrialization	Banking
Pre-industrial time	till 18th century	Formation of isolated economic power centres in Europe (Pisa, Genoa, Venice, Barcelona, Augsburg).	The roots of modern banking are to be found in Venice, triggered by the need for refinancing the wars of the city state. Role of intermediary: - lot size transformation - maturity transformation.
Industrialisation 1.0	end 18th century	mechanical production powered by water and steam (1st mechanical loom).	Emergence of capitalism by pooling the assets of noble families in Britain and investing in industries, modern exchanges emerge as marketplaces for equity - lot size transformation - maturity transformation - information transformation
Industrialisation 2.0	start 20th century	mass production powered by electricity.	Banks operate as war financiers, modern central banks emerge, - lot size transformation - maturity transformation - information transformation - market transformation
Industrialisation 3.0	start 70s of 20th century	electronics and IT automized production.	Globalisation of finance as wells modern global investment banking emerges - lot size transformation - maturity transformation - information transformation - market transformation - risk transformation
Industrialisation 4.0	now	cyber-physical systems data as new gold claim.	Modern banking regulation restricts banks' activities, because of the subprime crisis. Global corporations take on the tasks of classical banks. - lot size transformation - maturity transformation - information transformation - market transformation (- risk transformation)

Source: Own elaboration based on (Kellenbenz, 1979; Read, 1999; Bloem et al., 2014; Steinmetz, 2015).

Banking has undergone during the five phases of industrialization a change in *business models*. These changes were initially an adaptation to the social and economic environment (Senior et al., 2009). The technological developments of the modern era accelerated the adjustments and opened new versions and supplements of the old *business models*. However, until the current phase of industrialization 4.0, there has never been a change in the nucleus of banking services. The focus was always on the role of the liquidity intermediary funded by deposits.

The focus on the demand and supply sides as the essence of social change can only be superficial here. Country-by-country specifications have not been taken into consideration (Ligt, 1993; Fohlin, 1997; Tilly, 1998).

In the following, supply and demand for banking services are compared in a highly abstract manner with reference to the phases of industrialization. At the end of this subchapter, this leads to an overview of the earnings pillars of classic *universal banks*.

Pre-industrial time supply of banking services

According to historical records, a banking system by then existed in the late period of Egyptian high culture. The reconstruction of a banking system is already possible at the time of Ptolemaic Egypt (reign of Ptolemaic 332 BC to 30 BC starting with the conquests of Alexander the Great). There was a central bank in Alexandria with branches in up to 22 Egyptian metropolises and 14 subordinated cities. They had the task of a collection point of government revenue, to which, for example, taxes, sale of royal goods, rental income, monopoly income and religious income were counted. The transfer of liquidity was thus only carried out in the direction of the emperor’s treasury (Bogaert, 1981).

This phase ended with Roman interference and conquests. In the Roman Empire, not only the economic but also the religious achievements of Egyptian and Greek high cultures were taken over. Thus, a banking system with a more pronounced intermediary function existed already at the time (TEMIN, 2004). According to records, the functions of the commission-oriented money changer (argentarius or nummularius), the interest-induced short-term and long-term lending, are detectable to the state as a financial intermediary. Even the beginnings of asset management could be seen in the records (Adam, 2012).

Modern banking received further development advances due to the needs of northern Italian city states (e.g. Venice) (Hildreth, 1837). The rise of the Fugger (part of the family of the Lilly) was made possible by a smartly constructed conglomerate. Like any banker, the Fugger created their success only to a small extent with their own money, but mainly with deposits from customers, which they then issued as a loan to holders like the Habsburgs (Steinmetz, 2015).

The Fugger were superior to their competitors, especially in their ability to attract deposits of wealthy customers (Steinmetz, 2015). A further development was initiated by the competitors of the Fugger as bankers of the Spanish crown under Charles V. Thus, the interest-induced, deposit-based role of the intermediary took shape, despite church bans on interest-taking and debtor punishment (Spann, 2004).

Pre-industrial time demand of banking services.

Pre-industrial European society was characterized by a concentration on feudalism and urban guilds (Trebilcock, 2014). The demand for organized banking services was thus mainly concentrated on dynasties, trade, and service companies. War financing was often the focus (Pompeo Litta et al., 1852).

Of course, private individuals also needed loans (e.g. farmers in poor crops). From antiquity to modern times, however, there was livelong debt bondage as pledging of the individual work force to the creditor (Spann, 2004). As a further development, the debt towers have been introduced, which deterred (Gratzer et al., 2008).

As a result, the demand of today's so-called private customers only arose in later phases of industrialization.

Industrialisation 1.0 supply of banking services.

The banks of continental Europe and the United Kingdom are already being attested to the intermediate role of capital allocation as well as the credit assessment of debtors at this time. However, the focus of the houses was on industry and public finance. Private customers were less focused at that time (Collins, 2012). The banks achieved interest margins through lot size and maturity transformation.

Already at this time, efficient capital market exchanges (bonds and stocks) existed, which opened a new dimension in the intermediary activities (PREVITS et al., 1994). They had been created based on commodities and bill exchanges. The transformation information, news as good, was born. Evidence of this is the creation of the asset stock of the Rothschild bank by Nathan Rothschild using carrier pigeons (Cassis, 2016).

He took opportunity of a knowledge advantage gained through carrier pigeons and psychological assessment of the outcome of the Battle of Waterloo of 24 hours against the British Government and the other capital market participants in London (Cassis, 2016).

Another proof of the importance of information transformation, initially from stock exchange data, is the establishment of the Reuters news service in Aachen in 1849 (Read, 1999).

In addition to these classic tasks, banks of this time are attested to a significant role in the catalysis of the industrialization of nations on their way to the First World War (Calomiris, 1995).

On the eve of the First World War, armed and radicalized parts of European society faced different historically grown appearances. At first, European dynasties represented the power centres. However, this had to be gradually handed over to the representatives of industry. A very strong interlinkage of industry and banks is historically reconstructible (Trebilcock, 2014).

Consumption and self-development (triggered by the Renaissance: Petrarch) (Stierle, 2005) at the beginning were reserved only to a few. Thus, demand for organized banking products, as in the meantime also functioning stock exchanges, has concentrated on states, primary industry companies, manufacturing industry and a privatized minority (Hildreth, 1837).

First pension schemes are created (Conde-Ruiz et al., 2016). This has a beneficial effect on the further development of the insurance industry, with its own liquidity needs (Koch, 2012).

Industrialization 2.0 supply of banking services.

At that time, investment banks arise to meet a new dimension of financial intermediation, the risk transformation. Initially, they acted as underwriters of securities.

The economic recovery after the First World War is being put to an end by a gigantic crisis of over-production, which flows into the so-called black Friday on 25th October 1929, This event skipped over to Europe, due to the sudden withdrawal of American direct investments (Kindleberger et al., 1984; Müller-Luckner, 2009).

In 1933, the Glass-Steagall Act enacted a separation bank law that distinguished between commercial banking (borrowing and lending) and investment banking (underwriting of securities). This law will not be repealed until Bill Clinton's presidency in 1999 (Gramm-Leach-Bliley Act).

Industrialization 2.0 demand of banking services.

At the heart of this phase of post-World War I industrialization is mass production to satisfy mass demand. The needs of the private customer are now on the focus of attention.

Classic *universal banks* still shy away from private consumer finance (Marichal, 2009). For this reason, corporates set up their own banks (e.g. 1926 Ford Motor Credit Company).

Industrialisation 3.0 supply of banking services.

The technological achievements of the Second World War (change of analogue to digital technologies) enabled an unprecedented expansion of the classic established commercial model of *universal banks*. The scenarios of the cold war as well as economic necessities accelerated the development of Internet 1.0.

On this basis, the volumes of business activities (commercial banking such as investment banking) were increased. Regarding risk transformation, global trading of derivatives became possible. In addition to the technical achievements, legal liberalizations of the financial markets (Gamble, 1994) led to increasingly new and riskier products. This era was ended by the global economic crisis (beginning with the subprime crisis in the USA in 2006/2007).

Until then, however, only an extension of the banks' well-known *business model* has taken place and its addition to modern technology. This is often intended to generate more revenue and reduce costs.

Industrialization 3.0 demand of banking services.

This phase of the industrialization of the Western world through more pronounced possibilities of self-realization of the individual, from consumption to leisure activities to information gathering. As a result, liquidity needs increased more than in the preliminary phase (Wright, 1998). Banks also assumed an increasingly central role in payment transactions. For example, in the early 1970s, the pay bag was finally abolished at Volkswagen Baunatal plant near Kassel (Dilling, 2017). As a result, banks have been provided with additional sources of fee income and interest margin.

Driven by private sector growth, the demand for hedging instruments initially increased for market price risk. After the decline of the Bretton Woods system (Bordo et al., 2019), a free float of the USD deployed internationally, increasing, for example, the need for exchange rate hedging instruments exponentially. This opened a new source of income for the banks. The trading income was created.

Industrialisation 4.0 supply of banking services.

This phase is characterized by a wide range of regulatory limitations on the traditional banking *business model*. Initially, however, their limits are gradually not modified by the regulatory equity to be retained in accordance with risk weighted assets (RWA Risk Weighted Assets).

The second step is to regulate the liquidity coverage ratio (LCR liquidity coverage ratio and net stable funding ratio). In the third step, the composition of the liabilities side (liquidity coverage ratio) is regulated.

An absolute novelty is the assessment of the banks' *business model* within the framework of the SSM SREP (Single Supervisory Mechanism, Supervisory Review and Evaluation Process).

In this way, the development of banks' *business models* over the centuries took place, from physical stone banks to the landfill of tax levies to high technology, global corporations capable of threatening financial stability.

So far, the supply side of liquidity has been highlighted. It is also interesting to compare this with the change in demand for liquid funds.

Industrialization 4.0 demand of banking services.

This phase of industrialization is characterized by technological achievements, such as the internet (from internet 1.0 to 4.0 the IoT). Their disruptive character is equivalent to the domination of fire or the invention of the wheel (Vermeulen, 2017).

Individuals and companies are thus opening opportunities for individual development, consumption, and networking, as is the case with the invention and continuous development of associated electronic devices (PC, smartphone, tablet, wearables).

The expectations of Generation Z customers (Seemiller et al., 2016) are estimated as little loyalty, impatient, quick to have wanted and absolutely internet-focused (ACCENTURE, 2019).

These digital possibilities call into question the classical *business model* of the banks for the first time after many hundred years. From now on, not only the banking products are interchangeable, but also the intermediaries. This forces banks to develop new *business models* in order to survive (Stewart et al., 2000).

Industrialization 5.0 supply and demand of banking services.

In 1969, the Internet experienced its birth and founded the basis of a *disruptive* change in international society with incalculably wide-ranging consequences. 50 years later, it developed over 4 evolutionary stages to form the basis of today's digital society (Skobelev et al., 2017).

The focus of this development ranges from data storage, communication and exchange of goods to the current Internet of things (IoT) (Atzori et al., 2010). This enabled the evolution from the information society of the 90ties (McCain, 2000) to the current digital society.

This society is characterized by the fact that the individuals are permanently networked. Geographical, political and religious boundaries as well as traditional norms and values systems (leisure society) (Veal, 2019) fall into the background. Electronic devices continuously record the lives of individuals and can even intervene if necessary (Caldeiro Pedreira et al., 2019) (connected cars like VW Golf 8, car's brake assist (Shaout et al., 2011)).

In the phase of industrialization 5.0, artificial intelligence will assume autonomous repetitive tasks, such as opening an account, carrying out financing or setting up a depot (UBS, 2020). If applicable, electronic devices might anticipate the volumes of supply and demand of financial products.

Today, the Internet of things enables machines to operate autonomously (washing machine selects the cheapest electricity supplier, fridge orders food, autonomous truck purchases energy) (Atzori et al., 2010).

Digital networking thus enables real, physical consequences. Militarily, this was exemplified by the acceleration of uranium enrichment plants in Iran by virus feed via the normal power grid (Langner, 2011).

What impact does this development have on the supply and demand of financial products?

A shift in the nature of the market from the supply market to the demand market can be observed. It seems that this technology has increased the efficiency of the market (Fama et al., 1970).

Consumers, regardless of their business segments affiliation (private or corporate clients), can switch suppliers of financial products in seconds. New disciplines such as Internet marketing have become necessary.

Once mutually concluded contracts (e.g. a liquidity facility) can be called up in nanoseconds by the customer or triggered by a digital event.

New previously unknown risks have arisen (cyber risks), the quantification of which is only in the beginning (Grimwade, 2019).

The shift in market characteristics to the detriment of traditional suppliers of banking services (*universal banks*) could be compensated for by datamining on the part of *bigtech* in favour of providers.

Consumers voluntarily disclose structured and unstructured data on their (social media) platforms, from which e.g. creditworthiness assessments are calculable.

Bigtechs thus might take the place of traditional banks as suppliers of banking services. This disruptive development applies not only to the market for financial products, but also to traditional stock exchanges. As a result of the development of Blockchain, traditional capital markets intermediaries, as well as banks, will have to rethink their *business model* in the future.

The terrestrial Internet can also be reached in orbit (Jia et al., 2019; Kuksov, 2019). The question now arises as to what shape the society of the future will take and what demand behaviour for financial products will emerge.

If the moon or mars are finally settled as additive continent of the world (Bakhtian et al., 2012; May, 2017; Lorenzen, 2019), the first population will hardly need banking services. Analogous to the exploration of the geographic north pole and south pole (Leon et al., 1989), all resources must first be taken from the starting point.

For the private-sector realization of these projects (Allen, 2019), terrestrial funding will be necessary (Hilton, 1967; Concini et al., 2019). In the course of a further development of the extra-terrestrial society, demand and supply for financial products will arise like the population on earth (Zaun, 2000).

Due to the arising freight costs, it is expected that in this society no cash will be in circulation in the classic sense. The society could be cash-free, but in no case without payment means.

To sum it up, the banks' role of the intermediary, which has been secured for centuries, is challenged. The centrepiece of revenues of the *business model* of classic *universal banks* is thus subject to an irreversible historical first-time disruption.

A shift from interest-induced margin business to commission and fee income and to other income has been observable since the sub-prime crisis to date (Buch, 2018).

The following information regarding the earnings pillars can be gathered from the above descriptions:

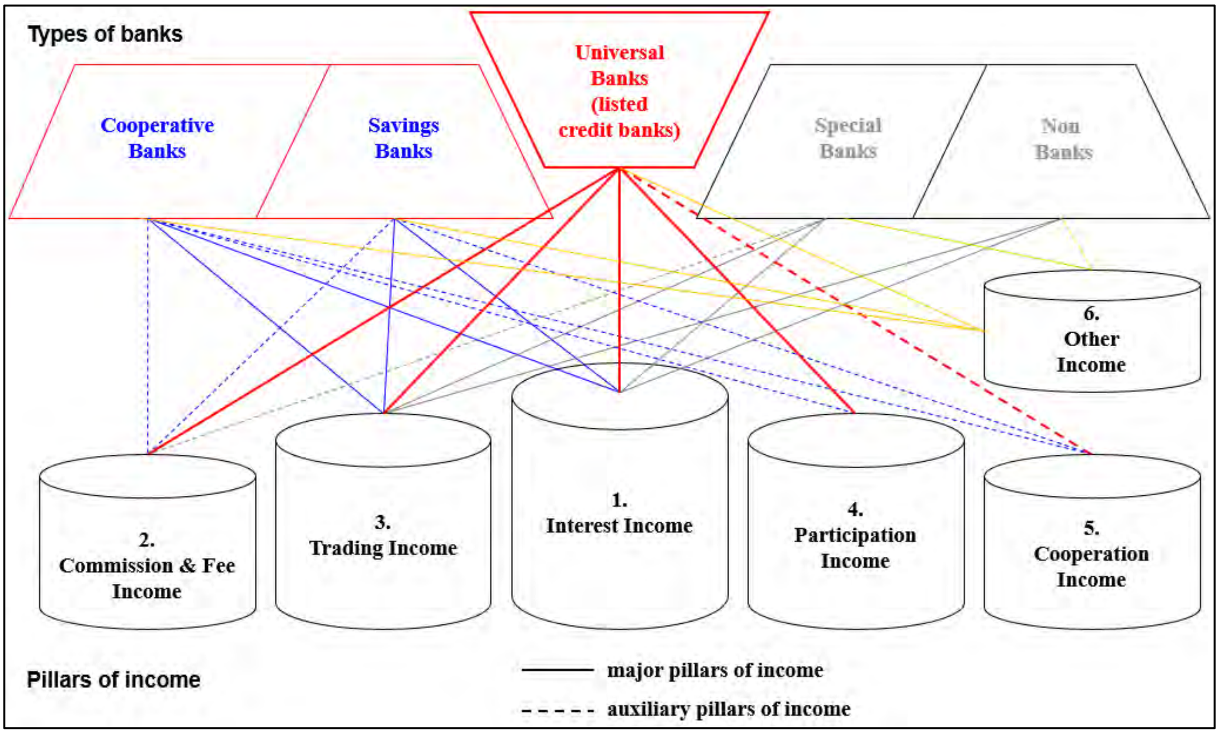
Table 8: Comparison of changed supply and demand behaviour and the revenue pillars.

Phase of industrialization	Demand of banking services	Supply of banking services	Revenue pillar
Pre-BC	Taxation and collection.	Government-controlled collection system.	None legally, forerunners of the tax authorities.
Pre-AD	Trade Financing, war financing, taxation, public and private sector investments.	Government-controlled collection system, state as financial service provider, currency exchange and financing of the private sector arise, wealth management, information transformation.	Interest income Commission & Fee income, Other Income.
1.0	Trade financing, war financing, dominant and capital-intensive private sector investments, strategic investments.	Risk transformation, preforms of investment banking, participations of banks and industry, globalization of banking, capital markets started.	Participation income, corporation income, trading income.
2.0	Consume financing of the private sector started.	Industrial consumer banks came up with new products (e.g. leasing)	Interest income.
3.0	Focus on the private sector concerning private customer and corporate.	Enforcement of risk transformation, 1974 collapse of Bankhaus Herstatt due to FX risk, new banking services.	Trading income (proprietary trading) Commission and fee income.
4.0	Due to digitalization change from supply to demand market.	Focused on the private customer and its change in behavior online channels became more and more involved for banking purposes.	Due to the consequences of the subprime crisis shift from interest income to substituting revenue pillars.
5.0	Funding ever larger technology and sustainable projects.	Risk transformation and loan syndication; adaption of the *business model*.	All income pillars with trading income in an inferior position.

Source: Own elaboration.

As a result, six sources of interest and non-interest revenues have developed over the centuries during the evolution of modern banking. The following Figure 10 shows the revenue pillars in a coherent manner and in the context of the types of banks existing.

Figure 10: Revenue pillars of financial institutions.



Source: Own elaboration.

The current banking sector depends on six major pillars of revenue (Stiroh, 2004). Depending on the *business model* of the given financial institution either all or only some of the pillars are used:

Pillar 1: Interest (interest-related) (e.g. income margin between fundraising and lending).

Interest is usually defined as the provision of temporary capital (Bieg et al., 2017) (§§28, 29 RechKredV).

Pillar 2: Commission & Fee Income (non-interest related) (e.g. for bank services).

In contrast to interest income, commission income means the price for the provision of services (Bieg et al., 2017) (§30 RechKredV). Fees to further differentiate between interest and commissions are often mentioned in connection with non-traditional banking services (brokerage, insurance sales, credit card issuance, account management, cash supply) (DeYoung et al., 2013).

Pillar 3: Trading Income (interest-related) (e.g. proprietary trading).

In accordance with §340c HGB, the trading result means income and expenses from financial transactions in own name and for own account with securities, derivatives, foreign exchange and precious metals.

Pillar 4: Participation Income (interest-relation possible) (e.g. strategic investment in a corporate in the form of shares or corporate bonds).

According to §340c HGB, this includes both the valuation result from investments and direct interest and dividend income. Participations are investments in affiliated companies that are not yet subject to consolidation.

Pillar 5: Cooperation Income (interest-relation possible) (e.g. sharing comparative cost advantages or participating in the insurance industry).

This includes income and expenses within corporations (association of savings banks, cooperatives or within the group). For example, often only the head office has the mandate to do foreign currency transactions.

Pillar 6: Other Income (e.g. additional rent income of real estate, cross selling effects with life insurances or real estate brokerage or software brokerage).

The other operating result is the collective item for those income and expenses from the operating business that have no connection to the interest, commission or trading result (Bieg et al. 2017).

At this point it should be noted that the allocation of income to interest income, trading income and commission and fees income is sometimes not clearly separable. This is related to the often interest-induced nature of the earnings components.

The banking sector which developed on these pillars includes all the different types of banks with their *business models* (e.g. in Germany the banking sector's main types are Savings Banks, Cooperative Bank and *Universal Banks*):

Type 1: *Universal Banks* (offer the entire product range).

Type 2: Savings Banks (concentrate on retail banking).

Type 3: Cooperative Banks (focus on retail banking which often has an agricultural origin).

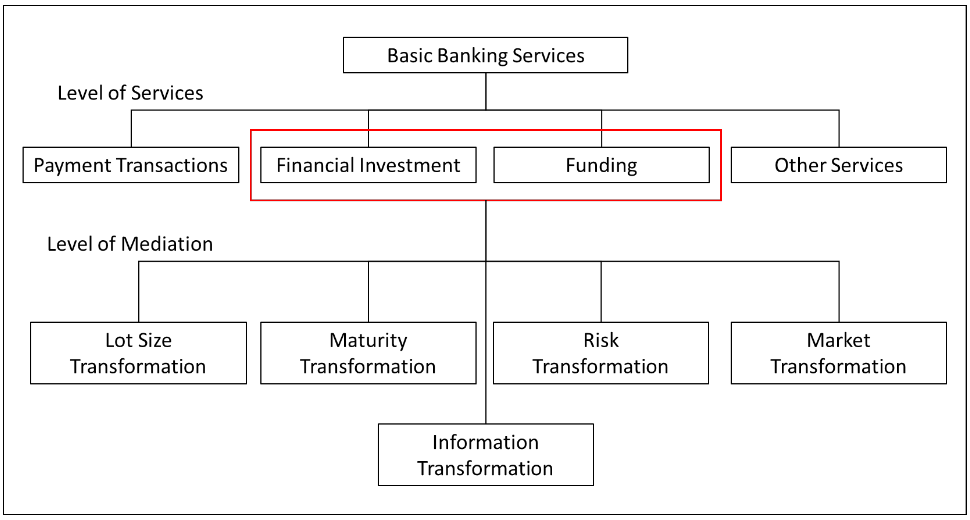
Type 4: *Special Banks* (e.g. the banks of car manufacturers).

Type 5: Non-Banks (e.g. paypal or Amazon which are focused on payments transactions and simple retail banking mentioned,) The subject of the investigations of this dissertation are banks of type 1 and 5 with all earnings pillars.

Basic Bank Services and Intermediation.

Intermediation is the credit institutions' classic role in the circulation of money. They are entrusted with the settlement of payments and the satisfaction of money demand by money supply (Grill et al., 2016). In the last decades of the previous century the risk transformation was added with increasing computing power and stochastic basic understanding (Fohlin, 2018). From an economic perspective, credit institutions perform the following intermediary functions by executing their banking services:

Figure 11: Basic banking services and mediation.



Source: Own elaboration based on (Grill et al., 2016).

Payment Transactions means the execution of payments nationally and internationally. Investment services represent from the customer's point of view the offer of investment opportunities. This includes, for example, the classic savings account. From the point of view of the bank, this service is reflected on the liability side of the bank's balance sheet. Economically, the money supply is meant. From a customer perspective, Funding represents the opportunity to refinance. For example, the refinancing need in the private or corporate customer business is satisfied through the demand for a classic loan. This means money demand from an economic point of view. A banking service displayed on the asset side of the bank's balance sheet.

A bank must pool its assets and liabilities on the balance sheet efficiently and performant. On the one hand, the following requirements of the intermediary services must be reflected and on the other hand the liquidity must always be maintained. Nothing is more threatening in terms of public and private economy than a bankruptcy.

The last service *Others* includes, for example, the asset management or the simple offer of lockers in the private customer segment. The banking benefits shown above are reflected in Figure 4. They are part of the value chain of a *universal bank*. Attached (cf. Annex III. on page xlv) is a complete overview of the banking services of Commerzbank AG approved by BaFin (bank license by German Federal Financial Supervisory Authority).

For the exercise of the basic banking services Financial Investment and Funding, the credit institutes assume the previously profitable role of the intermediary. These functions, seemingly secure for centuries, are at the centre of the investigation of this thesis. They represent the major sources of income for banks worldwide. New technologies and social developments pose a disruptive challenge for them.

Lot Size Transformation: Means of payment are accepted in many small amounts and/ or in a few large amounts as a deposit on the liability side. In the balance sheet, these are liabilities to banks or customers. Ideally, these amounts are then matched in corresponding maturities as loans in larger or smaller amounts on the asset side. These are claims on banks and customers on the balance sheet.

Maturity Transformation: The maturities and fixed interest periods of issued funds differ from those of the funds received. Credit institutions achieve margins results from this.

Risk Transformation: Credit institutions, for example, compensate for the latent default risks of their depositors by lending the incoming funds through risk diversification and credit selection. For depositors, this results in a lower investment risk than in a direct investment. In addition, banks operating in the investment banking environment can transform any type of risk. This in the role of a market maker (liquidity provider).

Market Transformation: Both nationally and transnationally, credit institutions can balance money supply and money demand.

Information Transformation: By providing information, banks are saving lenders and money-seekers a time-consuming individual search for the right market partner. This transformational function will become increasingly important in the future.

The lot size and maturity transformation functions are increasingly being challenged by *fintechs* and *bigtechs* (cf. chapter 4).

Bank's value chain.

Value Chain (practical internal view of a *business model*) is the term used to describe all stages of a work process, ultimately providing the customer with a product or service from conception through production (Weil, 1985).

At the end of this process, there should be added value (surplus) both from the perspective of the buyer and the supplier (Porter, 1985).

The following diagram shows the typical relationship between the value chain of a *universal bank* and its segments. The basic bank services which are part of the value chain are presented in Figure 11 on page 49. The importance of segment reporting (IFRS 8) and its implicit message, due to the structure of the segments, is discussed in subchapter 2.3.

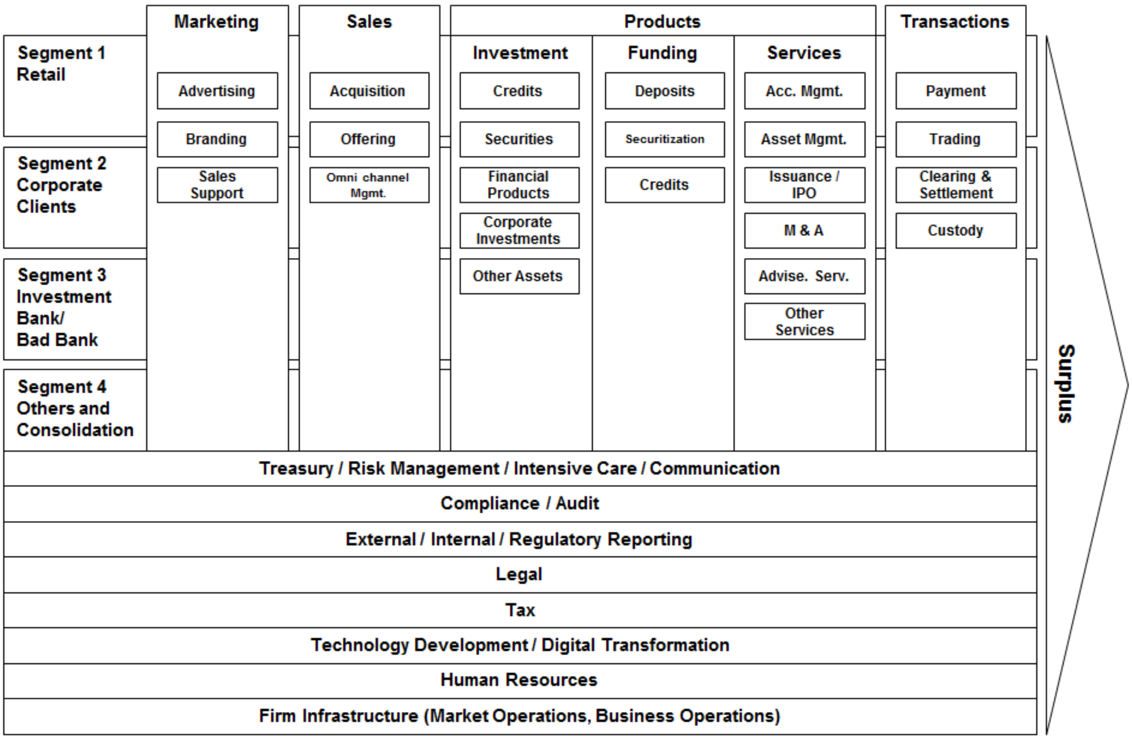
Figure 12 shows Porter's approach of analysing the object's value chain horizontally divided into primary activities and supporting activities (Weil, 1985). The value chain is the sequence of activities of a company (combination of production factors). At its end there is the creation of added value through the sale and earning the surplus.

Porter developed this analysis tool in the context of his considerations to achieve competitive advantages. These advantages should help companies to achieve higher returns in an already highly competitive and divided market (Red Ocean).

Ultimately, banks followed this approach for decades by increasing the technological efficiency of the supporting activities.

It can easily be seen from the graphic that a wealth of supporting activities across the company are necessary across segments to be able to efficiently generate banking services on demand.

Figure 12: Value chain of a *universal bank*.



Source: Own elaboration based on (Porter, 1996).

Horizontally displayed in the illustration above are the stages of the bank-specific value chain from the customer contact (marketing/sales) to the transactions (often called “accounting factory”) where the products are finally generated by posting activities.

A bank-specific value chain usually consists of the components of initiation (marketing, sales), concrete product offer (product) and production (transaction) (Lamarque, 2000). Vertically the production stations (stages) extend over several operating segments.

An operating segment is a component of an entity that (a) generates revenues and expenses (b) is reviewed by a so-called chief operating decision maker and (c) is reported separately (IFRS 8 Appendix A) (cf. subchapter 2.3).

In order to optimize the allocation of resources and respond to market conditions (Weil, 1985), the *universal banks* are usually divided into the segments retail (private), corporate (corporate), investment banking (sometimes transferred to bad bank) and other (internal departments from audit to operations) segments.

The components of the value chain, which are massively supported by the 4th segment, are to be understood across segments. They provide all segments of the bank with their services.

In relation to this dissertation, Figure 12 is intended to convey two things. On the one hand, the presentation of the value chain of the *universal banks* should identify potential targets for *fintechs* and *bigtechs*.

On the other hand, the further question already arises here of how the future added value would be represented.

A first indication has already been given by the above representation of the *ecosystems*. Their internal cohesion is achieved through more commission-based value creation and no longer through the generation of interest margin-based surpluses.

2.2 General view of *universal banks*.

After the previous brief historical outline of the origins of the banks' income pillars, this sub-chapter is dedicated to the banks themselves as subjects of investigation. The contribution of this chapter to the overall work consists of:

- the presentation of the current European banking *ecosystem*,

- identification and discussion of the selection criteria of the objects of interest,

- establishing an understatement of the banks' value chain.

In this subsection, the environmental analysis is carried out in three steps from the outside to the inside of the analysed objects.

First, banks are embedded in their economic environment using a PESTEL (Political, Economic, Social-cultural, Technological, Environmental and Legal) analysis (Aguilar et al., 1967). Components of this analysis are presented in depth in this dissertation others not.

In addition, the understanding of *ecosystems* is presented in a second step.

Thirdly, before the objects to be analysed are identified, they are embedded in the legal framework.

Finally, the objects of investigation of the qualitative part of the work are presented.

Only a look at their value chain permits to identify potential or current revenue targets of *fintechs* and *bigtechs*.

PESTEL analysis.

This part of the sub-chapter will show the current environment in which European banks are operating.

The aim of the presentation is to provide the reader with the knowledge to be taken into consideration in a potential strategic realignment.

For this purpose, a brief PESTEL analysis was carried out (Mohamad Daud et al., 2017). In addition to the PEST analysis (Aguilar et al., 1967), the acronym PESTEL stands for political, economic, social-cultural, technological and in addition to the PEST analysis environmental and legal factors. This analysis is a framework to scan all exogenous variables that influence a company's economic development (Yüksel, 2012).

The next step in generating a new strategy would be a SWOT analysis based on the PESTEL analysis (Helms et al., 2010). However, a SWOT analysis is not carried out here, as the focus of this analysis is the identification of competitive advantages in an existing market environment (Porter, 1979).

This work on the contrary, takes the view that the strategic solution lies in identifying new at the beginning non-competitive environments for economic development.

Thus, only the attempt was made to structure possible exogenous factors for further analysis.

Table 9: PESTEL Analysis of European Banks 2020.

European Banking PESTEL Analysis 2020	
Political factors	**Economic factors**
- government as equity investor (aftermath of GFC) - elections - taxation of the financial industry - separate banking system - Brexit-uncertainty - new regulatory initiatives (e.g. on remuneration, dividend policy, additional capital requirements, cluster risk regulation)	- low or negative key interest rates in Europe - slowing pace of world economic growth - moderate BIP growth (Ø 1% 2008-2018) (EU_19 and EU_28) - declining OECD confidence index of manufacturing industry
Social factors	**Technological factors**
- see chapter 2.1 - industrialisation 4.0 to 5.0 - generation Z => work-life-balance awareness - changes in customer behavior - aging of society => change in demand of banking services - liberalisation of market access by entities in third world countries	- see chapters 3 and 4 - internet 4.0 as basic innovation => IoT - new disruptive digital technologies (see chapter 3) - rise of fintechs - rise of bigtechs - historic first-time thread of the banks' business models - cyber security risk
Environmental factors	**Legal factors**
- see chapter 7.3 - change from egocentric resource consuming to sustainable behavior - carbone and nitrogen oxid reduction to reduce the greenhouse effect - abandonment of the use of fossil fuels - expansion of the human habitat into the universe	- see chapter 2.2 - cum-ex lawsuit by tax authorities and prosecutor - Panama papers - consumer protection (MiFID II) - US monitor and FATCA - anti money laundering - terrorism financing

Source: Own elaboration based on (Eurostat 2018; Dt. Sachverständigenrat Konjunkturprognose 2019).

The exogenous factor technology shown in green colour is examined in detail in the third and fourth chapters.

The two factors highlighted in grey generally do not play any further role in this investigation. Only economic factors are included in the quantitative analysis on the margins.

In light green colorized exogenous factors are presented besides this PESTEL analysis more detailed in three steps in this work.

The figure below shows grouped column by column individual exogenous influencing factors. Their effects must be investigated both individually and in their overly complex interconnectedness. The impact of the factors on performance by this way can be negatively and positively correlated.

At this point in the investigation, the matrix serves qualitatively as a non-conclusive presentation of exogenous factors, which a single bank can often no longer meet alone.

Figure 13: Coordinates of the banking sector.

Heat map of the banking sector				
Business Model	Financial Market	Technology	Regulation	Society
Intermediary Functions	New characterization of the market	Innovation in distribution channels and processes	Increasing control and banking regulation	New challenges and opportunities
Excessive banking in Europe	Changes customer profile and sophistication	Intensive banking versus extensive product internalization	Solvency efficiency delinquency-coverage gap financing	Client and social changes
Transformation savings banks and banking models	Increased financial literacy	Search for suitable dimensions and synergies	ROE and ROA margin reduction	Uncertainty about the welfare state
Rearrangement Restructuring Concentration	Lower customer loyalty	Commercial / private / business banking specialization	Deleveraging	"Back to basis"
Regulation business models and functions	Customer protection regulation (MiFID,…)	Financial engineering "shadow banking"	Public debt portfolio risk and crowding out effect	Competition with technology companies

Source: Elaboration based on ideas of Prof. Dr. Ricardo J. Palomo Catedrático de Economía Financiera / Full Professor of Finance Universidad CEU San Pablo.

Figure 13 shows an extensive map of the banking sector's coordinates in sense of exogenous factors constantly to monitor. The banks' current situation is to characterize that way that by ignoring these factors shown above a strategic crisis would arise slowly but ending with illiquidity (Helwege, 2010) and corporate law measures (e.g. fusion, acquisition or splitting).

Significant environmental changes affecting incumbent banks are shown in the map's columns. These changes include such as innovation in distribution channels, the impact of increasing regulation after the financial crisis, social and customer changes, margin reduction or the uncertainty about the welfare state with its consequences on savings and investment in the medium and long term.

One of the major changes that are currently taking place is that the centuries-old *business model* of banks is being questioned by technology companies (*bigtechs*).

Against the backdrop of the complexity of the emerging facts as well as the globalization of the financial system, contemporary literature is increasingly talking about a financial *ecosystem*.

The individual banks are a small component in such a system. In addition to the banks, the system itself also includes non-bank components.

Financial ecosystem.

The term *ecosystem* was originally shaped in biology (Odum et al., 2005).

"An *ecosystem* is a large community of living organisms (plants, animals and microbes) in a particular area. The living and physical components are linked together through nutrient cycles and energy flows. *Ecosystems* are of any size, but usually they are in particular places. Each *ecosystem* has its own community. The species in a community are divided into populations according to the particular habitats and ecological niches in the *ecosystem*" (Odum et al., 2005).

No single species is thus able or forced to survive independently. *Ecosystems* are stable, but not rigid. They react to major changes in the environment, especially climate changes.

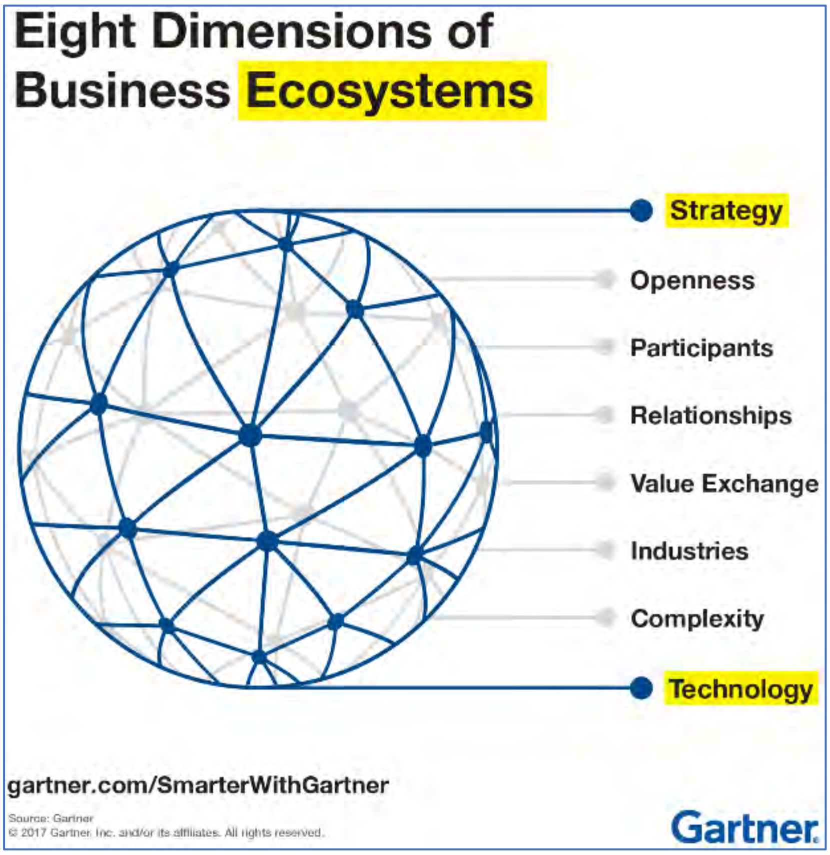
What drives all *ecosystems* is the primary production. Primary production is the production of organic matter from inorganic carbon sources. This happens through photosynthesis. It drives the carbon cycle, which influences global climate via the greenhouse effect (Odum et al., 2005).

Transferred to economic contexts, the species form individual entities, which are sometimes also related to energy flows. The cohesion of economic *ecosystems* is created by the common quest for income and/or recognition, influence in the form of lobbying or similar (Panetta, 2017).

Economic *ecosystems* do not necessarily have to be stable. They can be dissolved after achieving a common project objective (BWM and Toyota due to battery research). The challenge is to create a regulatory framework for economic *ecosystems* (Panetta, 2017).

Gartner, a global consulting, and research company, presents the economic ecosystem as shown in the following graphic:

Figure 14: Business *ecosystems*.



Source: based on (Panetta, 2017).

The connection of the *ecosystem*'s nodes (species) is shown in this special picture eight-dimensional.

Strategy and *technology* are the bottom-line dimensions of the system. The major *strategic* challenge is the integration of the own unit (species) into one or more *ecosystems*. This, for optimal participation in the common value creation process.

Technology represents the necessary framework condition that enables the systems to be networked and maintained.

The degree of *openness* refers to whether the *ecosystem* is public, private or hybrid.

The *diversity* of the participants depends on who is integrated into the system (e.g. Customers, banks, consultants, technology companies) and their rapidly changing roles. This dimension is strengthened by the diversity of industries. The idea is that units of different industries and production levels are connected along the value chain in such a system.

The *relationships* dimension represents the challenge of connecting A) 7 billion participants with 30 billion electronic devices estimated via technology platforms and B) the type of incentive for networking. Often, the participants find themselves together on a commission basis (e.g. Airbnb, ebay).

Value Exchange can take place in such an *ecosystem*, both monetary and non-monetary. For example, a unit can work with vendors on joint product development (Mainincubator and Mercedes Benz => e-token for autonomous driving trucks). This dimension has a strong bond and thus stabilizes the system.

With the *complexity* of multiple economic *ecosystems*, it is described that individual units can act as nucleus or participant of parallel *ecosystems*. It is important to understand common synergies and possible breakages. What changes do these *ecosystems* respond to in what way? Moreover, this complexity poses a major challenge for regulatory measures in both the individual economy and financial stability. Overlapping *ecosystems* could create by this way new *ecosystems*.

Following this general, sector-unspecific explanation, a survey of literature of leading consulting companies follows the umbrella term *financial ecosystem* (136.000.000 findings as of Tuesday 04th February 2020).

Table 10: Shapes of financial *ecosystems*.

Source	Title	Publication	Message	Eco system	Digital	*Fintech*	*Bigtech*
PWC Study	Platform Banking & Digital *Ecosystems.*	March 2019	• Partnership development is gaining momentum • Different plays in the new *ecosystem* • How to make banking *ecosystems* work.	100	99	28	0
Deloitte	How artificial intelligence is transforming the financial *ecosystem* The new physics of financial services.	January 2020	Much ink has been spilled on the role of artificial intelligence (AI) in financial services. But the bulk of it has been about technical requirements or near-term trends. For those trying to understand the strategic implications of AI in the industry, the body of work has been slim.	39	12	10	0
Forrester	Predictions 2019: Financial Services Firms Shift Their Focus to Operational Efficiency.	2018	*2019 is the year that transformation goes pragmatic. To understand the 14 major dynamics that will impact firms next year, download Forrester's Predictions 2019 guide.*	1	13	4	0

Source	Title	Publication	Message	Eco system	Digital	*Fintech*	*Bigtech*
McKinsey	The *ecosystem* playbook: Winning in a world of *ecosystems.*	2019	Asia is currently amid a boom in digital and technological innovation. The emergence of digital giants— including China's Tencent, Alibaba, and Baidu; Japan's Rakuten and SoftBank; South East Asia's Grab and Go-Jek; and India's Paytm—is clear evidence of the trend. Fast-moving and aggressive, these companies and others are thriving because they have access to capital and because Asian consumers are especially receptive to new mobile and internet technologies.	297	46	3	0
Capgemini	World Fintech Report.	2019	With *ecosystem* partnerships being recognized and valued, open banking will eventually transition into an Open X phase in which standardized API's, insights excellence that fosters a seamless exchange of resources improved experience.	72	33	143	7
BCG	What Does a Successful Digital *Ecosystem* Look Like?.	2019	As digitization and the Internet of Things (IoT) make homes, phones, and cars increasingly "smart," corporate partners are beginning to work together in order to create interconnected offerings that are proving more valuable than a single company's isolated product or service. These digital *ecosystems* are often orchestrated by market share leaders and are quickly reshaping a wide array of industries, such as consumer products, health care, and automotive.	51	28	0	0
Oliver Wyman	RISK SURVEY REPORT.	2019	The Evolving Treasury *Ecosystem.*	10	1	3	0
EY	How FinTech is fuelling an *ecosystem* future in Europe.	2019	A wave of FinTech innovation is spurring a race to form *ecosystems* that deliver value to European consumers.	10	6	54	0

Source: Own elaboration based on the named consultants' internet marketing brochures.

According to the simple evaluation of the number of words *Ecosystem*, Digital, *Fintech* and *bigtech* in current websites of leading international consulting companies, the term *ecosystem* is used above average in connection with digital and fintech. It is striking that only one consulting firm mentions *bigtech's* in the report.

This simple observation leads to the conclusion that the current interpretations of digital *ecosystems* have a strong connection to *fintechs*, but hardly a connection to *bigtechs*. The latter seem to be left out in the current representations.

A simple reason, not further examined here, could be that the consultancy companies mentioned are specialists in banking, have no contracts with *bigtechs*. The latter may each represent their own *ecosystems*. An overlap of these *ecosystems* could arise, for example, from Siri, Alexa, Google assistant (Kaplan et al., 2019b).

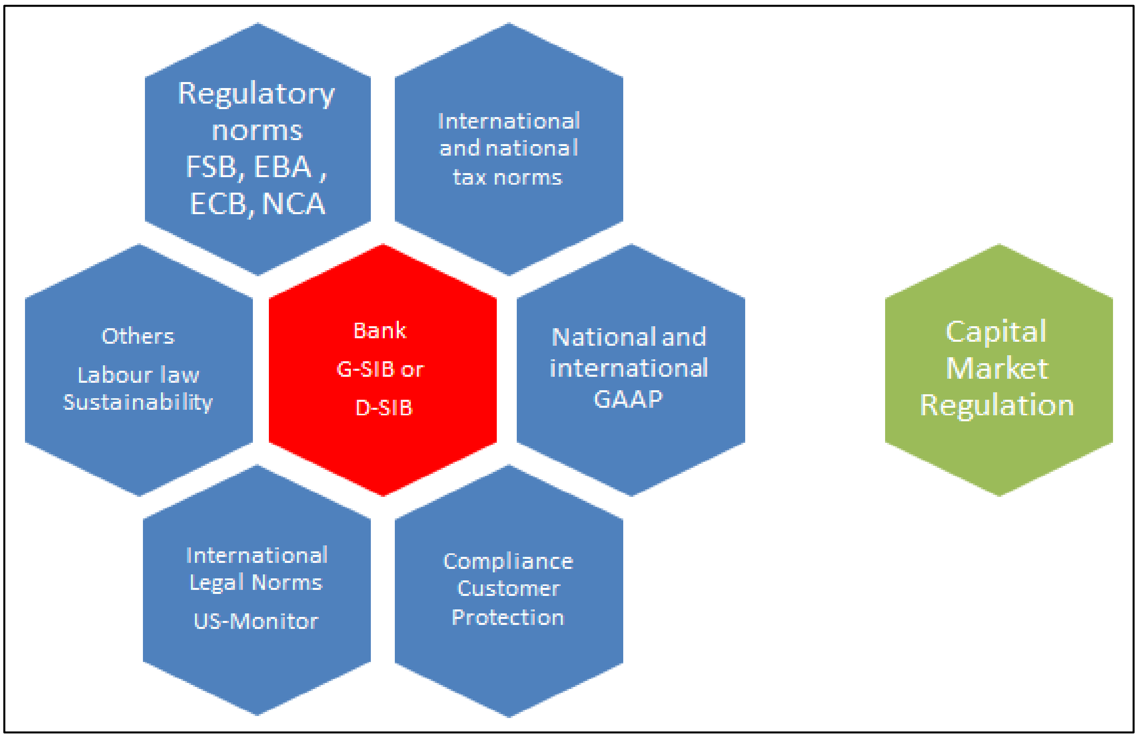
At this point in work, a small intermediate conclusion might be drawn regarding the higher-level hypotheses H1-H5 (see Figure 4 p.21 and Table 5: Combination of hypothesis and resource allocation. Table 5 p.21). The above qualitative evaluation of contemporary literature allows a first conclusion on the development of financial *ecosystems* towards the hypothesis H1 (evolution of the old *business model*) as well H3 (disruption of the old and creation of new *business models*).

According to the insights of Table 10 p.58 seems to be not yet a part of the financial *ecosystem* worth mentioning. Based on the first sightings of contemporary literature, the authors deal separately with *bigtechs*. These are already referred to as an independent *ecosystem* (King et al., 2019).

Legal environment.

To conduct global banking business with great care, the actors must comply with a multitude of national and international standards. Without claim to completeness, these are shown in the following figure. Clockwise around the central point banks marked in red, the standards are grouped thematically according to their degree of impact in the event of non-compliance.

Figure 15: Banks' legal environment.



Source: Own elaboration.

A. National and international regulatory norms.

These standards use risk-weighted assets (RWA) to deposit regulatory equity, regulate liquidity (LCR Liquidity Coverage Ratio and NSFR Net Stable Funding Ratio), and quasi-standardize the composition of liabilities (LR Leverage Ratio), bank funding.

In sum, all the design options of the *business model* have now been regulated. In the second pillar of the Basel III three-pillar model, banking supervision has taken on the task of carrying out a review of the banks' *business models*.

This is carried out independently by the competent authority without duping the management.

Nevertheless, according to a multi-tier model, quantitative and qualitative aspects are used to assess the current situation, such as the strategic orientation of the banks, and are reflected in the form of a SREP[14] surcharge on the already high level of regulatory equity (CET 1).

Here, the regulator takes the approach of not wanting to directly restrict the banks' risk appetite, but indirectly by creating, among other things, accounting hurdles.

[14] SREP ECB Supervisory Review and Evaluation Process.

A serious disregard for these standards can lead to the withdrawal of the banking license. A minor disregard of these standards (e.g. Deutsche Bank's unauthorized trading in its own Tier 2 bonds) (Handelsblatt, 2019) may result in fines of minimum twice the income or savings.

B. International and national tax norms.

By accurately compiling the tax balance sheet as a tax base, legal design of tax matters, early participation in the legal process of forming will, the tax department is able to make a very high contribution to the value-added process of a company.

To this end, the tax department relies on a timely delivery of commercial data (principle of dimensional accuracy). In addition, it is increasingly involved in advising on the design of new products, the optimization of existing process chains and group design.

Failure to comply with national tax regulations can lead to considerable economic damage, reputational damage, and personal imprisonment of the actors (Panama Papers, Cum-Ex, Cum-Cum).

Sporting cross-border tax arrangements can sometimes lead to costly reporting obligations (country-by-country reporting) as a consequence. In terms of the international perspective, the dominant international influence of American tax legislation is cited as an example (FATCA[15]).

According to this, all credit institutions with respect to the USA as economic area or only American citizens are downgraded to vicarious agents of American financial authorities. For this reason, Swiss and Luxembourg credit institutions, among others, had to rethink their once highly performing *business models* in a sustainable way.

Since the commercial standards sometimes serve as the basis for drawing up the tax measurement (authoritative principle) as well as deferred tax assets and deferred tax liabilities, there is an extraordinarily strong link between points B and C.

C. National and international GAAP[16].

As regards the individual clearance, national trade-law standards are initially applicable (which are sometimes already adapted to EU legal requirements (BilMoG, BilRuG)).

In the case of control status (full consolidation requirement) and compliance with the conditions of EG Regulation 1606/2002 (headquarters in the EU, capital market orientation), the obligation to prepare the external Group reporting pursuant to IAS/IFRS arises.

[15] US Foreign Account Tax Compliance Act (2010).
[16] Generally Accepted Accounting Principles.

Failure to comply with these requirements would result in a limited attestation by the external auditor at a first step. In the worst case, a refusal by the auditor of the test.

In the second step, the financial authorities would intervene. Since both, the individual financial statements and the consolidated financial statements are used by the financial authorities to determine the tax measurement, there is a strong interdependence between points *B* and *C*.

At present, even an increasing dependence of items A and C can be observed, as the regulator intervenes in the corresponding commercial requirements under IFRS 9 about provisions for credit risk.

In addition, in future, banking supervision reserves the right to review a bank's legal capacity to pay a dividend in addition to the commercial requirements.

At this point, the possible regulatory reservations regarding variable remuneration are also mentioned (InstitutsVergV [InstitutsVergütungsVerordnung]). Here, it could lead to a collision with point G (Labor law), in the case of a claim back after already paid out variable remuneration.

D. Capital Market Regulation.

Triggered by the GFC (Global Financial Crisis) after 2006/2007, the European Parliament decided on September 22, 2010 to found ESMA (European Securities and Markets Authority). The supervisory authority is based in Paris.

The authority's task is to protect the public interest by contributing to the short, medium, and long-term stability and effectiveness of the financial system for the European Union's economy, its citizens and companies. It is authorized to submit proposals for regulations to the EU-Commission, or to act directly on national authorities and, in special cases, on individual market participants (see article 1 (5), first sentence, of the ESMA Regulation).

Among other things, ESMA is responsible for the approval of rating agencies. It also has sovereignty over which derivatives that have previously been traded via CCP (Central Counter Party) will have to be traded on exchanges in the future due to their inherent systemic risk.

Violations led to the first time that the actors of the EURIBOR scandal were sentenced to prison (Volkery, 2018).

This scandal has direct consequences for the banks involved due to the penalties (Treanor, 2015) and indirect consequences for the replacement of LIBOR and EURIBOR with new reference interest rates (Abrantes-Metz et al., 2012). The overriding requirement to trade clearance on the OTC market via CCP (Central Counterparties) or certain derivatives directly on exchanges has an impact on the balance sheet. These relate to the offsetting of receivables and liabilities in the banks' balance sheet and thus the creation of scope for new RWAs (Risk Weighted Assets).

Thus, besides the direct impact of capital market regulation for banks concerning its own funding or trading with assets and liabilities be it on own accounts for own name or on third-party account there is also a strong link between *C* and *D*.

E. Compliance.

In the narrower sense, the term compliance means compliance with law by the company and its employees. Compliance management means implementing a structure of internal rules and guidelines that are adhered to by the company's employees (Haufe, 2019).

To implement the corresponding legal requirements (KonTraG 05. March 1998), the TLoD (Three-lines-of-defence) model based on the IIA (British Chartered Institute of Internal Auditors) has been established (Minto et al., 2015).

Since then, the management has been solely responsible for risk control as the first line of defence. The second line of defence consists of internal risk control measures. Internal auditing is referred to as the third line of defence (Minto et al., 2015).

E. therefore has the task of coordinating, supervising and often executing the other points *A. - D.* and *F. – G.*. This has a negative impact on the CIR, since the departments created for this purpose are cost centres and thus no profit centres.

In addition, employees must be trained regularly on certain topics, for which purpose an own IT infrastructure must be created (e.g. anti-money laundering, fraud, bribery, IT security).

F. International Legal Norms.

In March 2015, Commerzbank was fined with $ 1.45 billion for improper use of American money laundering prevention laws. As a further consequence, the bank was forced by the New York State Department of Financial Services (DFS) to install a team of an American law firm as a monitor function. It has the task of supervising the implementation of compliance requirements and thus legal requirements (Kröner, 2019).

On April 30, 2019, the Department of Justice (DOJ) Criminal Division updated its guidelines for corporate compliance programs.

In addition to the actual penalties, which are often designed in such a way that the convicted companies are deprived of an entire annual income (or more), the monitors incur additional expenses. The convicted company itself must pay for the monitor.

G. Others.

Since it is not possible to claim that all legal norms that a bank must comply with have been called in this section, the nationally as well as supranational shaped labour law and sustainability requirements are representative of the missing norms.

A skilful implementation of labour law requirements, considering and promoting individual performance, supports the continued existence of the company. If the company cannot find ways to use the intrinsic motivation beyond the extrinsic, there will be a long-term lack of innovative strength (Frey et al., 2002).

Employees who can think innovatively and cross-linked and who also courageously break new ground will look for employers where they believe their skills are better off.

An unbalanced handling of labour law conditions can have an external impact on the company's reputation as an employer[17] and an internal one on employee satisfaction. The degree of satisfaction of the employees can be seen, albeit with caution, about fluctuation, the number of sick days and the number of labour court proceedings.

In this context, sustainability is to be understood primarily as the social change towards CO^2 neutrality (Davos 2020). This can have negative as well as positive implications for existing *business models*. Negative by no longer investing in industries that generate greenhouse gases through lending. Positive in terms of opportunities by investing in products that promote CO^2 neutrality (Green Bonds)[18] or deal with the consequences of climate change (CAT Catastrophe Bonds)[19].

What do these legal insights mean specifically for this dissertation?

The redesign of the *business models*, a possible international orientation as well as the commitment of the employees are to be considered along with many others in their complexity.

All in all, this is another indication of having to develop from well-known traditional *business models* (red ocean) to new *business models* in a new economic environment (blue

[17] (see kununu: evaluation platform for employers, Europe's Most Attractive Employers (EMAE))
[18] Climate bonds are fixed income financial instruments that are somehow linked to solutions to climate change.
[19] Assurance companies are funding their weather risks on the capital market.

ocean). The exciting question remains whether this process is slowly evolutionary, disruptive or inevitably quickly revolutionary.

If the old, traditional *business models* are adhered to, the regulatory costs will increase more and more. On the other hand, the opportunities to compensate for this with income are being increasingly curtailed.

Regulatory Costs.

This means the costs that the company incurs to meet the regulatory requirements in total. According to internal sources, about 40% of the project capacities were already occupied by regulators in 2015 (Hackethal et al., 2015). These costs represent a significant cut in corporate earnings and are rarely reported.

The legal components in Figure 15 on p.61 are arranged that way that clockwise the first ones generate the highest regulatory costs in implementation. The last components sometimes generate the lowest regulatory costs.

As a result, to purely economic considerations, commercial decisions should always be taken by having in mind fiscal, commercial, and regulatory aspects.

The knowledge gained in the previous subsections 2.1 and 2.2 can be summarized in a description of the value creation process of a *universal bank*. Understanding this fragile and sometimes cost-intensive process of a bank also opens the view for further studies.

Identification of the banks analysed in this dissertation.

The research object of this dissertation is European private law listed major banks as part of the universal banking sector. The specific nature of their current and future role as financial intermediaries is examined.

In this subsection the objects of investigation of this work are identified. As part of the identification process, the term *universal bank* is first clarified based on both regulatory and legal definitions. Then there is a reason for the selection of the European research objects.

Universal banks (credit institutions) are defined as companies undertaking the business to take deposits or other repayable funds from the public and to grant credits for its own accounts (CRR Article 4(1)).

Additional, *universal banks' business models* consist in combining standard deposit-taking and lending with more sophisticated investment banking activity often across national borders (Merck-Martel et al., 2012).

Universal banks were selected from the existing banking landscape because they offer more weak points to *fintechs* and *bigtechs* due to the traditional broad structure of their business model (retail, corporate and investment banking) than, for example, small highly specialized banks (wealth management, guarantee banks, ship banks) (Duran, 2019). The ownership structure forces these banks to respond more quickly to changes in order to remain profitable (stock listing as catalyst).

Before the conditions for the optimal selection of examination objects can be determined, the term *universal bank* must first be worked out precisely. This is necessary because, following the global financial crisis (GFC), at least eight partially different explanatory approaches have emerged for this term, as can be seen in Table 11 on page 70.

Some of the definitions come from supranational regulatory agencies, and some have been codified by national banking lawmakers. The individual definitions can be found in Table 11 on page 70 and are not listed further here.

The generic approach (Kahlke, 2014) is the best to make a structure recognizable in this variety of terms.

Today's definition of the term *universal bank* originated from two different temporal perspectives, driven by economically drastic events, both of historical magnitude.

After the Great Depression in 1929, the separation banking system was introduced in the United States (Glass-Steagall-Act 1932). In line with this legal requirement, the distinction between *universal bank* and *special bank* emerged in Europe from the point of view of the central banks (NCB National Central Bank). The Deutsche Bundesbank continued this distinction until 2013. (NCBs are a subset of NBAs).

Alerted by the global financial crisis (GFC) in 2008 (on the aftermath of the American subprime crisis), a multitude of regulatory activities were triggered internationally. The G20 Leaders at the Seoul Summit in 2010 endorsed the FSB (Financial Stability Board) policy framework for reducing the moral hazard of SIFIs (Systemically Important Financial Institutions).

SIFIs generally include worldwide all companies in the financial industry potentially causing *systemic risk*. However, the implicit abundance of globally active banks, insurance companies and other financial institutions could not be regulated all at once.

Therefore, the FSB (Financial Stability Board with a permanent seat at the BIS (Bank of International Settlement) in Basel) initially focused on the banks with potential *systemic risk*.

The FSB therefore presents the list of G-SIBs (Global Systemically Important Banks) annually in November. These banks, which, depending on the bucket, must hold an additional buffer of regulatory capital (TLAC buffer (Total Loss-Absorbing Capacity)).

G-SIBs represent a subset of the SIFIs. D-SIBs (Domestic Systemically Important Banks) form the opposite of the G-SIBs. These are defined by the NCAs (National Competent Authorities) in combination with the ECB (European Central Bank).

The ECB has sole supervisory authority over the G-SIBs in its area of responsibility. D-SIBs in Europe are supervised by joint teams (ECB and NCB National Central Banks).

European G-SIBs and D-SIBs are statistically recorded in the MFI list (list of Monetary Financial Institutions) published by the ECB (see Table 12 on page71).

Here the ECB makes the distinction between SI (Significant Institutions) and LSI (Less Significant Institutions) from the supervising perspective. The SI are supervised by the ECB either directly or in joint teams (onsite inspections). LSIs, however, are monitored by the NCA alone.

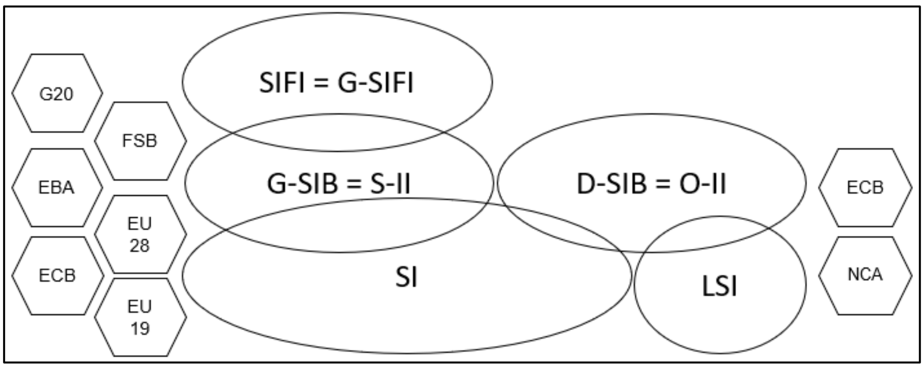
As part of this dissertation, the *universal banks* to be analysed are selected from the set of European SIs. The definitory content of the term *universal bank* is therefore definitely used as SI in the sense of the progress of this analyse.

As of 2nd January 2019, the ECB managed 119 European banks directly as SIs (see “List of Supervised Entities” not listed here due to its 96 pages printed in .pdf format).

The ECB reserves the right to raise an institute from the LSI status to the SI status at any time. The SI decision is made based on four criteria (cf. Table 11 on page 70) or if the bank is one of the three most important in a country of the European currency area (EU_19).

The impact of such a decision is not negligible for the institution concerned (Nikolaus, 2017).

Figure 16: European categorization of banks.



Source: Own elaboration.

Figure 16 shows that the categorizations at the level of the FSB (BIS) and the EBA are identical. G-SIB represent a subset of the G-SIFI. The main idea behind this structure is the international financial market stability. The ECB categorizes the banks in their area of responsibility (EU_19) according to the criteria mentioned with a view to direct versus indirect monitoring in SIs and LSIs. G-SIB and D-SIB can be SIs. G-SIB and D-SIB not located in the EU_19 area is supervised by the respective NCB.

Table 11: Regulatory and legal definitions of banks.

G20 => FSB/BIS	**G-SIFI**	
- Size - Interconnectedness - Lack of readily available substitutes - Cross-jurisdictional activity - Complexity	A systemically important financial institution (SIFI) is a bank, insurance or other financial institution that U.S. federal regulators determine would pose a serious risk to the economy if it were to collapse. A SIFI is viewed as "too big to fail" and imposed with extra regulatory burdens to prevent them from going under. However, a SIFI label brings more scrutiny and extra regulations.	
FSB/BIS	**G-SIB**	**D-SIB**
- Size - Interconnectedness - Lack of readily available substitutes - Cross-jurisdictional activity - Complexity	global systemically important bank is bank whose systemic risk profile is deemed to be of such importance that the bank's failure would trigger a wider financial crisis and threaten the global economy. The Basel Committee has developed a formula for determining which banks are G-Sibs, deploying criteria including size, interconnectedness and complexity. National regulators subject banks determined to be G-Sibs to stricter prudential regulation such as higher capital requirements and extra surcharges, or more stringent stress tests.	The D-SIB framework is focused on the impact a bank may have on the domestic economy if it fails (rather than the risk of failure), and therefore not only covers consolidated groups, but also subsidiaries. This followed the work that had already been done on the policy measures designed for global systemically important banks ("G-SIBs"), to enhance their loss absorbency capacity over and above Basel III requirements. Jurisdictions may also classify a branch as a D-SIB. It is designed to provide a complementary perspective to the G-SIB framework, focusing on the impact that the distress of banks (including international banks) may have on a jurisdiction's domestic economy.
EBA	**G-SII**	**O-SII**
- Size - Interconnectedness - Lack of readily available substitutes - Cross-jurisdictional activity - Complexity	The list of banks included in these annual sections follows the EBA Guidelines on disclosure of indicators of global systemic importance. These EBA Guidelines not only increase the transparency in the G-SIIs identification process but also achieve a level playing field in terms of disclosure requirements between global systemically important institutions (G-SIIs) and other large institutions with an overall exposure measure of more than EUR 200 billion at the end of each year. Institutions that are close to but below the given measure may occasionally participate. Consequently, all EU institutions, which are potentially systemically relevant, will be subject to the same disclosure requirement as the G-SIIs. In turn, the mentioned EBA Guidelines follow closely the Basel Committee recommendations and efforts to identify G-SIB and provides data which contribute to assess EU banks' systemic riskiness.	O-SIIs are institutions that, due to their systemic importance, are more likely to create risks to financial stability. Whilst maximizing private benefits through rational decisions, these institutions may bring negative externalities into the system and contribute to market distortions.
ECB	**SI**	**LSI**
- Size - Interconnectedness - Lack of readily available substitutes - Cross-jurisdictional activity - Complexity	Significant institutions (SIs) are Euro area banks fulfilling the significance criteria specified in the SSM regulation. Significance criteria are: Size => the total value of its assets exceeds 130 billion Economic importance => for the specific country or the EU economy as a whole Cross-border activities => the total value of its assets exceeds 15 billion and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above 20% Direct public financial assistance => it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility	Less significant institutions (LSIs) are euro area banks that do not fulfil any of the significance criteria specified in the SSM Regulation – in contrast to significant institutions (SIs) that do fulfil at least one of them. The significance criteria relate to, among other things, a bank's size, its importance to the economy of a specific euro area country or the EU as a whole, and the significance of its cross-border activities. In practice, the bulk of LSIs are smaller euro area banks whose assets do not exceed 130 billion.
CRR	credit institutions CRR Art 4 (1)	financial institutions CRR Art 4 (26)
	'credit institution' means an undertaking the business of which is to take deposits or other repayable funds from the public and to grant credits for its own account;	'financial institution' means an undertaking other than an institution, the principal activity of which is to acquire holdings or to pursue one or more of the activities listed in points 2 to 12 and point 15 of Annex I to Directive 2013/36/EU, including a financial holding company, a mixed financial holding company, a payment institution within the meaning of Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market (1), and an asset management company, but excluding insurance holding companies and mixed-activity insurance holding companies as defined in point (g) of Article 212(1) of Directive 2009/138/E;
KWG	Kreditinstitut §1(1) KWG Begriffsbestimmungen	Finanzdientleistungsinstitut §1(1a) KWG Begriffsbestimmungen
	Kreditinstitute sind Unternehmen, die Bankgeschäfte gewerbsmäßig oder in einem Umfang betreiben, der einen in kaufmännischer Weise eingerichteten Geschäftsbetrieb erfordert.	Finanzdienstleistungsinstitute sind Unternehmen, die Finanzdienstleistungen für andere gewerbsmäßig oder in einem Umfang erbringen, der einen in kaufmännischer Weise eingerichteten Geschäftsbetrieb erfordert, und die keine Kreditinstitute sind.
NCA Bundesbank, BDE	MFI Monetary Financial Institution	Non-MFI
	Financial institutions which together form the money-issuing sector of the euro area. These include the Eurosystem, resident credit institutions (as defined in EU law) and all other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their own account (at least in economic terms), to grant credit and/or invest in securities. The latter group consists predominantly of money market funds.	Institutions acting like MFI without being listed as MFI or households.
NCA Bundesbank until 2013	Universal bank	Special bank (separate banking system)
	Universal banks (also called full banks) are credit institutions that conduct all banking business and offer this to all customer groups.	Special bank is a bank in banking that only offers specific banking transactions and / or works with certain customer groups.

Source: Own elaboration based on original definitions.

Table 12: ECB list of MFI (Monetary Financial Institutions) as of September 2019.

CRR Art.4(27)	Insurance companies		**Banks**		**Financial institutions**	
aof 19th November 2019			**Universal banks**		**Special banks**	
EU countries	**Eurozone**		**National Central Bank**	**Credit institutions**	**MMF Money Market Funds**	**Other deposit taking corporation**
Austria	Austria	AT	1	540		2
Belgium	Belgium	BE	1	84	7	6
Bulgaria		BG	1	26		
Croatia		HR	1	25	1	
Cyprus	Cyprus	CY	1	29		14
Czech Republic		CZ	1	58		
Denmark		DK	1	98	2	2
Estonia	Estonia	EE	1	41		
Finland	Finland	FI	1	247	2	
France	France	FR	1	405	134	118
Germany	Germany	DE	1	1.555	11	4
Greece	Greece	GR	1	34	9	2
Hungary		HU	1	59	9	
Ireland	Ireland	IE	1	320	118	8
Italy	Italy	IT	1	493	3	7
Latvia	Latvia	LV	1	55		1
Lithuania	Lithuania	LT	1	82		
Luxembourg	Luxembourg	LU	1	130	149	9
Malta	Malta	MT	1	24	1	
Netherlands	Netherlands	NL	1	94	13	4
Poland		PL	1	632		
Portugal	Portugal	PT	1	150	3	
Romania		RO	1	74		2
Slovakia	Slovakia	SK	1	27		
Slovenia	Slovenia	SI	1	17	3	
Spain	Spain	ES	1	198	2	49
Sweden		SE	1	158	1	5
Swiss		CH	1	234		14
United Kingdom		GB	1	398	43	9

Source: Own elaboration based on ECB Monetary Financial Institutions as of March 2019 (ECB, 2019).

The *universal banks* selected for the purpose of analysis for this work are listed European SIs. Eight credit institutions were selected from the EU_28 area. However, the ECB's mandate for monitoring extends "only" to the EU_19 area. Banks of the EU_28 states that do not belong to the European currency area (EU_28 ≠ EU_19) are categorized by the NCA in accordance with the criteria of the EBA (S-II and O-II).

In these cases, the ECB is also available to provide advice. In the above overview of MFIs, these are to be assigned to the grey-coloured credit institutions (see Table 12 on p.71).

The reason for the decision to analyse listed credit institutions lies in the uniform reporting obligation. This ensured that the institutes uniformly prepare their group reporting in accordance with IAS / IFRS. This is also the reason why the involvement of, for example, American listed institutions (Bank of America; Wells Fargo) has been waived. The intensive reconciliation of the reports in accordance with US GAAP to IAS / IFRS reading was thus avoided.

Condition of the objects to be analysed.

The aim of a research project should be to gain robust insights that can be transferred from the actual research issue to further questions (Baker, 2000). To put light on the issue, research objects must be identified following an appropriate research methodology. To ensure the selection of a representative and largely homogenous population (Kothari et al., 2014; Smith, 2020) of research objects, they had to fulfil 5 conditions:

- condition 1 (geography): headquarters in an EEA member state,
- condition 2 (regulatory importance): must be a G-SIB or D-SIB => SI,
- condition 3 (ownership structure): listed on a stock exchange,
- condition 4 (language of financial reports): IAS/IFRS
- condition 5 (availability of data): availability of historical time series.

Conditions 1 and 4 are supporting a uniform economic and legal understanding of the research objects.

Condition 2 points out the importance of the banks from the regulatory point of view.

The share-based ownership structure (condition 3) involves the banks' pressure towards the shareholder for quick adaptions to the environment to remain profitable.

Conditions 3 and 4 are mutually dependent. The listing on the European market requires external reporting according to IAS / IFRS foreseen by the exchange operators. This is based on the postulate of having to present fair value based (IFRS 13) decision-relevant information to current and future investors (IAS / IFRS framework).

A simple and gap free data availability is a "*conditio sine qua non*" for further quantitative analysis (condition 5).

To meet these conditions placed on the objects to be examined, European listed *universal banks* are selected. The selection of the objects to be examined is reflected below.

G-SIBs as first approach to select universal banks.

The first thought to identify the objects of investigation was to select international G-SIBs according to the criteria of the FSB (Financial Stability Board) (cf. Annex I on page xliii).

The list of published G-SIBs already shows a conclusion on the heterogeneity of the potential objects under investigation. Internationally seating and operating companies are not obliged to report externally according to IFRS. They also use different reporting currencies.

As of the reporting date, these can be converted into EUR and are therefore not a further challenge for preparing the data.

However, for an external reader, it is much more difficult to create reconciliation calculations, for example between US GAAP and IAS / IFRS, without internal knowledge. For this reason, the idea of only selecting G-SIBs for the investigation was rejected.

Universal banks are therefore at the centre of the impact analysis. They offer *fintechs* and *bigtechs* an exceptionally large target area due to the highly exposed structure of their *business models*. Strongly focused *special banks* are only of minor importance in these considerations.

The European banking regulation incorporated these thoughts regarding the *special banks* as well as the national forms of the *universal banks*. The bank regulation intents to take account of the principle of proportionality (Zilioli, 2016) as well as the separation of the supervisory authorities into SI (ECB) and LSI (NCB) supervision.

Listing on a stock exchange.

This condition for the objects to be examined is borrowed from the third pillar of the model of European banking supervision according to Basle II (Neyer et al., 2014). The third pillar represents the regulatory power of the capital market.

The information needs of the capital market must be met by an additional, regulatory-based reporting obligation, the so-called *Pillar III. Report*.

The capital market should intervene in a regulatory manner due to the possible difference between expected and received information through increased or reallocated investments in the shares of the companies concerned. This would have an immediate impact on the price-to-book ratio.

Regional aspect and object mix between G-SIBs and D-SIBs.

The selection of objects was firstly limited to the (EU_19) countries of the European currency area under remit of the ECB. The idea was to ideally identify two listed *universal banks* from each country.

To counteract the risk of excessive homogeneity of the objects under investigation, banks from EU countries but the non-EUR zone, were added to contrast.

Therefore, the geographical area was extended to the EEA countries (EU_28) in such a way that Great Britain, Denmark, Sweden, Switzerland, and Czech Republic were included on a discretionary basis.

Great Britain offers expanded regulatory frameworks even before Brexit than in the rest of the EU (see regulatory sandboxes) (Dostov et al., 2017).

The same applies to *Switzerland*, which has offered its banks up to FATCA[20] a competitive advantage thanks to Swiss banking secrecy (Christians, 2013).

Denmark and Sweden are countries that are dominant in digitalization according to the EU Digital Economy and Society Index (DESI) (EU Commission, 2020).

A country was mixed with the Czech Republic, which on the one hand has extraordinarily strong ties to the countries of the European Monetary Area and on the other hand has preserved its own currency. A bank was included in the investigation (Komerční banka), which has been part of the French Société Générale Group since 2001. However, the brand was considered to the extent that it continued to exist alongside the logo of the French group. The expectation was that research objects from these two EU_28 countries would be able to contrast the remaining objects of the EU_19 countries.

Based on these geographical considerations, it became apparent that the systemic importance of the banks had to be expanded from G-SIBs to D-SIBs.

List of SIs and LSIs by the ECB as source of the objects' choice.

The following final selection was made according to the ECB's parameters for classifying a bank as SI or LSI[21]. This approach was also retained for the selected banks in Switzerland and Great Britain. Double assignments of cross-border institutes had to be avoided.

[20] (US Foreign Account Tax Compliance Act).

[21] Full list of supervised entities (cut-off date for changes: 1 January 2020),

Table 13: Selection of investigation objects.

Country code	Country	EU region	Financial institution	G-SIB or D-SIB	SI or LSI or NCA	Grounds for significance aof ECB cut-off date 01.01.2020	ECB type of bank	International Securities Identification Number	RIC	Bloomberg Code	IFRS	CCY	Object Count
AT	Austria	EU_19	Erste Group Bank	D-SIB	SI	Size (total assets EUR 150-300 bn)	Credit Institution	AT0000652011	ERST.VI	EBS AV	✓	EUR	1
AT	Austria	EU_19	Raiffeisenbank International	D-SIB	SI	Size (total assets EUR 100-150 bn)	Credit Institution	AT0000606306	RBIV.VI	RBI AV	✓	EUR	1
BE	Belgium	EU_19	Belfius Banque SA	D-SIB	SI	Size (total assets EUR 100-150 bn)	Credit Institution	BE0002483585	BE0002483585	DEXB BB	✓	EUR	0
BE	Belgium	EU_19	KBC Groep NV	D-SIB	SI	Size (total assets EUR 150-300 bn)	Mixed Financial Holding	BE0003565737	KBC.BR	KBC BB	✓	EUR	1
CY	Cyprus	EU_19	Bank of Cyprus Plc	D-SIB	SI	Total assets above 20% of GDP	Financial Holding	IE00BD5B1Y92	BOCH.CY	BOCH LN	✓	EUR	1
CY	Cyprus	EU_19	Hellenic Bank Plc	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	CY0000300117	HBNK.CY	HB PZ	✓	EUR	1
CZ	Czech Republic	EU_28	Komercni Banka as	D-SIB	SI	Member of the Société Générale Group since 2001	n/a	CZ0008019106	BKOM.PR	KOMB CP	✓	CZK	1
DE	Germany	EU_19	Commerzbank	D-SIB	SI	Size (total assets EUR 300-500 bn)	Credit Institution	DE000CBK1001	CBKG.DE	CBK GR	✓	EUR	1
DE	Germany	EU_19	Deutsche Bank	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	DE0005140008	DBKGN.DE	DBK GR	✓	EUR	1
DK	Denmark	EU_28	Danske Bank Plc	D-SIB	NCA	by Ministery of Business and Growth Denmark	n/a	DK0010274414	DANSKE.CO	DANSKE DC	✓	DKK	1
EE	Estonia	EU_19	AS SEB Pank	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	SEB is main shareholder (2002 squeeze out of remaining shareholders)			✓	EUR	0
EE	Estonia	EU_19	Luminor Holding AS	D-SIB	SI	Total assets above 20% of GDP	Financial Holding	in 2019 by Nordea and DNB sold Luminor to Blackrock (Private Equity Fund)			✓	EUR	0
EL	Greece	EU_19	Alpha Bank	D-SIB	SI	Size (total assets EUR 50-75 bn)	Credit Institution	GRS015003007	ACBR.AT	ALPHA GA	✓	EUR	1
EL	Greece	EU_19	National Bank of Greece	D-SIB	SI	Size (total assets EUR 50-75 bn)	Credit Institution	GRS003003027	NBGR.AT	ETE GA	✓	EUR	1
ES	Spain	EU_19	Banco Santander, S.A.	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	ES0113900J37	SAN.MC	SAN SM	✓	EUR	1
ES	Spain	EU_19	Banco Bilbao Vizcaya Argentaria, S.A.	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	ES0113211835	BBVA.MC	BBVA SM	✓	EUR	1
FI	Finnland	EU_19	Nordea Bank Finland Plc	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	SE0000427361	NDA.ST	NDA SS	✓	EUR	1
FI	Finnland	EU_19	OP Osuuskunta	D-SIB	SI	Size (total assets EUR 100-150 bn)	Credit Institution	Customer owned cooperative bank			✓	EUR	0
FR	France	EU_19	BNP Paribas	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	FR0000131104	BNPP.PA	BNP FP	✓	EUR	1
FR	France	EU_19	Société Générale	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	FR0000130809	SOGN.PA	GLE FP	✓	EUR	1
IE	Ireland	EU_19	Allied Irish Banks plc	D-SIB	SI	Size (total assets EUR 75-100 bn)	Financial Holding	IE00BYSZ9G33	AIBG.I	ALBK ID	✓	EUR	1
IE	Ireland	EU_19	Bank of Ireland Group plc	D-SIB	SI	Size (total assets EUR 100-150 bn)	Financial Holding	IE0030606259	BIRG.I	BKIR ID	✓	EUR	1
IT	Italy	EU_19	Gruppo Intesa-Sanpaolo	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	IT0000072618	ISP.MI	ISP IM	✓	EUR	1
IT	Italy	EU_19	UniCredit S.p.A.	G-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	IT0005239360	CRDI.MI	UCG IM	✓	EUR	1
LT	Lithuania	EU_19	Akcinė bendrovė Šiaulių bankas	D-SIB	SI	Among the three largest credit institutions in the Member State	Credit Institution	Securitization			✓	EUR	0
LT	Lithuania	EU_19	AB SEB bankas	D-SIB	SI	Among the three largest credit institutions in the Member State	Credit Institution	SE0000148884	SEBa.ST	SEBA SS	✓	EUR	0
LU	Luxembourg	EU_19	Banque et Caisse d'Epargne de l'Etat, Luxembourg	D-SIB	SI	Size (total assets EUR 30-50 bn)	Credit Institution	Savings bank			✓	EUR	0
LU	Luxembourg	EU_19	Banque Internationale à Luxembourg S.A.	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	Private Equity			✓	EUR	0
LV	Latvia	EU_19	Akciju sabiedrība "Citadele banka"	D-SIB	LSI	NCB (National Central Bank)	Credit Institution	CBLBR.RI	CBLBR.RI	#N/A Invalid Security	✓	EUR	0
LV	Latvia	EU_19	AS PNB banka	D-SIB	SI	Article 6(5)(b) of Regulation (EU) No 1024/2013	Credit Institution	NO0010031479	DNB.OL	DNB NO	✓	NOK	1
MT	Malta	EU_19	Bank of Valletta Group (BOV)	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	MT0000021338	BOV.MT	#N/A Field Not Applicable	✓	EUR	0
MT	Malta	EU_19	HSBC Bank Malta plc (HSBC)	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	923893	HSBA.L	#N/A Invalid Security	✓	EUR	0
NL	Netherlands	EU_19	ABN AMRO Bank N.V.	D-SIB	SI	Size (total assets EUR 300-500 bn)	Credit Institution	NL0011540547	ABND.AS	ABN NA	✓	EUR	1
NL	Netherlands	EU_19	ING-Bank	G-SIB	SI	Size (total assets EUR 500-1,000 bn)	Mixed Financial Holding	NL0011821202	INGA.AS	INGA NA	✓	EUR	1
PT	Portugal	EU_19	Banco Comercial Português	D-SIB	SI	Size (total assets EUR 75-100 bn)	Credit Institution	PTBCP0AM0007	BCP.LS	BCPL LN	✓	EUR	1
PT	Portugal	EU_19	Caixa Geral de Depósitos	D-SIB	SI	Size (total assets EUR 75-100 bn)	Credit Institution	XS0230957424	0	#N/A Field Not Applicable	✓	EUR	0
SE	Sweden	EU_28	AS SEB Bank	D-SIB	NCB	EBA systemic risk buffer 0-SII	n/a	SE0000148884	SEBA.ST	SEBA SS	✓	SEK	1
SE	Sweden	EU_28	Swedbank AS	D-SIB	NCB	EBA systemic risk buffer 0-SII	n/a	SE0000242455	SWEDA.ST	SWEDA SS	✓	SEK	1
SI	Slovenia	EU_19	NLB (Nova Ljubljanska banka)	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	not oficially quoted	IPO-NOVA.LJ	#N/A Invalid Security	✓	EUR	0
SI	Slovenia	EU_19	Biser Topco S.à.r.l.	D-SIB	SI	Among the three largest credit institutions in the Member State	Financial Holding	Unlisted corporation headquartered in Luxembourg			✓	EUR	0
SK	Slovakia	EU_19	Tatra banka, a.s.	D-SIB	SI	Among the three largest credit institutions in the Member State	Credit Institution	0	0	#N/A Invalid Security	✓	EUR	0
SK	Slovakia	EU_19	Všeobecná úverová banka a.s.	D-SIB	SI	Among the three largest credit institutions in the Member State	Credit Institution	SK1110001437	1VUB02AE.BV	VUB SK	✓	EUR	1
UK	England	EU_28	Barclays	G-SIB	G-SIB	Bucket (1,5%)	n/a	GB0031348658	BARC.L	BARC LN	✓	GBP	1
UK	England	EU_28	HSBC	G-SIB	G-SIB	Bucket (2,0%)	n/a	GB0005405286	HSBA.L	HSBA LN	✓	USD	1
CH	Swiss	EU_28	UBS Group AG	G-SIB	G-SIB	Bucket (1,0%)	n/a	CH0244767585	UBSG.S	UBSG SW	✓	CHF	1
CH	Swiss	EU_28	Credit Swiss Group AG	G-SIB	G-SIB	Bucket (1,0%)	n/a	CH0012138530	CSGN.S	CSGN SW	✓	CHF	1
								Total sample					31

Source: Own elaboration based on Bloomberg, Refinitiv and ECB.

Table 13 on page 75 contains, from left to right, the objects of study selected for further analysis in this dissertation.

The banks are initially assigned to the EU_19 and EU_28 states on the left. The categorization criteria of the ECB for classification as SI are mentioned (ECB grounds for significance), as well as the criteria of the other NCAs.

In preparation for further research, the banks were examined for their stock exchange listing (ISIN), their external reporting in accordance with IAS / IFRS (IFRS)) and their reporting currency (CCY). A lack of issued shares or their availability on an active market (IFRS 13 A) led to the rejection of twelve research objects.

In this way, the selection fell to 31 from the original 43 banks. The column (Object count) on the far right contains the information 0 (rejected) or 1 (not rejected).

2.3 Implicit significance of segment reporting.

To identify the vulnerability of banks' *business models* to *fintechs* and *bigtechs*, it is necessary to identify an externally accessible medium. This publicly accessible medium should ideally reflect the *business model* of the respective bank. Only an understanding of the value chain of a *universal bank* in combination with an understanding of the respective characteristics of the *business models* enables a complete picture of such a company.

Segment reporting in accordance with IFRS 8 lends itself to this. It is compulsory and subject to the same auditing duties of the external auditor as the qualitative and quantitative information in the rest of the annual report.

In preparation for the further investigation, it is the task of this chapter to present the external segment reporting. The procedure of the SSM SREP is also presented to evaluate the value of these insights. The implicit objective of this subchapter is to approach the term *business model* in the following steps:

- General business explanation of the term *business model*.

- Explanation of segment reporting in accordance with IFRS 8.

- Explanation of the SREP's Business Model Assessment (SSM).

- Tabular overview of the banks' standardized segments including SREP factor.

The subsection ends with an overview of the segments of the banks examined (as of 2010 and 2018). These segments are then merged into a standard picture of all banks.

To verify the insights gained, the SREP factor is added to each research object. This is an additional requirement for regulatory capital based on past assessments by the SRB. The factor does not have to be published, but it expresses the supervisory authorities' view of the business model (from stable to risky).

These considerations are important in preparation for the quantitative analysis of Chapter 5. For this purpose, segment-specific parameters are sometimes selected as the addressees.

Basis structure of the business model.

A business model is defined as an abstract representation of some aspect of a firm's strategy (Porter, 1996). *Business models* can thus be understood as an abstraction of the strategies of individual companies to generate income (Seddon et al., 2004). This can be done in a highly competitive environment or, due to innovative *business models*, initially (for a limited time) in a low-competitive environment (Kim et al., 2015).

The mere existence of a business model without an adequate strategy, however, only "helps" the company to generate short-term profits. The focus should be on sustainable added value (sustainable: to be understood here in the sense of "stable") (Porter, 1996).

As part of the second pillar of the European banking supervision model, the SRB (Single Resolution Board) in Brussels has started to assess even these qualitative aspects of a bank.

Segment Reporting according to IFRS 8.

According to IFRS 8.2-3, only companies whose securities are publicly traded are subject to the obligation for the external group segment reporting. The reporting obligation also arises if the company prepares to trade its securities on the stock exchange.

In this context, securities mean both equity and debt securities. Active markets in the sense of any domestic or foreign stock exchange and over the counter, including local and regional markets, are considered to be public markets.

This means that all objects under investigation are required to report the segments in accordance with IFRS 8. Usually, the segment report can be found in the notes to the consolidated annual reports.

The intention of the IASC (International Accounting Standards Committee (today's IASB (International Accounting Standards Board))) to provide current and future investors with decision-useful information (IFRS Framework) such way that the *management approach* was based on (Botosan et al., 2000; Aleksanyan et al., 2015).

Segment reporting must inevitably be based on a company's internal reporting system. A complete changeover of the internal data for external accounting alone is neither practical nor in the interest of the addressees interested in internal performance indicators (Lüdenbach et al., 2019).

IFRS 8 (5-10) already requires orientation to internal reporting for the segment definition. This is also required for the derivation of quantitative segment data. The business segments (operating segments) are to be presented in accordance with the segmentation for internal company decisions. The internal management of the companies thus forms the basis for segment reporting. The external segment report is this way fed directly by data from the internal reporting system as reported for the CODM (Chief Operating Decision Maker) (Lüdenbach et al., 2019).

With this systematic approach, the standards' provider hoped for three advantages over the old standard according to IAS 14 (risk and reward approach) (Lüdenbach et al., 2019):

- Information of the final addressees through the eyes of the management.

- No additional reporting effort.

- Less subjectivity when designing the reporting units.

Based on these theoretical considerations, it is obvious that by concentrating on the internal management perspective, part of the *business model* is also made accessible externally (Leisenring et al., 2012).

A positive correlation between the frequency of segment reporting (quarterly versus yearly) and stock market value can be seen from early studies (Botosan et al., 2000).

Another way to gain a cautious insight into the true structure of a company would be to evaluate the CGUs (Cash Generating Units). The so-called smallest cash-generating units do not have to be congruent with the segment reporting. Commerzbank AG has a match here.

In such a case, however, there is no added value in terms of structural understanding. A CGU structure must be reported in accordance with IFRS 3 (in combination with IAS 36) if goodwill has arisen due to company acquisitions (Lüdenbach et al., 2019).

SRB's SREP Business Model Assessment.

This digression into current regulatory events is important for the progress of this work. However, the risk appetite of the individual institutes is an important building block for an overall understanding of the banks' economic situation.

At the end of the analysis, an assessment of the risk orientation of the institutes validated by the regulator should be derivable. A further component of the status quo is thus determined, on the way to comprehensively assessing the impact of digitization.

After the Global Financial Crisis (GFC in 2008), a European single supervisory mechanism of the Significant and Less Significant Institutions (SIs and LSIs) (SSM Single Supervisory Mechanism) was created. This has expanded the second pillar of the *three-pillar model* of European banking supervision.

On 7th July 2014, the EBA issued the SREP guidelines ("Guidelines for common procedures and methodologies for the supervisory review and evaluation process") for the specific structure of the review and evaluation of the institutes (BCBS128, 2006). These were implemented step by step by the ECB (for SI), the respective NCB (for LSI) or NCA (for O-SII). The first results of the assessments are now available.

The guidelines were applied and gradually implemented from 01/01/2016. The aim is to ensure the security and soundness of the European banking system.

At this point, all components of the sound risk assessment for SI are not presented in detail (SREP Methodology Booklet 2018 (ECB, 2018b)). The elements of the qualitative and quantitative assessment of the *business models* of the institutes that are important here are selected.

In fact, the SRB takes on a not uncritical role with the ECB by assessing the strategic orientation and *business models*. The supervisory bodies cannot assume the role of management. Nevertheless, their view is incorporated into an additional capital requirement, the so called (SREP buffer).

The result of the assessment of the *business model*, the governance and ICS (Internal Control System), the capital risks and the liquidity risks is a 4-level score:

1 = no recognizable risks to 4 = high risk.

The overall SREP assessment of the institute is then carried out based on the findings from the partial assessments.

This in particular with regard to the risks of the institute, its ability to manage the weaknesses with the help of the governance and control systems, or to avoid them using the *business model* and the strategy own funds and liquidity reserves adequately cover the risks and the positive and negative interaction of these sub-elements.

The ECB publishes SREP Results annually. However, this only at a highly aggregated level and not published per individual institution (ECB SSM, 2020). The challenge will be to assign results to individual institutes from an external perspective.

According to the SSM SREP Methodology Booklet (2018 edition – to be applied in 2019) the SSM (Single Supervisory Mechanism) of the ECB, annually carries out mandatory risk assessment of the 117 SIs in the European currency area (EU_19).

To ensure one level playing field on banking supervision in Europe, the annual risk assessment is based on a common methodology and introduces the condensed information to a common decision-making process.

This risk assessment is the first holistic approach combining quantitative and qualitative elements. It takes account of institution-specific particularities (keyword: proportionality).

According to the result of the risk assessment, the first outcome is additional legally binding capital requirements (P2R (Pillar 2 Requirement => as part of the TSCR (Total SREP Capital Requirements)). In future, P2R will be subject to 100% minimum requirements with CET1 (Core Equity Tier 1) in addition to the P1R (Pillar 1 Requirement).

The second result of the assessment is an additional P2G (Pillar 2 Guidance), which is a legally non-binding recommendation for additional capital adequacy. It is to be assumed that P2G will gradually move into P2R over the coming years, especially if an institution refuses serving P2G.

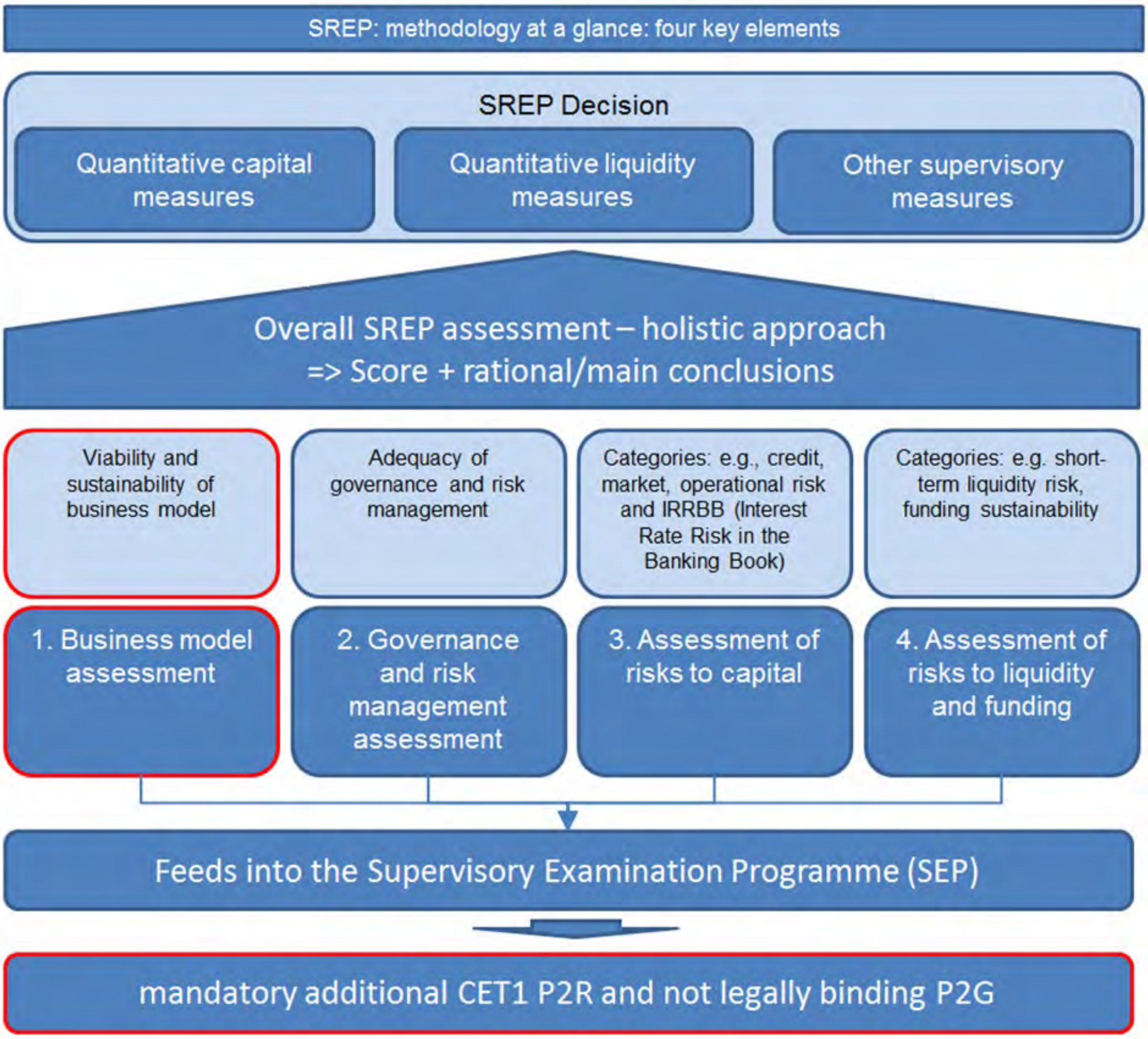
The additional P2R and P2G capital requirements represent a percentage relative to the Risk Weighted Assets (RWA). They are derived from a three-dimensional scoring model.

On its x-axis, the risk category scores of the 4 key elements shown in Figure 17 on page 82 are recorded. On the y-axis, various risk aspects and exogenous elements on the z-axis are removed, such as a peer analysis to institutes of EEA states (EU_28).

In the spirit of European banking supervisions' third pillar, the capital market is being involved as a corrective. On 30 January 2020, the ECB published the results of the SREP assessment on its homepage in accordance with the institutes.

In addition, apart from 2019 the institutes are recommended to publish the P2R SREP buffer in their annual report. This is the only publicly available information that constitutes a valid indicator of the risk appetite of the banks' respective *business model*.

Figure 17: SREP Methodology.



Source: Own elaboration based on ECB's SREP Methodology Booklet 2018 (ECB, 2018b).

However, the nuances of the *business models* themselves that may be relevant to the progress of this analysis are not published on an institution-specific basis.

The following nuances were detected on an aggregated level by the SREP assessments:

- G-SII

- custodian bank (depository bank)- diversified lender

- retail lender

- small *universal bank*

- specialized lender

- *universal bank*.

It is remarkable that the distinctions between the *business models* so far only refer to nuances on the assets side. They could also be supplemented by the amount of funding on the liabilities side.

The terms in themselves already allow some conclusions to be drawn about the possible risk exposure. For example, a custodian bank traditionally operates more risk-averse commission business (Depot B).

However, this business is distributed among a few players worldwide (e.g. State Street Europe Holdings Germany S.a.r.l. & Co. Kg or The Bank of New York First Mellon). A retail lender is rather heavily dependent on the interest-reduced margin business.

The SSM SREP assessment is achieved by

A) a qualitative identification of the Bank's main activities.

B) an analysis of exogenous factors.

C) an analysis of the strategy and liquidity plans to be presented.

D) an analysis of the *business model*.

E) an analysis of the bank's main vulnerability.

The analysis of the *business model* D) is divided into the following aspects:

- viability (within one year)
- sustainability (within three years)
- sustainability over the cycle (more than three years).

At this very point, the relationship between the external segment reporting according to IFRS 8 (subchapter 2.2) and the SSM SREP understanding of a *business model* (subchapter 2.3) is obvious.

Banking supervision is based on data from IAS/IFRS reporting because of the underlying fair value principle (BCBS, 2005). Other supervisory data sources include, in addition to external reporting, internal reporting, regulatory reporting, audit reporting, and recovery and resolution plans (BCBS, 2019).

Thus, the assumption is supported at this point that from the point of view of an external observer (role of this analysis) segment reporting according to IFRS 8 evaluated by the SSM SREP buffer is the best way to gain an insight into the *business model* of the respective bank.

As already shown in section 2.2, the management approach of the reporting segment is the common denominator for the SSM SREP risk assessment.

Taking this observation into account, the annual reports of the banks to be examined in 2010 and 2018 were evaluated on their segment data. This should reflect the change in the total period of the investigation period of the work. Intermediate possible iterations were ignored.

The comparison resulted in a general segment structure that is applicable to all companies in terms of understanding. Thematically related disclosure information about the segments is displayed in the same colour. The segments/*business models* thus only consist of the main pillars of private customers, corporate clients, investment banking (although not in unison) and others.

In many cases, Miscellaneous contains the processing of the toxic financial instruments from the zenith of investment banking prior to the Global Financial Crisis (GFC 2008) (so-called Non-Core Assets). The SSM SREP Buffer 2020 column (published by the ECB on 30.01.2020) is virtually the validation of the view regarding risk indication.

As a result, there is no automatic analogue correlation between the statement made by the bank itself that it is still (possibly risky) investing and the SSM SREP Buffer 2020.

For example, Banco Santander as G-SII (G-SIB) has "only" received a legally binding SSM SREP buffer of 1.50% CET 1 to RWA. Greek banks, on the other hand, have received a high SSM SREP buffer of 3.00%.

The creation of the SREP Buffer 2020 column is an attempt to intuitively identify the risk orientation of the respective *business model*.

In the last column, a separate discretionary allocation of the *business models* identified by the SREP to the banks analysed was made. Black font highlights here security of the assignment, while grey font highlights uncertainty.

Presentations of the banks' standardized segments and SSM SREP buffer.

The following tabular overviews show the relationship between the segments as an expression of the respective *business model* and its (rudimentary) published verification by the SSM (SREP buffer). As of 31st December 2018, 13 banks were still operating the riskier investment banking business.

Of these, however, only 4 banks were allocated high SSM SREP buffers (marked in red). As a result, no direct correlation between the external presentation of the banks' *business model* and the assessment of risk affinity from a regulatory perspective could be established.

Table 14: Banks' segments and SREP buffer (1).

Country code	Country	EU region	Financial institution	G-SIB or D-SIB	SI or LSI or NCA	Grounds for significance aof ECB cut-off date 01.01.2020	ECB type of bank	Segments 2010	Segments 2018	Segments Standard: Private Client	Segments Standard: Corporate Clients	Segments Standard: Investment Banking	Segments Standard: Others	SREP BUFFER 2020	Assumed SREP BMA result	IFRS	CCY	Object Count
AT	Austria	EU_19	Erste Group Bank	D-SIB	SI	Size (total assets EUR 150-300 bn)	Credit Institution	Retail + SME, group coporate + investment banking, group markets corporate center, others	Retail, corporate, group markets (sales + trading), asset management, saving banks, others	X	X	X	X	1,75%	Universal Bank	√	EUR	1
AT	Austria	EU_19	Raiffeisenbank International	D-SIB	SI	Size (total assets EUR 100-150 bn)	Credit Institution	Central Europe, South East E, Russia, other countries (alle retail+SME), group coporate,group markets, coporate center, other	Coporate, Retail, Investment B. (keine Zahlen) sonst Central Europe, Southeastern Europe, Eastern Europe, Group Corporates & Markets	X	X	X	X	2,25%	Universal Bank	√	EUR	1
BE	Belgium	EU_19	KBC Groep NV	D-SIB	SI	Size (total assets EUR 150-300 bn)	Mixed Financial Holding	Belgium; Central + Eastern Europe, Merchant Banking, Groupe Center (Bank & Insurance)	nur nach Ländern: Belgium Business Unit, Czech Republic Business Unit, International Markets	X	X		X	1,75%	Diversified Lender	√	EUR	1
CY	Cyprus	EU_19	Bank of Cyprus Plc	D-SIB	SI	Total assets above 20% of GDP	Financial Holding	Banking and financial services (Retail + Coporate), Insurance services, Property and hotel business	Corporate, Small and medium-sized enterprise, Retail, Restructuring and recoveries, International	X	X		X	3,00%	Diversified Lender	√	EUR	1
CY	Cyprus	EU_19	Hellenic Bank Plc	D-SIB	SI	Total assets above 20% of GDP	Credit Institution	Bank (Reatail, Private, Coporate) no numbers + Insurance	Bank (Reatail, Private, Coporate) no numbers + Insurance	X	X		X	3,20%	Diversified Lender	√	EUR	1
CZ	Czech Reput	EU_28	Komercni Banka as	D-SIB	SI	Member of the Société Générale Group since 2001	n/a	Retail / SME: Private individuals and entrepreneurs and companies, Corporate, Financial markets and Asset Liability Management, Group Centre	Retail: Private individuals and entrepreneurs, Relationship services: Corporate companies, Financial markets: investment products and services to institutional investors + asset management, Specialised banking: mortgages and pension funds	X	X	X	X	4,50%	Universal Bank	√	CZK	1
DE	Germany	EU_19	Commerzbank	D-SIB	SI	Size (total assets EUR 300-500 bn)	Credit Institution	Corporate & Investment Bank, Private Clients and Asset Management, **Corporate Investments**	Corporate & Investment Bank, Private + Commercial, Asset management, non-core operations, coporate and others	X	X	X	X	2,50%	Universal Bank	√	EUR	1
DE	Germany	EU_19	Deutsche Bank	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	Privatkunden, Mittelstandsbank, Central + Eastern Europe, Coparates + Markets, Asset Based Finance, Portfolio Restructuring Unit, Other	Privat- und Unternehmerkunden, Firmenkunden, Asset+Capital recovery, sonstiges	X	X		X	2,00%	Universal Bank	√	EUR	1
DK	Denmark	EU_28	Danske Bank Plc	D-SIB	NCA	by Ministery of Business and Growth Denmark	n/a	Banking Activities (all types of retail and Coporate custumers), Danske Markets, Danske Capital, Dancia Pension, Other	Banking Nordic+ DK, Coperates + Institutions, Wealth Managment, non-core, ireland, other	X	X		X	3,00%	Universal Bank	√	DKK	1
EL	Greece	EU_19	Alpha Bank	D-SIB	SI	Size (total assets EUR 50-75 bn)	Credit Institution	Retail, Corporate Banking, Asset Management/ Insurance, Investment Banking/ Treasury, South-Eastern Europe, Other	Retail, Corporate Banking, Asset Management/ Insurance, Investment Banking/ Treasury, South-Eastern Europe, Other	X	X	X	X	3,00%	Universal Bank	√	EUR	1
EL	Greece	EU_19	National Bank of Greece	D-SIB	SI	Size (total assets EUR 50-75 bn)	Credit Institution	Retail, Corporate Banking, SAU, Asset Management, Insurance, International, Turkish Operations, Other	Retail, Corporate Banking, SAU, Asset Management, Insurance, International Banking operations, Other	X	X		X	3,00%	Diversified Lender	√	EUR	1
ES	Spain	EU_19	Banco Santander, S.A.	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	Retail, Wholesale Banking (Coporate), Asset Management and Insurance	Retail Banking, Corporate & Investment Banking, Asset Management and Private Banking, Real	X	X		X	1,50%	G-SII	√	EUR	1
ES	Spain	EU_19	Banco Bilbao Vizcaya Argentaria, S.A.	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	Private, Wholesale Banking and Asset Management	orderly to Banking in Spain, US, Mexico, Turkey, South America, rest, non core real estate	X	X		X	1,50%	Universal Bank	√	EUR	1
FI	Finnland	EU_19	Nordea Bank Finland Plc	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	Nordic Banking (household customers and corporate custumers), New European Markets, Financial Institutions and Shipping, Oil Services & International	Personal Banking, Commercial + Business, Wholesale, Asset + Vealt M., Group Finance + Trasury, Other	X	X		X	1,50%	Universal Bank	√	EUR	1
FR	France	EU_19	BNP Paribas	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	Investment Solutions, Retail Banking, Corporate & Investment Banking	Retail Banking & Services, Corporate & Institutional Banking	X	X	X	X	1,25%	G-SII	√	EUR	1
FR	France	EU_19	Société Générale	G-SIB	SI	Size (total assets above EUR 1,000 bn)	Credit Institution	French Retail Banking, International Retail Banking, Specialized Financial Services + Insurance, Private Banking, Global Investment management, services, Coporate + Investment Banking, Coporate Center	French Retail Banking, International Retail Banking & Financial Services, Global Banking and Investor Solutions	X	X		X	1,75%	G-SII	√	EUR	1

Source: Own elaboration.

Table 15: Banks' segments and SREP buffer (2).

Country code	Country	EU region	Financial institution	G-SIB or D-SIB	SI or LSI or NCA	Grounds for significance aof ECB cut-off date 01.01.2020	ECB type of bank	Segments 2010	Segments 2018	Segments Standard Private Client	Corporate Clients	Investment Banking	Others	SREP BUFFER 2020	Assumed SREP BMA result	IFRS	CCY	Object Count
IE	Ireland	EU_19	Bank of Ireland Group plc	D-SIB	SI	Size (total assets EUR 100-150 bn)	Financial Holding	Retail Republic of Ireland, Bank of Ireland Life, UK Financial Services, Capital Markets, Group center	Retail Ireland, Wealth and Insurance (formerly Bank of Ireland Life), Retail UK, Corporate and Treasury, Group Centre	X	X		X	2,25%	Universal Bank	✓	EUR	1
IT	Italy	EU_19	Gruppo Intesa-Sanpaolo	D-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	Banca die Territori,Corporate and Investment Banking, Public Finance, International Subsidiary Banks, Eurizon Capital, Banca Fideuram	Banca die Territori,Corporate and Investment Banking, International Subsidiary Banks, Private Banking, Asset Management, Insurance, Coporate Center	X	X	X	X	1,50%	Universal Bank	✓	EUR	1
IT	Italy	EU_19	UniCredit S.p.A.	G-SIB	SI	Size (total assets EUR 500-1,000 bn)	Credit Institution	Retail, Corporate & Investment Banking, Private, Banking, Asset Management and Central & Eastern Europe	Commercial, Coporate + Investment Bank	X	X	X	X	1,75%	G-SII	✓	EUR	1
LV	Latvia	EU_19	AS PNB banka	D-SIB	SI	Article 6(5)(b) of Regulation (EU) No 1024/2013	Credit Institution		Insolvency in 2019 (on 04th April 2019 ECB took over direct supervision)							✓	NOK	1
NL	Netherlands	EU_19	ABN AMRO Bank N.V.	D-SIB	SI	Size (total assets EUR 300-500 bn)	Credit Institution	Retail & Private Banking, Commercial & Merchant Banking, other	Retail Banking, Commercial Banking (SME), Private Banking, Corporate & Institutional Banking,	X	X		X	2,00%	Universal Bank	✓	EUR	1
NL	Netherlands	EU_19	ING-Bank	G-SIB	SI	Size (total assets EUR 500-1,000 bn)	Mixed Financial Holding	Retail + ING Direct, Commercial, real estate, coporate line (management activities and certain expenses that are not	Retail, Wholesale Banking (Corporate)	X	X		X	1,75%	Universal Bank	✓	EUR	1
PT	Portugal	EU_19	Banco Comercial Português	D-SIB	SI	Size (total assets EUR 75-100 bn)	Credit Institution	Retail Banking, Corporate & Investment Banking, Private Banking, Asset management, Forgein business, other	Retail Banking, Companies, Corporate & Investment Banking, Private Banking, Foreign	X	X	X	X	2,25%	Universal Bank	✓	EUR	1
SE	Sweden	EU_28	AS SEB Bank	D-SIB	NCB	EBA systemic risk buffer 0-SII	n/a	Merchant banking, Retail, Wealth management, Baltic	Large Coporations + Financial Institutions, Coporate + privat, Baltic, Life + Investment management	X	X		X	2,50%	Universal Bank	✓	SEK	1
SE	Sweden	EU_28	Swedbank AS	D-SIB	NCB	EBA systemic risk buffer 0-SII	n/a	Retail, Baltic Banking, large Coporates + Institutes, Asset management, Russia + Ukraine, Other	Swedish banking, Baltic Banking, large Coporates + Institutes, Other	X	X		X	2,00%	Universal Bank	✓	SEK	1
SK	Slovakia	EU_19	Všeobecná úverová banka a.s.	D-SIB	SI	Among the three largest credit institutions in the Member State	Credit Institution	Retail Banking, Corporate Banking and Central Treasury	Retail Banking, Corporate Banking and Central Treasury	X	X		X	1,50%	Diversified Lender	✓	EUR	1
UK	England	EU_28	Barclays	G-SIB	G-SIB	Bucket (1,5%)	n/a	UK Retail Banking, Barclaycard, Barclays Capital, Barclays Corporate, Barclays Wealth, Investment Management, other	Barclays UK: (Personal Banking + Card, Business Banking), Barclays International"": (Corporate and Investment Bank, Consumer, Cards and Payments) ""The division includes the large UK Corporate business	X	X	X	X	2,70%	G-SII	✓	GBP	1
UK	England	EU_28	HSBC	G-SIB	G-SIB	Bucket (2,0%)	n/a	Financial Services, Commercial Banking, Global Banking & Markets, Global Private Banking, Other	Retail, Banking and Wealth Management, Commercial Banking (SME) ,Global Banking and Markets, Global Private Banking, Corporate	X	X	X	X	3,00%	G-SII	✓	USD	1
CH	Swiss	EU_28	UBS Group AG	G-SIB	G-SIB	Bucket (1,0%)	n/a	Wealth Management & Suisse Bank (Retail & Corporates), Wealth Management Americas, Global Asset Management, Investment Bank, Treasury and Other Activities	Global Wealth Management, Personal & Corporate Banking, Asset Management, Investment Bank, Corporate Center (Services, ALM, Others)	X	X	X	X	n/a	G-SII	✓	CHF	1
CH	Swiss	EU_28	Credit Swiss Group AG	G-SIB	G-SIB	Bucket (1,0%)	n/a	Private Banking, Corporates and Institutions in Switzerland, Investment Banking, Asset Management, Others	Swiss Universal Banking, International Wealth Management, Asia Pacific, Global Markets, Investment Banking & Capital Markets, Corporate Center	X	(X)	X	X	n/a	G-SII	✓	CHF	1

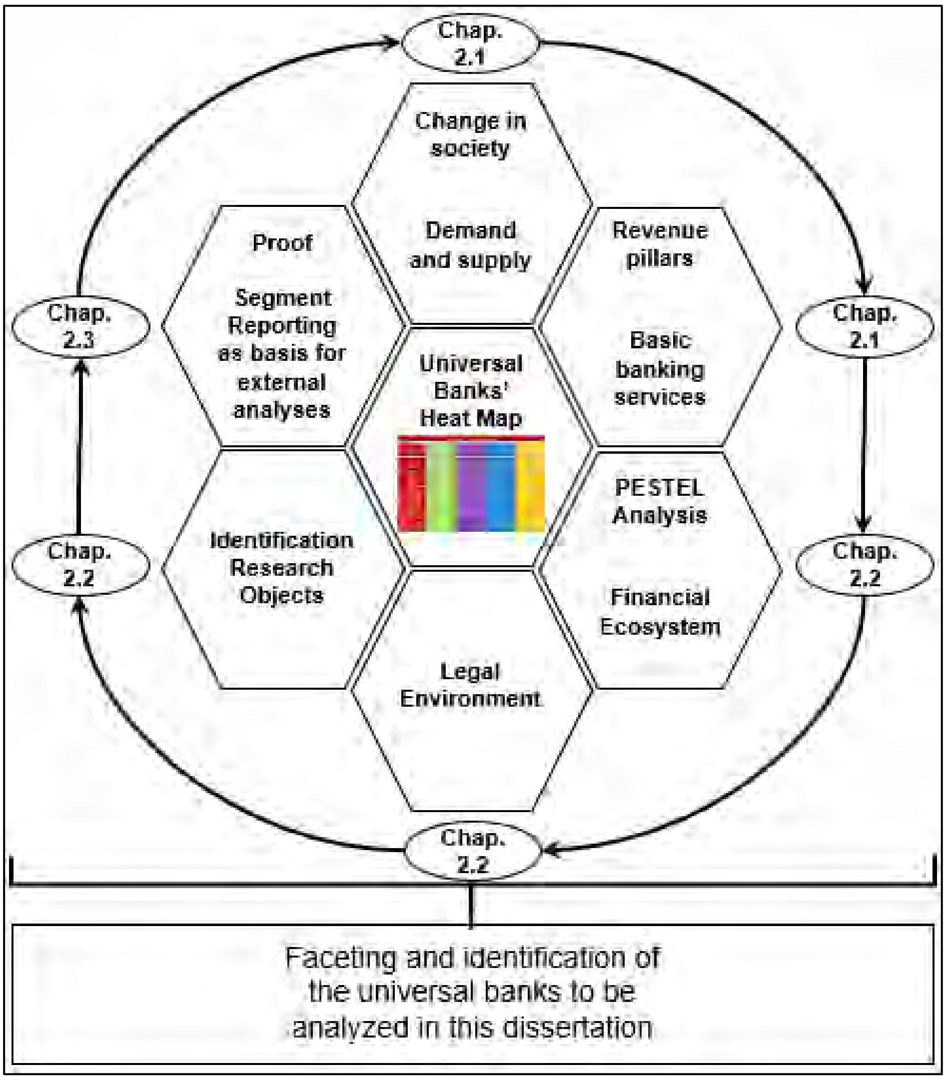
Source: Own elaboration.

Interim conclusion as the facets of a universal bank.

What contribution does this qualitative examination of the research object *universal bank* make to the overall work?

The following graphic (Figure 18) shows clockwise the facets that were presented in Chapter 2 to explain the term "*universal bank*". Ideally, the management of such a company should consider this 360-degree view at regular intervals.

Figure 18: The facets of a *universal bank*.



Source: Own elaboration.

The Banking Heat Map (Figure 13) is at the centre of the derivation of the central term "*universal bank*". Chapters 2.1 to 2.3 highlight facets that are particularly influential for the *universal bank's business model*. Attempts are being made to bridge the gap from social changes as the main trigger for changing demand behaviour to the mirror in Chapter 2.3, segment reporting. Insights are worked out in six steps.

Step 1 in chapter 2.1 Change in Society.

Following a generic approach, the emergence of the current *business model* of *universal banks* is shown. This is to be understood as the product of demand behaviour that has changed over the centuries. These changes are partly due to newly created basic technologies that have brought about social transformation.

Step 2 in chapter 2.1 Revenue Pillars.

Based on the findings of the first step, the main earning pillars of modern *universal banks* are identified. This highlights the possible areas of attack from external disturbances, such as *fintechs* and *bigtechs*. The point of view is refined through the presentation of essential banking services and a company-specific inside view in the form of the portrayal of the value chain (Figure 12 on page 51).

Step 3 in chapter 2.2 PESTEL ANALYSIS and Financial Ecosystem.

After the highlighting of a typical *universal bank's* inside view, an environmental analysis is carried out (Table 9 on page 54). The table shows the chapters in which the aspects are analysed in more detail. This exogenous overall view leads to the currently common presentation of the complex relationships surrounding a *universal bank* and their system-specific role as a financial *ecosystem* (Figure 14 on page 57).

Step 4 in chapter 2.2 Legal Environment.

This section attempts to provide a legal all-round view. Regulations that have a massive impact on the *business model* of a *universal bank* must be considered. These are mostly of a commercial and regulatory nature. Even *fintechs* are sometimes subject to these rules. In a sense, they provide one level playing field. The internationally active regulators are also starting to put *bigtechs* to the test from this perspective. So far, these have mainly been subject to commercial law regulations and the norms of the capital market.

Step 5 in chapter 2.2 Identification of the research objects.

The identification of the research objects necessary for this investigation takes place here. The geographical and regulatory perspective is used for the selection process. The regulator is obliged to categorize the banks according to their risk content. First, the multitude of apparently different but sometimes identical terms is structured. Based on this, the *universal banks* are selected depending on the system relevance.

A detailed model-specific justification for the selection decision is made in preparation for the final samples (cf. Table 13 on page 75).

Step 6 Segment reporting as mirror of the business model.

To prepare and justify further investigation, the proof of the usability of the external segment reporting is presented. The focus is on the search for an understanding of the *business model* of the analysis objects. This is a way to identify their vulnerability to exogenous disturbances (caused by *fintechs* or *bigtechs*). From the external perspective, the segment reporting is the only external access to the inside of a reporting company due to the mandatory management approach.

The attempt was made to prove that the design of the current segment reporting reflects the market and thus a reaction to a society’s demand behaviour. It is reasonable to assume that the nuances of the respective *business models* are recognizable.

Once again, the regulatory perspective, which has now been secured, was initially adopted. The banking supervision is among others required to evaluate the *business models* of the banks to be supervised.

Only in their last annual financial statements the *universal banks* were encouraged to report externally the results of the assessments in the form of the SREP buffer.

The proof could not be completed because either the regulator itself or the banks often only report externally in a highly aggregated manner.

Based on the annual reports of 2010 and 2018, the different segment structures were transferred into a passe-partout for all analysis objects.

From the banks' point of view, the facets represent exogenous changes to which they continually have had to adapt. For further analysis (Chapter 5), the research objects were identified, on a qualitative basis their inside view conveyed and the approach across the segments verified.

Interim conclusion towards overarching hypotheses.

The following development-specific indications can be highlighted as arguments in sense of the overarching hypotheses (Figure 4 on page 21) of the work:

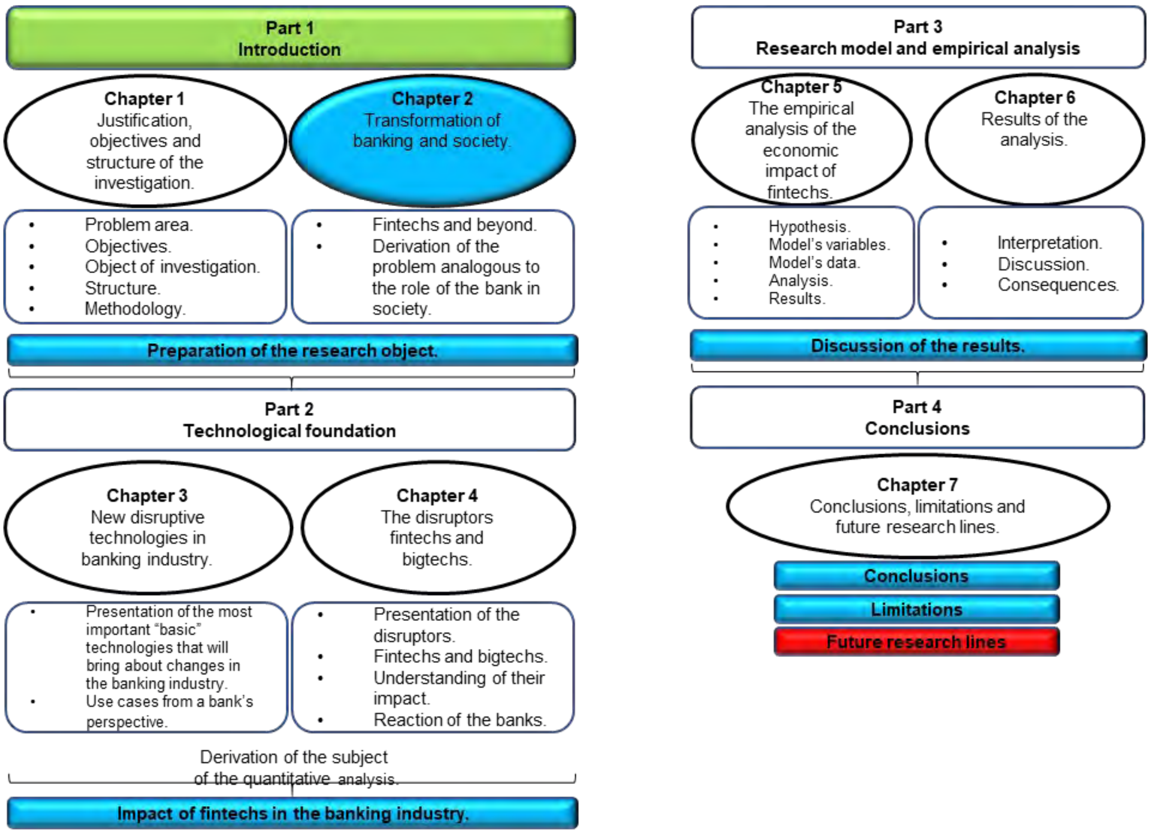
Table 16: Indications of chap. 2 insights towards overarching hypotheses.

Step	Key words	Indication for hypothesis	Transformation of *business model*	Argument
1	Change in society	H1	Evolutionary innovation	Banks have followed changes in demand behaviour for centuries. The *business model* remains robust.
2	Revenue pillars	H1 + H2 + H3	Evolutionary innovation Opportunistic innovation Disruptive innovation	New pillars of earnings emerged from serving changed needs. The *business model* remains robust.
3	PESTEL and Financial *Ecosystem*	H2 + H3	Disruptive and Revolutionary innovation	First signs of a disruptive change in the *business model* of *universal banks*. Together with *fintechs*, these begin to form a financial *ecosystem* to be able to offer the revolutionary changes by *bigtechs* pari.
4	Legal environment	H1	Evolutionary innovation	Banks must comply with the regulatory requirements, otherwise the bank license could be withdrawn. In commercial law, failure to comply will result in the annual accounts not being audited or being audited only to a limited extent.
5	Research objects	H1	Evolutionary innovation	As a rule, the regulator can only follow changes in the *business models* of banks ex post. Nevertheless, not only *fintechs* but also *bigtechs* are anticipated in the focus of supervision.
6	Segment reporting	H1	Evolutionary innovation	The segment structure generally follows the changing market conditions (demand behaviour). For example, investment banking disappeared almost completely.

Source: Own elaboration.

Part II. Technological foundation.

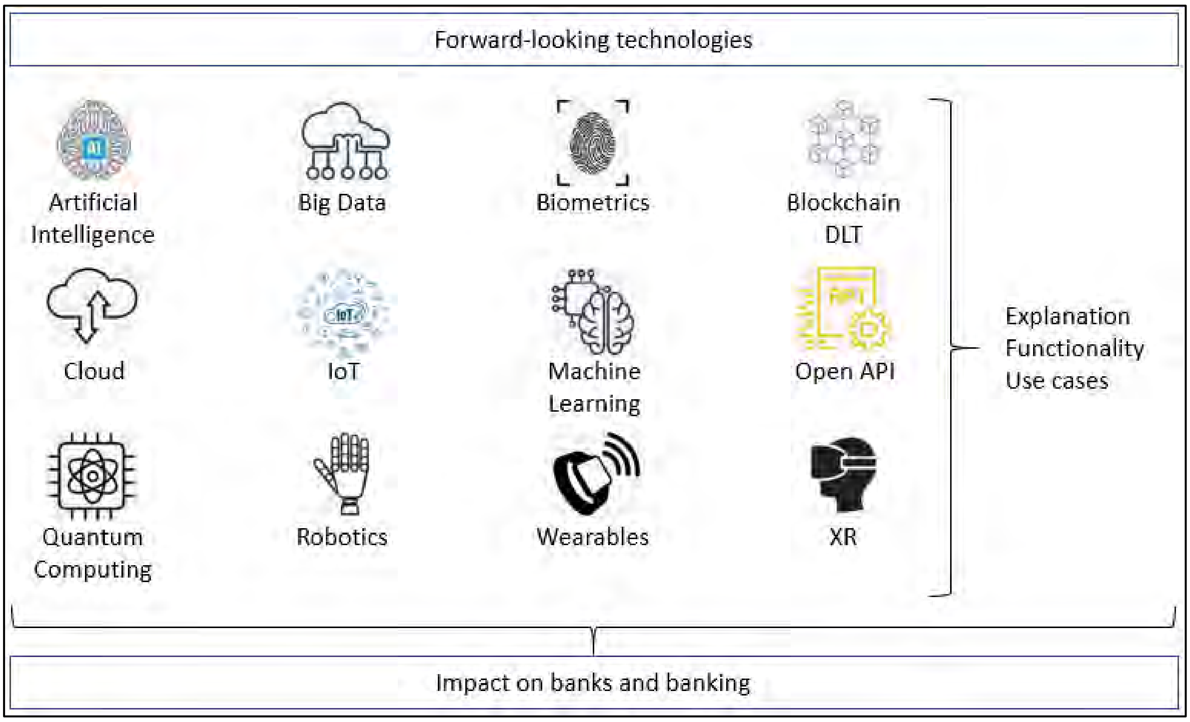
Chapter 3. New disruptive technologies in banking industry.



The aim of the third chapter is to present the basic innovations and their influence on the *business model* of traditional *universal banks*. At the beginning of the chapter, the innovations are determined which are and will be of importance to the credit institutions.

These innovations (basic technologies) are then presented and their advantages and disadvantages as well as use cases are visualised. The chapter concludes with a literature-based elaboration of possible *use cases* of new technologies in the financial sector.

Figure 19: New technologies and structure of chapter 3.



Source: Own elaboration.

This illustrates the challenges *fintechs* and *bigtechs* face to secure their share of the added value of traditional *universal banks*. More than 200 years ago, a quiet social revolution started in England, marked by an increase in work efficiency and the substitution of human and mechanical labour (Allen, 2009).

In 1767, the weaver James Hargraves invented a steam-powered loom (*Spinning Jenny*), which enabled the weaving mill to supply a spinner with yarn as a starting material through a weaver. The amount of hourly wages in relation to the price of capital at that time in England allowed for the use of technologies that saved manpower (Gragnolati et al., 2011). With the same output, the number of working hours decreased, but before the use of the mechanical loom still a ratio of 4 to 8 weavers was necessary to supply a spinner.

This was preceded by the invention of the stationary steam engine, which in addition to water and coal was the external source of power. The *Spinning Jenny* represents a milestone which enabled the first industrial revolution. The change in production techniques caused a social transformation, from the agricultural to the modern industrial state (Allen, 2010).

This revolution marks a profound and lasting change in economic and social conditions, working conditions and lifestyle, starting from England, through Western Europe in the USA to Japan and other Asian regions.

At present, the digital revolution is undergoing a similarly profound social transformation almost silently. This revolution was only made possible by other inventions, such as the internet followed by electronic devices of communication (e.g.: PC, smartphone, tablet), which allow almost unlimited access to the underlying data.

This dissertation deals with more than the qualitative notion of disruptors and the quantitative analysis of the impact on the *business models* of classical *universal banks*. The red thread is drawn to the pro and contra arguments of the social changes that have been quietly generated by the digital transformation.

3.1 Drivers of digital transformation.

Identification of the driving disruptive digital basic technologies, which already forced or force a change of the *business model* of the analysed *universal banks*. Based on this identification, it is explained why in this dissertation certain basic technologies were identified as drivers of digitization in the financial sector and others are not further evaluated.

Proceeding:

The literature-oriented investigative approach was selected in four steps for the qualitative identification of relevant technologies:

Step 1:

Selection of 15 vendors (consulting companies) who act as "digital accelerators" according to Forresters Wave TM Report Q1 2019.

Step 2:

Evaluation of volatile sources of these 15 vendors in the form of current advertising brochures (.pdf format) or if the web pages cannot be researched with reasonable effort.

Step 3:

Evaluation and transfer of the basic technologies discussed by the respective vendors (sometimes also use cases) into an Excel table as well as colour coding of recurring terms.

Step 4:

Securing the knowledge gained through the Gartner Hype Cycle, the view of leading international research institutions and the internal view of Commerzbank AG in Frankfurt am Main (Leichsenring, 2018).

In spring 2019, as part of this research, statistically reliable statements from the 31 banks analysed should be collected using a questionnaire (cf. chapter 5.7). None of the 31 investor relations departments of the European *universal banks* examined responded constructively to this. The evaluation was therefore only based on literature.

No order of identified technologies is established in this subchapter as all technologies are important. Grading is only possible insofar as technical relationships are recognizable (e.g. quantum computers and cloud computing => big data).

The basic technologies are presented as those that have or will have a direct influence on the change in the *business models* of classic *universal banks* as intermediaries. A classic *universal bank* can no longer ignore the economic effects of these technologies.

Other innovative technologies with primary meanings in the non-financial sector (e.g. virtual or augmented reality or robotics) are not examined further in this work. Nevertheless, these can have a secondary influence on the *business models* of *universal banks* (e.g. Trucks: Autonomous Driving Level 4 in combination with tokenization of central bank-guaranteed currency for the autonomous billing of freight, parking space and energy requirements, M2M payment (Altrichter, 2019)).

As a result, the banks may have to modify their existing products (product receipt) or offer completely new products (receipt). This does not, however, call into question the role of the bank as an intermediary.

Definitions:

All the technologies listed are important in the sense of basic technologies for the financial industry. In this work, a technology is referred to as the basic technology which, in the case of this investigation, enables the development of further disruptive information and communication technologies (analogy: stationary steam engine as the basic technology of the Spinning Jenny).

In contrast to the term basic technologies, the term *use cases* is understood in this work as a list of use cases that describe how a system or an application behaves under certain conditions (Jacobson, 1998).

According to prevailing literature opinion, the term digitization has a variety of meaning. The content gradation ranges from the original perspective of information technology to the recording of far-reaching social changes. There is therefore no clear definition for the term digitization.

Digitization originally referred to the conversion of analogy values into digital formats (Luber et al., 2019).

The result of this transformation are files consisting of a sequence of bits and bytes. According to estimates, humanity had already digitized 94% of its global information capacity in 2007 (Hilbert et al., 2011b).

Digitization can also mean the conversion of analogy technologies to digital formats of instruments, devices in general and vehicles to increase efficiency. One example is the automotive industry, which firstly digitized components of the vehicles and secondly network the vehicles with each another in a further pending development (1985 Audi: "*Vorsprung durch Technik*") (Winterkorn, 2003).

At present, this term is used much more comprehensively. According to this, digitization is a transformation process driven or enabled by technological developments of individual companies or entire industries.

A process that may far-reaching strategic, organizational and socio-cultural changes are brought about (Hill, 2017; Petry, 2018). These changes are already referred to in the literature as the digital revolution or the 4th industrial revolution (Schwab, 2017).

Abrupt and radical changes are commonly referred to as revolution (Schwab, 2017). In contrast, evolution means a gradual of the features of structures from generation to generation (Evans, 2001).

The current digital revolution was made possible by basic technologies such as semiconductors, mainframes (1960), personal computing (1970 and 1980) and the Internet (1990) (Schwab, 2017).

This term thus refers to the profound upheaval triggered by the above-mentioned technologies, which has affected almost all areas of life. This change has a profound impact like that of the first industrial revolution (Musson, 2013). In this work, the term digitization is used in the latter, the most modern sense of content.

The following American saying illustrates the need for digitization: "*Uber yourself before you get kodak'ed*" (2016 Silicon Valley).

Drivers of the digitization

The report: The Forrester Wave ™: Global Digital Business Transformation Accelerators, Q1 2019 was initially used for the efficient evaluation of internet-based sources from the consulting companies.

The American provider of this report aims to orient decision-makers, for example in the role of CIO's (Chief Information Officers). The report is intended to make it easier for the actors to make investment decisions in the consulting companies that are to accompany the digital transformation of the companies.

The positions of the 15 digital technology consulting companies mentioned in Forrester Report Q1 2019 were qualitatively evaluated and summarized in a table (cf. Table 19 on page 104). Identical technologies mentioned repeatedly were highlighted in colour to get an impression of which technologies are the focus of the digital transformation.

Volatile sources were evaluated in the form of current advertising brochures or, if these were not available, the web pages of the respective consulting companies (vendors).

In this way, the hypothesis is to be confirmed that (as of summer 2019) the following technologies are currently at the centre of digital transformation processes and are therefore being further investigated in this work:

Table 17: Overview of the technologies to be analysed.

Component	Technology	Comment	Relationship
A	Quantum Computing	Replacement of mainframes	Basic technology
B	Cloud Computing	Concentration and storage of data	Basic technology
C	Block Chain	Distributed Ledger Technology	Basic technology, A, B, D, E
D	(AI) Artificial Intelligence	Machine learning	A, B, C
E	Big Data	Data analytics	A, B, C

Source: Own elaboration.

These technologies in turn enable a wealth of use cases in the financial sector, which are highlighted in Chapter 3.8.

The most important forms of digitization are identified in four steps:

- *step 1: selection of the vendors:*

Selection of worldwide leading vendors based on the Forrester Report Q1 2019. These were identified in this report as those who are global leaders in technological advice. This means that they should have the greatest expertise.

- *step 2: sighting the sources:*

The vendors' advertising brochures published on the internet were visually inspected.

- *step 3: evaluation of the sources:*

The identified main topics were compiled in a table signed and counted (see Table 19 on page 104). Furthermore, their share of the total amount was shown in the form of a pie chart (cf. Figure 20 on page 105).

- *step 4: verification of the insights:*

The insights are checked with the Gartner Hype Cycle for Emerging Technologies (Dedehayir et al., 2016).

step 1: selection of the vendors.

The positioning as a global catalyst for digital solutions is fixed by two determinants. In the representation as a Cartesian coordinate system, the digital strategic alignment is plotted on the abscissa. The digital orientation of the offers was plotted on the ordinate. Both parameters are high at the consulting companies McKinsey & Company and EY. Therefore, they are leading the field of 15 consulting companies.

Table 18: Forrester Wave™: Global Digital Business Transformation Accelerators, Q1 2019.

Source: The Forrester Wave™ Q1 2019 Report (Forrester, 2019).

steps 2 and 3: sighting and evaluation of the sources.

The following table shows the insights from the literature research on the drivers of digitization:

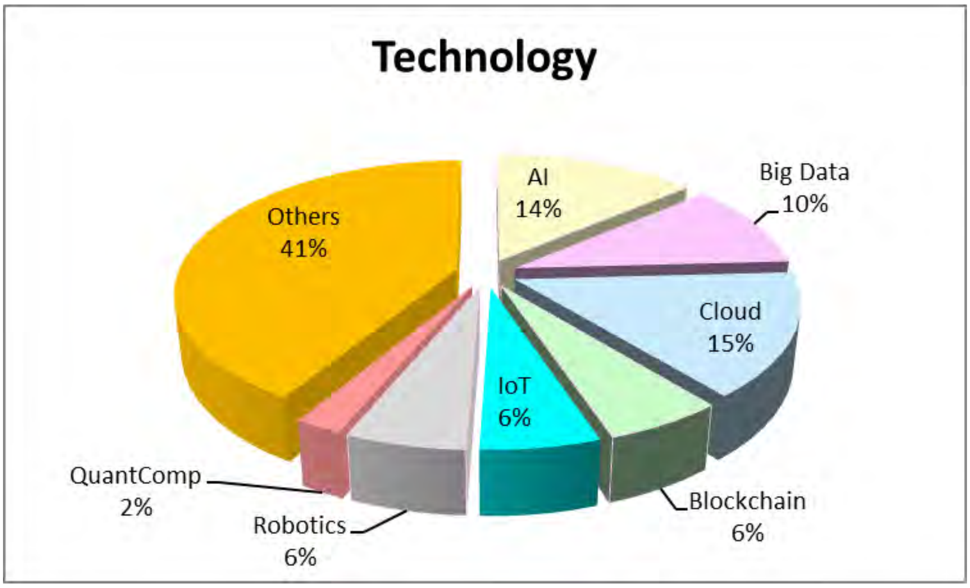
Table 19: Elaboration of digital drivers according to main vendors' internet sources.

No.	Vendor	Source	Title	Page	Publication	Methodology	Focus	Digital technologies mentionned in the respective document: 1	2	3	4	5	6	7	8	9	10	11	Tec Count
1	Accenture	https://www.accenture.com/_acnmedia/accenture/conversion-assets/wef/pdf/accenture-dti-executive-summary.pdf	Digital Transformation initiative (World Economic Forum in Cooperation with Accenture)	p.7	01/2017	inception 2015 to develop key drivers worldwide (egagement with 300 leaders)	worldwide industry	autonomous vehicules	big data analytics	big data and cloud	AI (Artificial Intelligence)	Customer manufactoring and 3D printing	IoT and connection devices	Robots and drones	Social Media and Platforms				8
2	Atos	https://atos.net/content/dam/global/flipbooks/journey-2020/index.html#p=1	Journey 2020 Digital Shockwaves in Business	p.40	2016	AtosScientific Community	worldwide industry	IoT & future networks	big data analytics	cloud continuum	cloud & containerization	additive manufacturin	quantum safe cryptography						6
3	CapGemini	https://www.capgemini.com/research/	Future of technology		2019	Webpage	worldwide cross industry	blockchain	AI (Artificial Intelligence)	cybersecurity + AI	5G	IoT in operations							5
4	Cognizant	https://www.cognizant.com/InsightsWhitepapers/a-framework-for-digital-business-transformation-codex-1048.pdf	A Framework for Digital Business Transformation	p.40	2014	Framework	worldwide	social digital solutions	mobile digital solutions	analytics digital solutions	cloud digital solutions								4
5	DeloitteUniversityPress + MITSloanManagementReview ResearchReport	https://www2.deloitte.com/insights/us/en/topics/digital-transformation/digital-transformation-strategy-digitally-mature.html	Strategy, not Technology, Drives Digital Transformation		2015	survey annually 4.800 key business persons	worldwide	social digital solutions	mobile digital solutions	analytics digital solutions	cloud digital solutions								4
6	DXC Technology	https://www.dxc.technology/banking?ref=dhpbb_z	Banking & Capital Markets		2019	Webpage	worldwide	predictive analytics	machine learning	intelligent chatbots	AI (Artificial Intelligence)								4
7	EY	https://www.ey.com/en_gl/digital/transformation	Digital Transformation		2019	Webpage	worldwide	Robotic process automation	AI (Artificial Intelligence)	Digital Grid Services	Smart Factory	blockchain	Intelligent Automation						6
8	IBM	https://www.ibm.com/industries/banking-financial-markets/openbanking	Openbanking		2019	Webpage	worldwide	Bridge from core to cloud	Achieve PSD2 compliance	Leverage an API Ecosystem	Built on industry standards	quantum computing							5
9	Infosys	https://www.infosys.com/insights/cloud/Pages/digital-transformation.aspx	Digital Transformation: Start at the Core, End with Customer Delight		2019	Webpage	worldwide	massively simplify core systems	monolithic, silo-based ERP systems into platform-led, lightly tied components built on open source software	Carve out fire lanes of microservices and APIs:	Start by migrating non-core elements to the cloud: The cloud is a major enabler of core								4
10	KPMG	https://assets.kpmg/content/dam/kpmg/us/pdf/2017/08/KPMG-Forbes-Digital-Transformation-report.pdf	Digital transformation - How advanced technologies are impacting financial reporting and auditing -	p.5	2017	survey	261 senior financial executives worldwide	cloud based applications	Robotics for routine alternatives	workplace automation	cognitive technologies	data analytics							5
11	McKinsey	https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Organization/Our%20Insights/Unlocking%20success%20in%20digital%20transformations/Unlocking-success-in-digital-transformations.ashx	Unlock success in digital transformations	p.3	2018	survey	Twenty-one keys to success (Europe)	Traditional web technologies	Cloud-based services	Mobile internet technologies	Big data and big data architecture (eg, data lakes)	Internet of Things	Design thinking	Artificial-intelligence tools	Robotics (eg, robotic process automation)	Advanced neural machine-learning techniques (eg, deep learning)	Augmented-reality technologies	Additive manufacturing (eg, 3-D printing)	11
12	Publicis Sapient	https://www.publicissapient.com/news/four-key-imperatives-for-businesses-to-transform-in-the-digital-age	Four Key Imperatives for Businesses to Transform in the Digital Age		2019	webpage	worldwide	Cloud	Machine Learning	Artificial Intelligence	Big Data								4
13	PWC	https://www.pwc.de/de/im-fokus/digitale-abschlusspruefung/pwc-digitalisation-in-finance-2018.pdf	Digitalisation in finance and accounting and what it means for financial statement audits	Preface and chapter 3 (p.25 f)	July 2018	Questionnaire (40 detailed questions)	76 large and medium enterprises in Germany, answers received at the end of 2017	ERP systems (enterprise ressource planning)	Robotics for routine alternatives	Shared Service Centers (for manual activities) with RPA (robotic process	AI (Artificial Intelligence)	blockchain	Datatransfer (e.g. with auditor)						6
14	Tata Consultancy Services	https://info.tcs.com/bts-secret-to-succeeding-pov	Digital Transformation to Business 4.0		2019	Webpage	worldwide	blockchain	cloud applications	cloud infrastructure	cognitive business	cyber security	Internet of Things (IoT)	artificial intelligence (AI)	analytics	enterprise applications	quality engineering		10
15	Wipro	https://www.wipro.com/content/dam/nexus/en/industries/communication-service-providers/solutions/wipro-digital-transformation-model.pdf	Wipro's Digital Transformation Model	p.4	2019	Framework	worldwide	Digital Customer Engagement Intelligent, intuitive, omni-channel customer engagement across buyer, user, and provider	Services & Capabilities at Speed New products, service operations, security & analytics across mobile, fixed, & digital services	Open ArchitectureDigital process engineering, micro-services, automation, APIs, Partner Ecosystem	"Born Digital" Applications Systems for Digital Business -Design, Build, Deliver, Provide, Assure & Manage	Cloud of the FutureSecure for Digital Business - SDN, NFV, Cloud							5

Source: Own elaboration.

Overall, by comparing the sources of the 15 vendors, 87 completely different, partly identical technologies with different characteristics (*use cases*) were identified:

Figure 20: Digital drivers according to vendors' source evaluation.



Source: Own elaboration.

result: driver of the digitization:

Based on the evaluation of the frequency of mention in the in-house advertising of the vendors, the drivers of digitization could be identified: Cloud (15%), AI (14%), Big Data (10%), Blockchain (6%), Robotics (6%) and quantum computing with (2%).

Others (41%) include technologies that partially are already strongly application-specific or whose potential (e.g. 5G standard) has yet to be tapped. These were only occasionally mentioned. For example, although social media include is not to be underestimated for marketing of the financial sector (customer acquisition), these isolated mentions of new technologies were not examined further (Domazet, 2019).

The comparison of sources has shown that from the perspective of the financial sector, both the IoT and robotics must be included in the decisions regarding a digital transformation. The hypothesis mentioned at the beginning was thus supplemented by two components in the further investigation.

step 4 verification of the insights.

The picture obtained in this way is contrasted with the view of the American analyst house Gartner Inc., the internal view of Commerzbank AG Frankfurt am Main and leading European research institutes (Frauenhofer Institut, Real Elcano). As part of its Commerzbank 4.0 strategy published in 2016 and the Main Incubator (R&D unit with labs, fintech support and client journeys), it focuses on blockchain, AI, cloud and big data. Quantum computing is also included in the current discussion.

The American analyst firm Gartner Inc. mentions AI, big data, robotics, blockchain in connection with the financial sector. The following ten technology trends for 2019 were listed in 2018[22]:

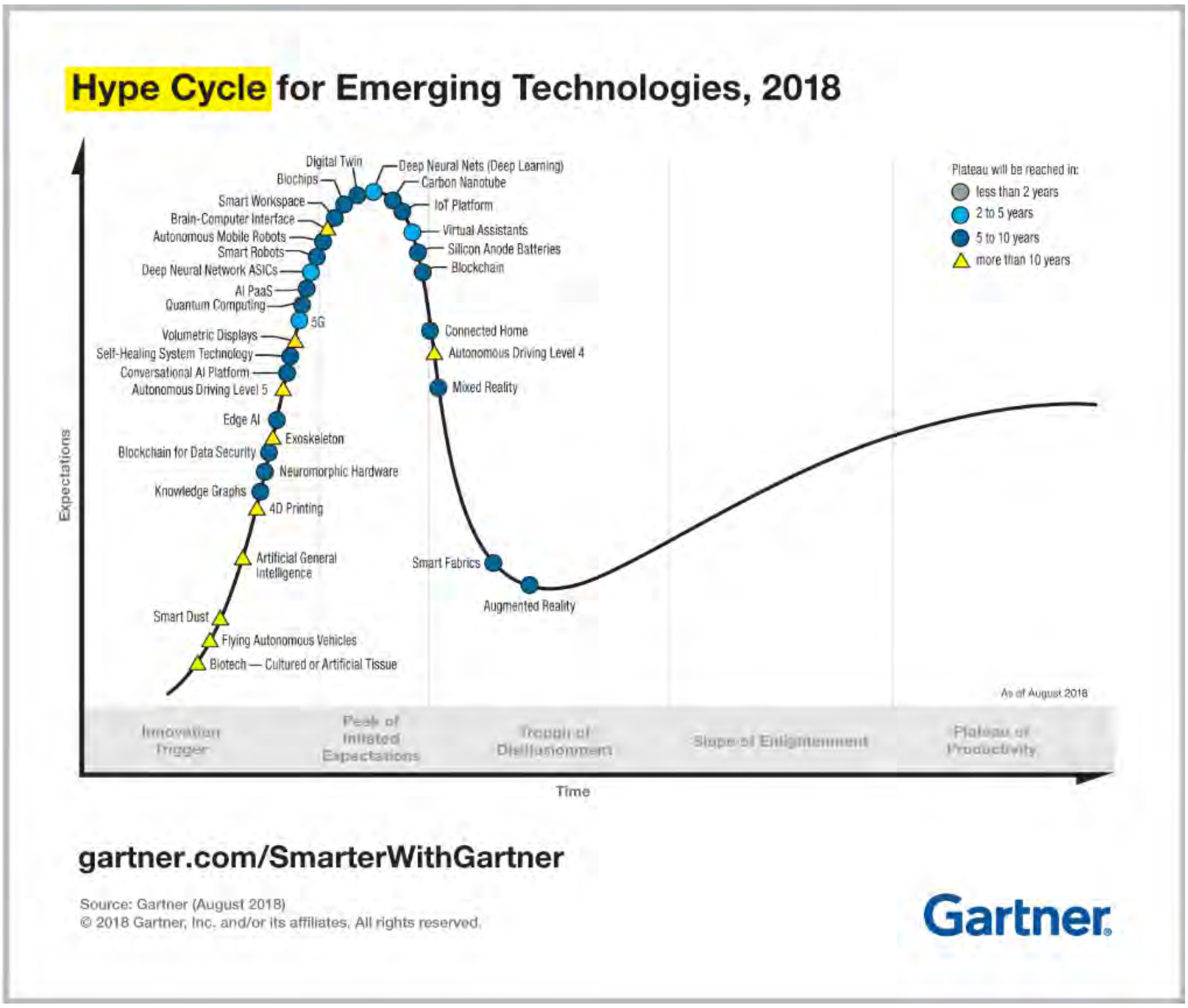
1. Autonomous things => AI
2. Augmented Analytics => Big Data
3. AI-driven development
4. Digital twins (mirroring of a real live object)
5. Empowered edge (place information processing and data collection closer to sources => sensor systems of IoT)
6. Immersive technologies (AR, VR, MR users' interaction with the world)
7. Blockchain
8. Smart Spaces (e.g. Smart Cities)
9. Digital Ethics and Privacy
10. Quantum computing.

The view is rounded off by the Gartner Hype Cycle for Emerging Technologies, which is published at regular intervals. The disruptive technologies mentioned several times above are also reflected here. Which further substantiated the knowledge gained above.

The core competence of the analyst house founded in 1979 (headquarters in Stamford, Connecticut USA) is market research and analysis as well as their visualization in the IT industry. The results are visualized in hype cycles and magic quadrants, which help decision-makers to orient themselves, for example, for future investments (Kocaoglu, 2010).

[22] https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2019/

Figure 21: Gartner Hype Cycle for Emerging Technologies, 2018.



Source: Based on (https:/www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/).

Renowned European research institutes (Fraunhofer, Institute for Prospective Technological Studies (JRC-IPTS Sevilla), Real Elcano (Madrid)) confirm these findings (Gasco, 2012; Andrés Ortega et al., 2019; Übelhör, 2019). Depending on the orders, specific studies are carried out here that reflect the technological picture obtained.

Conclusion: Contribution to this dissertation.

Based on the knowledge gained and secured in this subsection 3.1, the following disruptive technologies related to the financial sector will be incorporated into the further course of the analyse:

Table 20: Disruptive technologies analysed in this dissertation.

Component	Chapter	Technology	Comment	Relationship*
A	3.2	Block Chain	Distributed Ledger Technology	Basic technology, A, B, D, E
B	3.3	(AI) Artificial Intelligence	Autonomous algorithmic learning	A, B, C, H
C	3.4	Big Data	Data analytics	A, B, C, E; F, H
D	3.5	Cloud Computing	Concentration and storage of data	Basic technology
E	3.6	Quantum Computing	Replacement of mainframes	Basic technology
F	3.7	IoT	Worldwide sensor systems transformed in financial data	A, B, C, D
G	3.7	Open API	Door to non-financial *ecosystems*	Basic technology
H	3.7	ML	Subset of AI customer focus and risk predictability	B
I	3.7	Biometrics	Subordinated Access importance (Security)	F
J	3.7	Robotics	Execution of repetitive activities (e.g. evaluation of press information, scanning)	A, B, C, D, F
K	3.7	Wearables	Subordinated importance	F
L	3.7	XR	Subordinated Importance	F

Source: Own elaboration (*assumptions of the author).

These disruptive technologies will have primary and secondary effects on the *business models* of traditional *universal banks.* Primary effects question their established role as intermediaries. For example, secondary effects can result in the modification or redesign of currently offered products or sales channels, but they do not question the core of the *business model*, the trust-based function of an intermediary.

Classic *universal banks* are often not able, or only with a delay, to deal with these innovations independently, to identify and implement them. In addition to consulting companies, *fintechs* (see chapter 4) come into play here, which can use technological innovations more quickly to take over part of the classic added value of the *universal banks*.

Bigtechs can use a much greater leverage (see chapter 4), also by mastering and optimizing the disruptive technologies listed above.

3.2 Block chain technology.

The contribution of this sub-chapter to the entire work consists in the presentation of blockchain technology. This is to be classified as dominant and future-oriented (see Figure 20 on page 105).

The presentation of the respective disruptive technology is structured into the sections definition, history, mode of operation, advantages and disadvantages and conclusion. The aim is to expand the understanding to such an extent that a comprehensive discussion of advantages and disadvantages is possible.

Furthermore, the usability of the technology in the sense of banking should be shown.

Historical review

The history of blockchain (DLT Distributed Ledger Technology) is currently often associated with its application as a technological basis for Bitcoin (Nakamoto, 2008). However, cryptocurrencies are only one type of modern application of the DLT.

Originally, the focus was on the encryption of data transmission. The following milestones in their development can be represented according to the literature research:

1970s.

As early as the 1970s, the advanced technology of data transmission made two developments necessary. First, the handwritten signature had to be digitally replaced as a legal declaration of intent. Secondly new types of cryptographic systems were required which minimize the need for secure key distribution channels (Whitefield, 1976).

1980s.

Development of the hash threes by the scientist Ralph C. Merkle (Merkle, 1980). Hash threes are data structures in cryptography and computer science. Among other things, they serve to ensure the integrity of the data used. In addition to signatures, hash trees can be used to protect any type of data that is stored and exchanged from being changed.

1990s.

Another milestone in the 1990s was the development of distributed database management systems (DDBMS) and Peer-to-Peer (P2P) networks (Christensen et al., 2015; Taskinsoy, 2019).

2008 S.Nakamoto Blockchain and cryptocurrency

The use of the DLT as a basic instrument for the use of a cryptocurrency (Bitcoin) represents another important milestone. So, there was initially no further technological development. Nevertheless, the awareness of the DLT increases.

Driven by the cryptocurrencies, the media and thus public interest no longer extended to Bitcoin. A blockchain-based cryptocurrency created by a group of actors operating under the pseudonym Satoshi Nakamoto (Nakamoto, 2008).

The optimism regarding this currency, which is not supported by a central bank, fuelled discussions about new asset classes (Meisner, 2018), its high volatility (Pichl, 2017), hardware losses (Sulleyman, 2017) and the demand for regulatory activities of the new means of payment (Auer, 2018).

Analogous to the invention of the steam engine, this technology has the potential to enable profound positive and negative social changes (Nguyen, 2016).

Besides the definition, for better understanding the following terms must be considered:

Structure of the technology => properties => access => Proof of Work (PoW) => Proof of Stake (PoS) => smart contracts (Golosova et al., 2018).

Definition of the technical term blockchain.

Depending on the focus of the respective authors, essential subject areas can be derived from the different definitions of the term blockchain, which in their entirety represent the functioning of this information and communication technology.

In order to fully grasp the potential of the blockchain, both its functionality and its possible uses must be shown beyond the definition (Casino et al., 2019).

The original term blockchain is defined in the current literature as a decentralized, transparent database that contains all transaction data records. This database is evenly distributed across all participating network nodes. It is updated by its users (e.g. miners from bitcoins), does not belong to any individual user and is not controlled by a central authority (Swan, 2015). This first definition focuses on the network (Condos el al., 2016).

In a further definition, the blockchain is referred to as a type of database in which the data entries are grouped into blocks (Walport, 2015).

Walport already differentiates the terms DLT (distributed ledger technology) and blockchain. These are often used synonymously, which is not entirely correct.

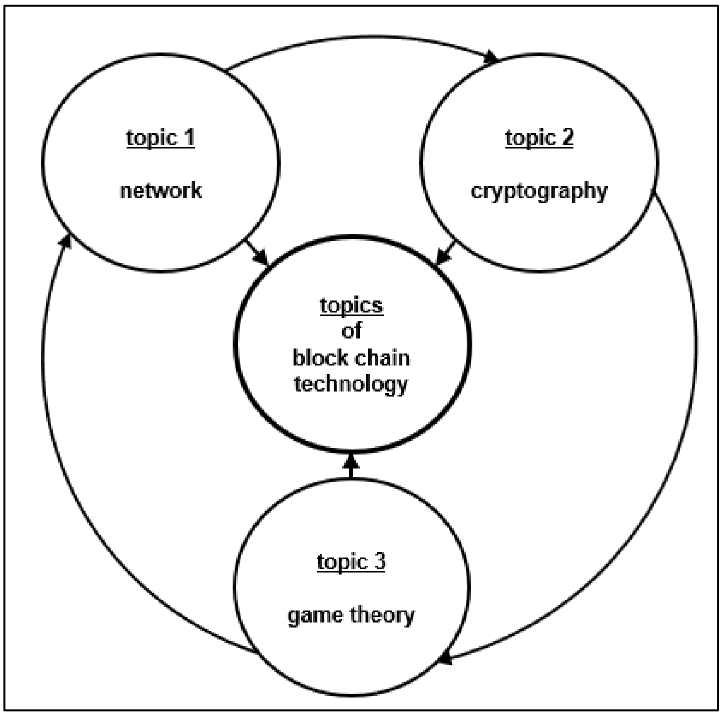
DLT is the superordinate general term. The blockchain is a certain type of distributed ledger, which is the focus of this work.

The special feature of the blockchain is the cryptographic signature (hash) for chaining the transaction data blocks (Azimdoust, 2018). The Walport definition focuses on cryptography as a tool for exchange and chaining.

According to a third definition (Glaser and et al., 2015) the associated management systems of a blockchain are referred to as consensus systems. The focus is on cryptography and peer-to-peer (P2P) principles. This means that the consensus of the individual transactions is no longer established by a central authority. In order to understand consensus building, game theoretical approaches should also be considered. Based on these definitions, three main topic areas were identified.

The blockchain works as a distributed database system. Transactions are cryptographically linked within this database system in chronological order (using a combination of private and public keys). The transactions are verified or falsified by building consensus within the system (Deloitte 2016). The following overview shows the topics that are necessary for a comprehensive understanding of blockchain technology.

Figure 22: Topics of the blockchain.



Source: Qwn elaboration based on (Schlatt, 2016).

Topic 1: network => structure of the blockchain.

Basis of a blockchain is a carefully selected and well-thought-out network infrastructure. The core of data management is no longer a central database, as previously stored on a computer (e.g. PC) or a server.

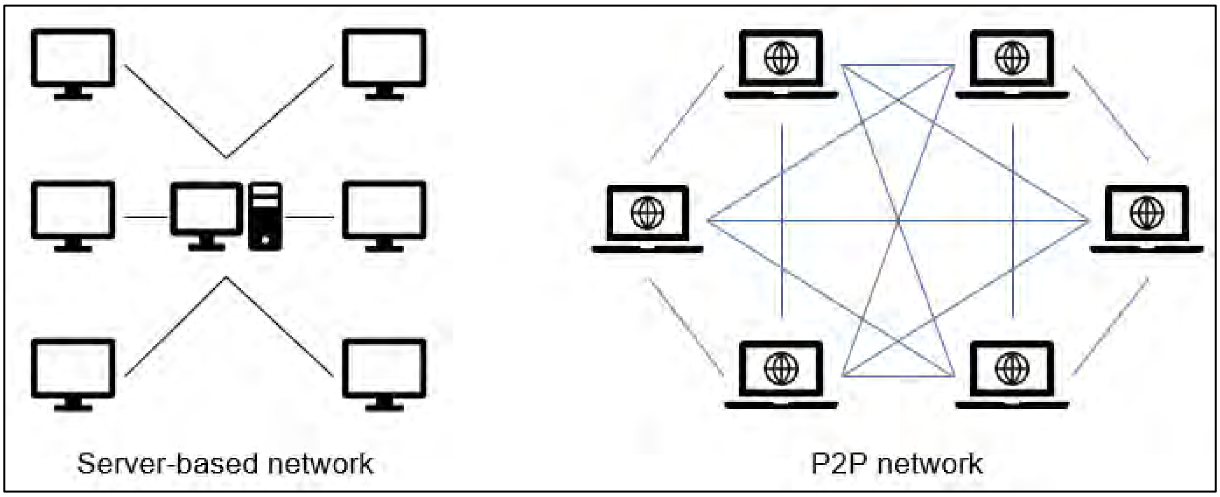
A transaction database is now created for all involved computers on which the protocol is executed (nodes). From now on, transactions between the individual nodes can be carried out worldwide without a central authority (e.g. credit institution as an intermediary) peer-to-peer (Tönnissen et al., 2018).

The individual transactions are replicated and verified by all nodes. This transaction continuously expands the transaction database. Furthermore, the procedure excludes the system-inherent weaknesses of a central database (single point of failure problem) and the manipulability of a central instance or by individual participants.

If, for example, a single database was manipulated as an element of the entire transaction database, this would be rejected by the other nodes. Manipulation would therefore have to be carried out on all nodes.

The following Figure 23 shows the difference between classic network architecture and the P2P (peer-to-peer) architecture. The latter represents one of the major strengths of DLT.

Figure 23: Network architecture.

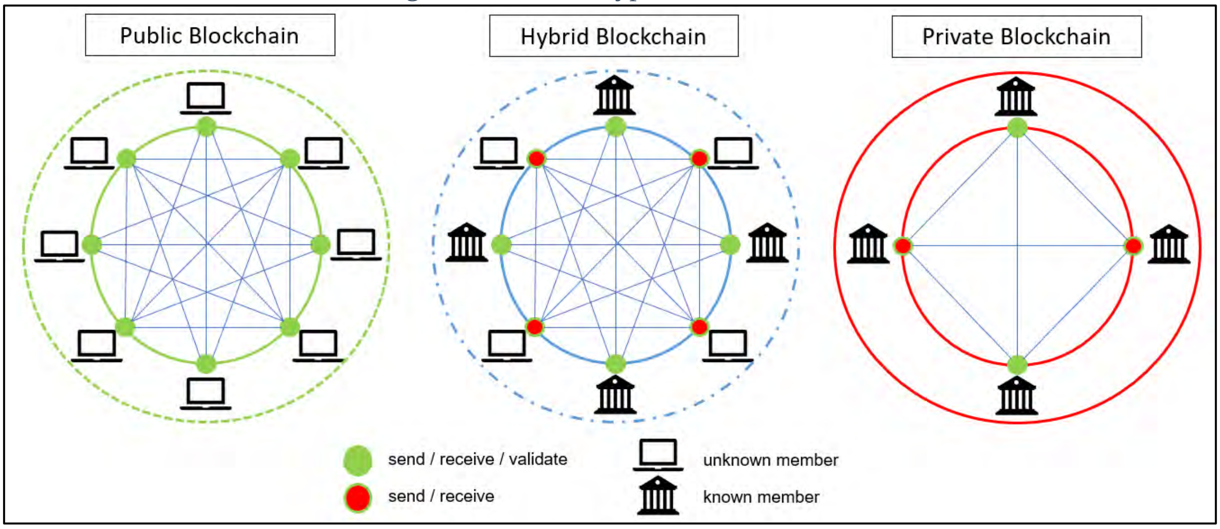


Source: Own elaboration.

Three blockchain network structures are currently used:

Public blockchain, hybrid/consortia blockchain and private blockchain (Zheng et al., 2017).

Figure 24: Current types of blockchain.



Source: Own elaboration based on (Jung et al., 2017).

Depending on the structure, the access rights remain limited. In the financial industry relentless for trust in the transactions. All blockchain variants have in common the typical characteristics like the timestamp, transactions and hash (Golosova et al., 2018).

The public blockchain has no access or transparency restrictions. In contrast to the other two network infrastructures, it enables each participant to validate and replicate transactions. However, this requires a combination of a private and a public key.

Blockchain private and hybrid networks, however, are subject to transaction restrictions. In this way, for example, only clearly identified participants can carry out validations and replications. In the case of hybrid networks, the number of network participants is limited, in the case of private networks this is only made available to selected participants.

The protocols of a private blockchain are not publicly accessible. That of a hybrid blockchain does not have to be publicly accessible. These two approaches are contrary to the original idea of a blockchain (Jung et al., 2017), however, they offer banks space for individual problem solutions (see chapter 3.8).

Table 21: Difference between public and private DLT.

Criteria	Public blockchain	Private blockchain
Access	Free read and write access.	read and write access controlled by authorisation.
Identity	Participants not necessarily knows to each other.	Participants known to each other.
Consensus mechanism	PoW/PoS.	Reliable network instances.
Transaction performance	Low – medium.	High – hyper performing.
Reliability	Low – medium.	High – remarkably high.
Flexibility	Possible with constraints.	Quick realisable.
Costs	no operator fees but high operating costs.	No operation costs but high operator fees.

Source: Elaboration based on (Seidel, 2019).

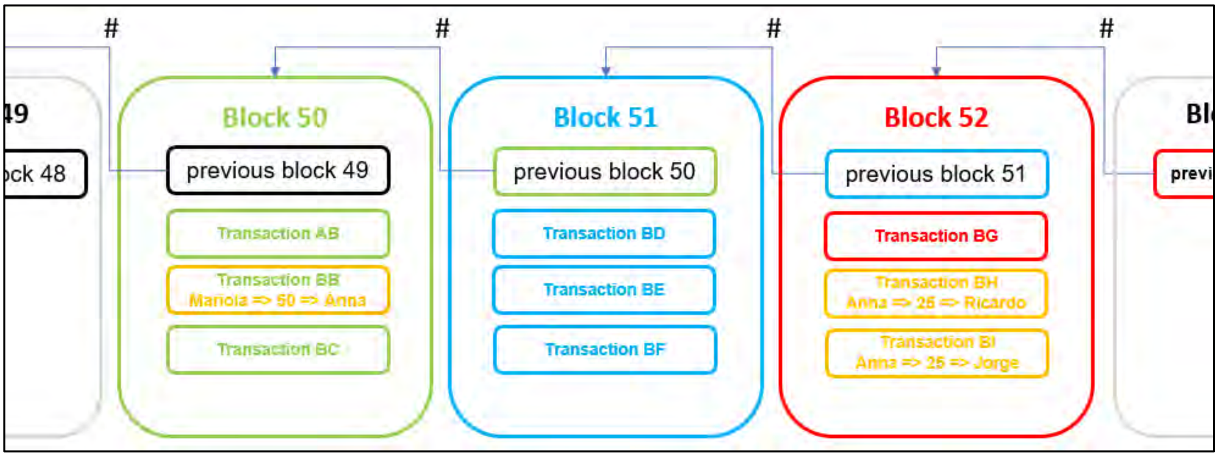
Topic 2: cryptography.

Without cryptography, block chain technology would not be conceivable in its current form. It is a central element in two application forms (Voshmgir, 2016). It is used for the verification of incoming transactions, such as their subsequent replication.

This is the inseparable attachment of another block of new transactions to the chain of existing blocks of transactions. The encrypted initial block is called genesis block. A block includes the current transactions and a summary of all previous transactions.

The link between the individual blocks is the hash value. Data transactions themselves can be of diverse origins, such as payment processing or the transmission of a cryptocurrency.

Figure 25: Schematic structure of the blockchain.



Source: Own elaboration based on (Plazibat, 2017).

The transaction blocks are validated for each participant in the network by combining a public and a private key. The keys are required for the receipt and exit of transactions.

The public key represents a kind of public reception address for incoming transactions of every network participant. Like a house number, this reception address is transparent for every network participant.

The private key is comparable to a digital signature. It serves to confirm outgoing transactions. When a new transaction is created, it is transmitted to the network either individually or already combined into a block and thus the entire transaction database.

A transfer is successful when the transaction (or the new block) has been verified by checking the sender's public and private keys. Only then will the new transactions be added to the chain of existing blocks. This further transmission to all nodes takes place using a second cryptographic method. As a result, all blocks contain encrypted information of all other preceding blocks.

Topic 3: Game theory.

Modern block chain technology would not be conceivable without elements of game theory. At its heart, the consensus protocols (PoW Proof of Work) are based on game theory considerations. This knowledge is also used to model the true intention of a counterparty and thus its trustworthiness. Considerations for incentivizing human behaviour (e.g. mining at Bitcoin) are also due to this.

Problem (thrust) of the Byzantine Generals.

An interesting game theoretical aspect (Abraham et al., 2011) is the handling of errors in a DLT (distributed ledger technology) system, known under the term *Byzantine generals problem* or *Byzantine fault* (Lamport et al., 1982). Components of a DLT system may fail and the information whether a component has failed or not may be imperfect (Siege of Byzantium).

To avoid a catastrophic failure of the system the nodes (generals) with different degrees of reliability must despite all agree on a concerted strategy.

In the case of a Byzantine fault one node can appear defaulted or still in function depending on the position of the observing device. Although it is difficult to identify a failed node the aim of the remaining actors is to shut this device out of the common network.

Advantages and disadvantages of the DLT.

The main benefit of this technology is its decentralisation. It can be used wherever a thrusted 3rd party is currently acting as an intermediary (Voshmgir, 2016). The currently still high costs represent one of the main disadvantages as well as the carbon footprint

A much more important disadvantage is that the apparent security of this technology can be overcome by more powerful computers (quantum computers).

Table 22: Impact of block chain on classical *universal banks' business model.*

Component	Pro	Contra	Expected or actual impact
A Thrust	No 3rd party necessary.	Corrective missing.	🡅 Challenges the role of the intermediary.
B Immutability of data	No change of a transaction possible.	No cancelability of a transaction in case of fraud.	➔ High control level DLT design necessary.
C Transparency	Each participant can read all data according to the design of the database.	public access to all data is not always desirable.	🡅 Protection of banking secrecy.
D High security	Individual entry to the network by public and private keys.	Loss of keys or all hardware.	🡅 Protection of cryptography towards more powerful technology.
E Pace of processing	Processing is faster.	Trade date versus settlement date logic could fall.	🡅 Faster processing always in two ways liquidity in and out.
F Energy consumption	Carbon reducing design.	High costs.	➔ Market barriers through high initial capital costs.
G Technology	DLT.	A weak node could break the immutability and transparency.	🡅 Cracking of the cryptographic by quantum algorithms => higher capital costs.
H Supervision	Cost reduction.	Transparency.	🡅 Supervisor can trust the DLT data.

Source: Own elaboration based on the insights of this subchapter and (Golosova et al., 2018).

Findings.

The classic role of credit institutions as well as exchanges as intermediaries are questioned by the DLT. Furthermore, a banks’ treasury will have to adjust to a much higher pace in asset liability management in the future. A corporate will be able to use a liquidity facility in nanoseconds, the bank must be able to fund it just as quickly (Carney, 2018).

In view of the short doubling cycles of human knowledge (5-12 years) and the ability to store knowledge on the World Wide Web (170 terabytes), it can be assumed that innovations will overtake this DLT. Users are therefore subject to continuous, cost-intensive pressure to innovate.

The DLT is to be designed in such a way that customers still have great confidence in the use of the data made available. Limitless interactions with regulators and tax authorities should also be considered.

In terms of overarching hypotheses (see Figure 4 on page 21) this technology has the greatest disruptive potential. This technique challenges the classic role of the intermediary and makes it virtually duplicable. Thus, a development regarding the hypotheses H3 through cooperation with *fintechs* or a revolutionary development towards H5 can be assumed.

This statement is supported by the presentation of the issue of a financial instrument (cf. Annex XI. on page lxv). Here, for example, the intermediary function of exchange operators and clearing houses is disruptively or revolutionarily challenged by the new technology.

3.3 Artificial Intelligence.

The contribution of this sub-chapter to the entire work consists in a short presentation of the meaning of artificial intelligence (AI).

AI is closely related to current social change. The development takes place from the information society to the digital society and perhaps to a smart digital society (Palomo Zurdo et al., 2019)

This technique is to be presented here to be able to discuss possible applications in the financial world.

Definition.

Artificial intelligence (AI) is a sub-area of computer science that deals with the automation of intelligent behaviour and machine learning. The term cannot be clearly delimited insofar as there is no precise definition of “intelligence”. Nevertheless, it is used in research and development.

In general, artificial intelligence refers to the attempt to simulate certain decision-making structures in humans. For example, a computer is built and programmed so that it can process problems relatively independently. Often, however, this is also used to refer to imitated intelligence, whereby mostly simple algorithms are used to simulate “intelligent behaviour”, for example in the case of computer opponents in computer games.

The understanding of the term artificial intelligence often reflects the enlightened idea of "man as a machine", the imitation of which the so-called strong AI aims to do: to create an intelligence that should mechanize human thinking, or to design and build a machine that responds intelligently or behaves like a human. After decades of research, the goals of strong AI are still visionary.

Determining a comprehensive definition of the technical term AI (Artificial Intelligence) is challenging due the variety of human behaviour (Kaplan et al., 2020). AI intents to duplicate the human way of thinking. This is exactly where the complexity of the definition rises exponentially.

First, what is human intelligence? The next step is to bring this complex concept to a machine.

Second, human behaviour tends to relieve mental strain once a machine was taught about AI to solve complex tasks. Furthermore, the observer tends to mentally impair a machine performance once it has been programmed. This is generally referred to as the AI effect

(McCorduck, 2004; Kaplan et al., 2019a). Due to this effect, the final definition of AI is a moving target. Thus, AI always seem to be one step ahead.

Third, different evolutionary stages are in literature observable. The span is spread from weak to strong AI. This means narrow to general to super-intelligence and can be classified into analytical, human-inspired, and humanized AI. All depending on its cognitive, emotional, and social competences (Kaplan et al., 2020).

Thus, AI in this context is defined as "a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation." (Haenlein et al., 2019).

Historical review.

Due to the extremely extensive development history, accelerated by technological knowledge of the Second World War, only one striking milestone is shown here every decade. All literal depictions go back to (Nilsson, 2010).

1950s.

Due to the scientific dialogue to generate an artificial brain (Webster, 2012) this field of research was founded as an academic discipline. The foundation stone for modern AI research was laid during the Dartmouth Conference of 1956 was organized by Marvin Minsky, John McCarthy and two senior scientists: Claude Shannon and Nathan Rochester of IBM (McCarthy et al., 1955).

1960s.

Several leading research programs have been pursued on the topics: Reasoning as search, Natural language, Micro-worlds. Belief in the power of artificial intelligence grew and culminated in an interview in Life Magazine: Marvin Minsky "In from three to eight years we will have a machine with the general intelligence of an average human being." (McCorduck, 2004).

1970s.

The first humanoid robot or android (WABOT-1) was developed by scientists of Waseda University in Japan. The "hands on" research project funding policy of MIT opened space for hacking.

1980s.

A revival of AI came up with the work of John Hopfield and David Rumelhart concerning connectionism. Derived from cognitive science, mental phenomena should be explained by using artificial neural networks (Hopfield et al., 1985; Rumelhart et al., 1999).

1990s.

The world chess champion Gary Kasparov was beaten by Deep Blue on 11th May 1997.

2000s.

AI started working behind the scenes. Algorithms of AI more and more are used behind data mining, industrial robotics, logistics, speech recognition, banking software, medical diagnosis, and Google's search engine.

Marvin Minsky asked why mankind was still not able to construct HAL 9000 (a character created by Arthur C. Clarke and Stanley Kubrick in 1968). His answer is that the scientists have been focused on economic benefit.

2010s.

The disciplines deep learning and big data came up through AI. The availability of data is seen as a new source of income.

Functionality.

AI enables the correct interpretation of external data, learning from it and using this knowledge. As a result, AI can achieve specified goals independently through flexible adaptation. Independent learning is also possible. There is talk of the design of intelligent agents (Poole et al., 1998).

AI is typically programmed to increase the likelihood of success in an analysed environment. AI uses for this so-called simple or complex utility functions or goals. As a result, AI can be used in medicine, for example, to develop remedies for serious to fatal diseases from the abundance of existing natural poisons (e.g. rattlesnake venom against heart attack) (Sánchez et al., 2001).

In connection with the target, reinforcement learning is important. Certain goals are rewarded (scoring) or punished. This can influence new behaviours. A so-called fitness function can be used to imitate animal behaviour to prefer to pursue certain goals (e.g. search for food). AI can also be so pronounced that it has the task of overcoming other functioning systems.

It is important for this work that AI can evaluate large amounts of data optimally and in depth. It is also able to recognize patterns in these large amounts of data. Therefore, AI is closely related to big data. The Internet of Things is also playing an increasingly important role in providing AI with the necessary external data.

AI is important for the financial environment in the following points (SAS, 2019b):

- *"AI automates repetitive learning and discovery through data."*
- *"AI adds intelligence to existing products."*
- *"AI adapts through progressive learning algorithms."*
- *"AI analyses more and deeper data."*
- *"AI achieves incredible accuracy."*
- *"AI gets the most out of data."*

This will make it possible, for example, to hand over simple, recurring processes to a learning machine, not only in banks but also in law and tax offices, compliance, financial management and banking supervision. In this way, the CIR (cost-income-ratio) could be reduced in an existing *business model*.

AI can also be used to collect credit characteristics from previously completely unknown customers and to condense them into a credit decision in fractions of a second (measurement of the user interface for the Quelle online catalogue or scoring by using postcodes).

Advantages and disadvantages.

The advantages of AI are clearly more powerful software and user interfaces. New questions from a wealth of scientific disciplines can be dealt with. AI also enables users to perform better data management and turn vast amounts of unstructured data into knowledge.

The disadvantages are currently the high start-up investments. Furthermore, not enough qualified programmers have been trained. Marketable products are also only in the making. These are obstacles that are limited in time. The more important question is whether AI can one day pose a threat to those involved and those not involved (McDermott et al., 2020).

Table 23: Impact of AI on classical *universal banks' business model*.

Component	Pro	Contra	Expected or actual impact
A Customer Engagement	Segmentation and insights.	Customers' acceptance, data integrity, operational risk by misuse.	↑ KYC will be possible on every platform.
B Operations	High standardized processes are possible, with a high degree in flexibility meeting demand growth.	The high speed can be both a curse and a blessing.	↑ banks will change to technology platforms
C Risk & Compliance	Cost reduction possible by automation of manual tracking and reviews, real time tracking will be possible (d-t-d results).	Rising cyber risk.	→calculating daily results would be a competitive advantage defending the existing business model
D Strategy	Strategic orientation by identification of patterns.	Egocentric alpha animal behaviour of management.	↓ only a weak impact is imaginable
E Sales	Offers of the salesforce even a cost covering pricing is imaginable.	The importance of personal contact with the customer should not be underestimated.	→ improvement on competitive advantages
F Corporate Functions	Asset and Liability Management could benefit.	High pace.	↑ funding patterns might change
G Channels	Responsiveness 24/7.	Digital affinity of all customers.	→ all groups of clients should remain involved in the support process
H Core-Functions	Higher efficiency of transactions; cost-cutting.	The algorithms can only reflect the habitus of the human sponsor.	↑ Downsizing and technology platform

Source: own elaboration based on the author's assumptions.

Findings.

AI can question the classic *business model* of incumbent *universal banks*. The classic core competence includes assessing the creditworthiness of customers and "onboarding" in the sense of the KYC (Know-Your-Customer) process.

With AI, this process can now be carried out efficiently and quickly by providers other than banks. These non-financial companies often have completely different insights.

The fact that customers were willing to reveal much more about themselves on their platforms than they would have done to your bank. Additive reading of data from Facebook, Instagram or similar social media is particularly critical here.

AI on the other hand can enforce the classic business by adding cost-cutting-potential. Nevertheless, even in this case, classic *universal banks* maybe would have to transform themselves into cost intensive technology platforms (or contractually secure the capacity).

3.4 Big data.

Already at the beginning of the past decade, big data was proclaimed the gold of the future (Lohr, 2012). To date, this view has not changed (Janczura, 2019). The evaluation of personal data provided voluntarily by users of social media, for example, is referred to as the gold of the future. Based on this, new *business models* are being worked on (Leichsenring, 2020), e.g. for proactive needs detection.

The contribution of this sub-chapter to the overall analysis is to examine the potential of Big Data for a change in banks' classic *business model*. For this purpose, the term is defined, a historical outline is conveyed, and its functioning is presented. Before typical bank-specific use cases are shown, advantages and disadvantages are discussed.

Big Data is a collective term for a conglomerate of digital technologies that, on the one hand, help to gather the data, manage its powerful data volumes and, on the other hand, evaluate them. This technology is also made responsible for social change (Reichert, 2014).

Definition and historical review.

Contemporary literature is recognizable over the past two decades at least 3 different nuances of a definition. The range of meaning reaches from a simple inventory of technological possibilities, to the idea of generating added value to concrete technical sketches. These are generic to better understand the term big data:

2001.

The term big data was first encompassed (not named) in a Meta (now Gartner) report. At that time, a trend in data handling was forecast, described by a three-dimensional definition: “Volume, Velocity and Variety”, the three “Vs”.

The three terms represent:

- Volume scope, data volume
- Velocity pace of generating and transferring data volumes
- Varity bandwidth of datatypes and sources

2012.

This definition was confirmed by Gartner and NIST[23]. IBM added a fourth V to the definition:

- Veracity Authenticity of data and trust

By Oracle, big data is an inclusion of additional data sources to augment, existing operations. Thus, big data is the derivation of value from traditional relational databases enriched with new sources of highly unstructured data. The sources may be blogs, social media, sensor networks, image data and other sources varying in size, structure, and volume.

Functionality.

Big data refers to structured and unstructured volumes of data that are often too large and too complex to be evaluated with conventional IT instruments (Dumbill, 2012).

Since 1980, the global information storage capacity per capita has been doubled every 40 months on an analogy basis (approx. 2.6 exabytes $2.6*2^{60}$ bytes on video tapes, cassettes, micro fiches…). At the time, however, only about 1% of human knowledge was stored on a digital basis (Hilbert et al., 2011a). As early as 2007, up to 94% of human knowledge was stored digitally, with a daily growth of 2.5 exabytes ($2.5*2^{60}$ bytes). In 2025, a stored data volume of 163 zettabytes ($163*2^{70}$ bytes) is predicted (Reinsel et al., 2018).

Against this backdrop, big data often is referred to as the gold of the future (Janczura, 2019). The main components of Big data are characterized as follows (Manyika et al., 2011):

- Analysing techniques (e.g. A/B testing and machine learning) (OLAP data cubes are predecessors of these techniques (Excel based in the 90ies))
- Big data storage technologies like cloud computing and multilayer databases
- Complex visualisation techniques (e.g. three-dimensional graphs).

Advantages and disadvantages.

A positive example is the search to be able to open efficient uses of natural poisons via big data pattern recognition. Human knowledge is not yet pronounced enough here. For example, snake venom is used to relieve the effects of strokes (reduction of blood clot formation by otters venom) (Condrea et al., 1964).

Contemporary literature states that large volumes of data do not necessarily lead to better pattern recognition. Here too, false acceptances such as erroneous rejections must be

[23] National Institute of Standards and Technology (U.S. Department of Commerce).

avoided. Furthermore, careful handling of big data is advisable, since misuse can quickly lead to reputational risks (Bottles et al., 2014).

Table 24: Impact of big data on classical *universal banks' business model*.

Component	Pro	Contra	Expected or actual impact
A Cost Savings	Possible in the long run.	Large start-up investment required => especially data structuring and cleanup necessary.	🡻 powerful instrument but at the very moment only additive to current *business model*
B Per-formance	Chance to build an integrated data set of internal, external and media data.	Very often no clearly defined unique data infrastructure.	🡻 only an enforcement of the current *business model*.
C Strategic Edge	Better customer focus and efficient risk measurement possible.	Higher concentration on IT knowledge:	🡻 Support of current *business model*. Only disruptive element could be the change to a higher IT competence (but it is source able).
D Reliability	Robust and reality tested algorithms after a while thinkable.	Time series will be necessary => danger of wrong decisions thinkable => reputation risk.	🡻 Only enforcing the current *business model*.
E Flexibility	Established, open and robust master data management framework necessary for structured and unstructured data sets => same positive effect as with US SOX requests thinkable.	An integrated, merged open dataset might be vulnerable towards cyber risks.	🡻 seems to be a tool making a clean-up of own datasets necessary.

Source: own elaboration based on the author's assumptions.

Interim Conclusion.

In combination with AI and ML (Machine Learning), this technology clearly shows the potential for stabilizing H1. Use would be discriminatory (H3) if non-financial service providers could identify potential demand for banking services.

The willingness of potential customers to use banking services based on this would then have to be sustainably high. The risk of misinterpretation and misuse increases.

3.5 Cloud computing.

The contribution of this subchapter is a brief description of cloud computing. This is a technology that has been increasingly mentioned in contemporary literature since 2006.

However, its roots can be found in the previous century. Towards the end of this technological excursus, advantages and disadvantages are presented.

Regarding the overarching hypotheses (see Figure 4 on page 21), an interim conclusion is drawn in the search for the location of the effects of this technology on the classic *business models* of the *universal banks* examined.

Definition

There is no single definition in contemporary but the NIST[24] definition is in lead even by European authorities!

“Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models” (Mell et al., 2011).

Cloud computing was driven by the economic needs of *bigtechs* like Google and Amazon (Qian et al., 2009).

Historical review.

The historical outline of this technological development is much less complex than, for example, the presentation of the development of DLT or AI. Nevertheless, only a few striking milestones are mentioned here.

1960s.

Stand-alone mainframe: RJE (Remote-job-entry) came up as a time-sharing concept. The communication concerning data processing between external workstations and mainframe computers was optimized.

[24] NIST: National Institute of Standards and Technology – US Department of Commerce

1970s.

Evolved mainframes with virtualization: Full time-sharing solutions in data processing between workstations and the mainframe were available. Predominant at that time were solutions from IBM.

1980s.

Client-server systems and local area networks (LANs) come to existence.

1990s.

On-premises ERP offerings and early cloud solutions (i.e., salesforce CRM): Telecommunication companies started offering VPNs (Virtual Private Networks) connecting private networks through public networks (A technical solution visitors of the Republic of China are using even nowadays).

2000s.

Amazon released Amazon Web Services (based on its Elastic Compute Cloud (EC2)) in August 2006. Google followed with its Google App Engine also in August 2006. In 2008 NASA's OpenNebula became the first open-source software for different types of clouds (e.g. private and hybrid clouds).

Today.

Cloud solutions (applications, data centres, APIs and storage): On February 2010 Microsoft Azure came up and IBM started on March 2011 with its SmartCloud and on June 2012 Oracle released the Oracle Cloud. The latter IT solution is the first solution which included the applications SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service).

Functionality.

In this strong service-oriented architecture every application is deployed as a service (aas). The providers of cloud computing applications are offering their services according to different models. These models have been standardised by NIST (Mell et al., 2011) to three models:

NIST definition of IaaS (Infrastructure as a Service):

"IaaS refers to online services that provide high-level APIs used to dereference various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc." (Mell et al., 2011)

NIST definition of PaaS (Platform as a Service):

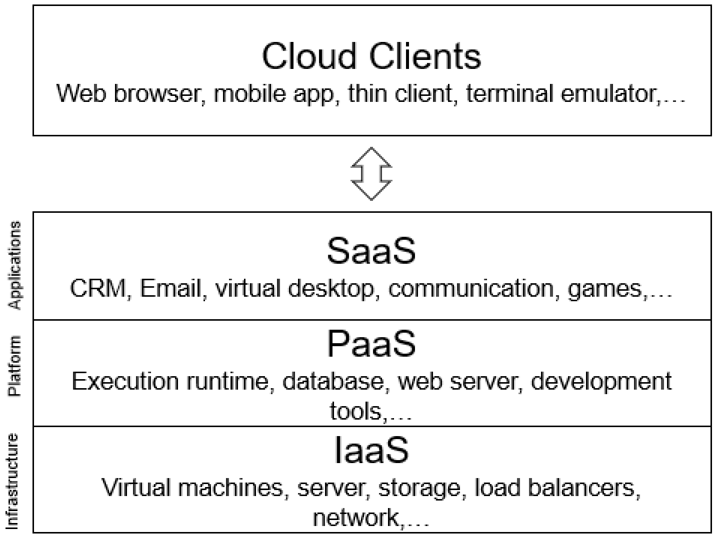
"The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment." (Mell et al., 2011)

NIST definition of SaaS (Software as a Service):

"The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings." (Mell et al., 2011)

The different service models very often are arranged as layers in a stack.

Figure 26: Cloud Computing Service Models.



Source: Elaboration based on (Duan et al., 2015).

The models are offering an increasing degree of abstraction and functionality. A user for example can use SaaS on physical machines without using underlying PaaS or IaaS layers.

The other way around a user can demand an application with direct access on IaaS without a SaaS application.

Cloud Computing's key potential lays in using permutations of the service models.

Advantages and disadvantages.

One of the biggest advantages of cloud computing is the potential to reduce costs. Hardware and software will no longer have to be created in-house but can be booked by service providers.

Another highlight is the ability of the cloud to have almost unlimited data storage capacity and to be able to adapt to changes seemingly infinitely quickly.

These advantages also represent the disadvantage that it will be difficult for an individual company to develop a unique selling point. This is particularly important in view of the interchangeability of the banking products (and thus the apps).

Another disadvantage is the question of data security. On the one hand, the companies participating in the cloud want to be sure that they have sovereignty over their data, on the other hand, the risk of cyber-attacks is increasing (cf. subchapter 3.9 on page 146).

A private cloud for instance could provide the companies with the security they need.

Table 25: Impact of cloud computing on classical *universal banks' business model*.

Component	Pro	Contra	Expected or actual impact
A Cost Savings	No high capital cost. No physical hardware necessary. The cloud service provider invests in hardware.	Downtime and lacks in support could hit a bank suddenly and cost intensive.	➔ could help to improve a bank's CIR
B Per-formance	High speed is possible. Services are deployable in a few seconds.	Performance can vary because the application is running on a server which must provide resources to other applications.	➔ improvement for existing *business models*
C Strategic edge	The latest applications are available any time. Software integration occurs automatically.	Banks are obliged to open their platforms. Customers would be able to demand apps from different credit institutions.	🡅 Downsizing and technology platform
D Reliability	Immediate updates of the changes of the data.	All sensitive data is shared with a third-party service provider. This provider could be influenced by a government or hacked.	🡇 currently still an obstacle to work extensively with the cloud
E Flexibility	Quick deployment of new customers. Unlimited Storage Capacity. API Access available.	A single branding would be challenging for a individual bank.	🡅 Downsizing and technology platform

Source: own elaboration based on the author's assumptions and (Rungta, 2020).

Interim Conclusion.

Cloud computing is suitable for preserving an existing *business model* in accordance with the overarching hypothesis H1. Evolutionary steps in reducing costs are conceivable.

The banks themselves, however, will also tend to use fintech's expertise to acquire them here, in line with hypothesis H3.

The platform concept with API access could be critical regarding the revolutionary questioning of existing *business models* aligning with H5.

As a result, banking services are possible quickly and anywhere without a bank as an intermediary. The pressure of a traditional bank could increase because of developing into a technology platform.

3.6 Quantum computing.

This subchapter introduces one of the basic technologies identified in chapter 3.1. It examines its disruptive potential to threaten the classic *business model* of a *universal bank* (role of the intermediary).

In the further course of the work (Chapter 4) *fintechs* and *bigtechs* are presented, which could also use this basic technology. In this way, the classic value chain of a *universal bank* could either be optimized or destroyed (by duplication by an external aggressor like a *bigtech*).

The special quantitative analysis of the current impact of this young basic technology on existing *business models* is not possible in Chapter 5 due to the lack of separate data.

Nevertheless, the reader should be given an impression of which technologies could form the basis of future banking.

Definition.

A quantum computer contains processors that process the information according to the laws of quantum mechanics. Classic computers, on the contrary, process the information according to the laws of classical physics.

This means that registers and memory contents contain only one information at a time (Wilhelm, Frank K., et al, 2018).

Quantum computers differ from classic computers in that they process information quantum mechanically. As a result, registers and memory contents can overlap several values simultaneously. A single quantum processor is thus able to act like several conventional processors at the same time.

Historical review.

About 20 years ago, quantum computers were introduced as hypothetical, theoretical constructs (Wilhelm, Frank K., et al, 2018).

The development was triggered by the fact that the continuous reduction of the transistors of classic processors would reach its limits.

In addition, increasing inefficiencies of the calculations can be observed with decreasing size. These can lead to data loss or incorrect calculations, for example (Bone and Castro, 1997).

Many scientists have been researching individual questions since the 1950s, the answers to which are building blocks of today's known technology (Fortnow and et al., 2003).

Two of the scientists are particularly noteworthy. Laureate Richard Feynman developed the idea in 1982 to use the laws of quantum physics for processors. At the time, he came to the conclusion that conventional processors would not be able to efficiently simulate quantum systems (Montanaro, 2015).

Another significant development was contributed by Peter Shor in 1994. He developed the algorithms that he used to demonstrate that computers can efficiently factor large integers. As a result, the Quantum computer was superior to the RSA[25] public key cryptosystem on which the security of the Internet is based (Montanaro, 2015).

In 1996, Lov Grover's algorithm helped to better master one of the biggest problems in computer science. It made faster searches in large databases possible (Montanaro, 2015).

Functionality.

Quantum processors work based on the use of quantum mechanical principles, which include

a) the superposition principle and

b) quantum entanglement.

The first principle a) denotes a state of quantum mechanics. What is meant is a superposition of the same physical quantities that do not interfere with each other. Holography is important here.

The second principle b) relates to the behaviour of a composite physical system versus its subsystems. For example, a system with several particles can assume a well-defined state without it being possible to assign a well-defined individual state to each of the subsystems.

This means that a quantum processor can go beyond the basic states 0 and 1 (current/ non-current) of a bit, the cornerstone of a classic computer. A quantum bit, also qubit, can exist, for example, in the classic state 0 or 1 and at the same time in a coherent superposition.

The idea is comparable to 2 parallel universes. In the first universe, the qubit assumes the state 0 and at the same time the counter position 1 in the second universe.

Appropriate handling of quantum circuits (quantum mechanically permitted gates) is necessary to coordinate the parallel states, for which appropriate algorithms had to be developed (Shor algorithm, Grover algorithm) (Lomonaco, 2002).

[25] Rivest–Shamir–Adleman algorithm for asymmetric encryption and decryption.

This enabled quantum computers to efficiently search large databases, learn by machine, and calculate simulations. They form the basis for other disruptive technologies that could change the classic role of the *universal banks* as intermediary.

The table below summarizes the current and expected impacts from the literature and discusses them in terms of the aim of this dissertation.

Table 26: Impact of quantum computing on classical *universal banks' business model*.

Component	Expected or actual impact	Pro	Contra	assumed impact factor
A	powerful tool for blockchain technology.	High relevance to cryptography.	Quantum secure cryptography will be necessary.	↑
B	powerful tool for artificial intelligence.	Better customer service, better understanding of the customer, KYC.	Possibly high initial investment and maintenance costs	→
C	powerful tool for data analytics		Misleading information	→
D	Deep learning => quantum machine learning.		Wrong customer exclusions Wrong advertising.	→
E	portfolio optimization.	Could be an afford to wealth management and corporate clients.	Possibly high initial investment and maintenance costs	→
F	find arbitrage opportunities.	Classic task of proprietary trading.	Banks are lowering these units due to regulatory conditions.	→
G	Quantum amplitude estimation.	High relevance to risk management (e.g. Monto Carlo Simulation, pricing of derivatives).	Possibly high initial investment and maintenance costs.	→
H	cost aspect.	Could help to lower CIR.	Possibly high initial investment and maintenance costs.	→

Source: Own elaboration based on (Orús et al., 2019).

An arrow pointing up indicates a potentially strong impact on the change in the *business model* of a classic *universal bank*. Block chain technology (A) strengthened by quantum computers will make it possible to replace the role of a bank's intermediary more quickly.

The other components (B-F) are classified as a supplement. None of the components will not affect the *business model* of a *universal bank* at all.

According to a study by the University of Saarbrücken, commissioned by the BSI (German Federal Office for Information Security) in May 2018, quantum computers are not yet as far as they are today.

They could not yet threaten the encryption of a blockchain and manipulate the transactions of all nodes (Wilhelm, Frank K., et al, 2018).

It is conceivable, however, that an industrialized nation that specializes in research in this area will soon have the necessary performance, expressed in qubits * SC cycles, for the error rate.

Computing services can already be purchased from IBM (IBM QX3) or Fujitsu. Google is also investing privately in this technology (google Xmons). The joint development with NASA (D-Wave Systems) did not seem to be sufficient for the purposes(Anthony, 2014).

Interim Conclusion.

What is important for this dissertation is the fact that quantum computing acts as a new basic technology. Block chain technologies, AI, big data, and others will become much more powerful in the future.

In the initial phase, computing power will be expensive to acquire, as the credit institutions do not currently operate their own quantum computers (Michael, 2019).

In the long term, this technology can make a contribution to reducing a bank's CIR and increasing earnings after start-up investments (Matt Langione et al., 2019).

3.7 Other technological drivers.

The task of this subchapter is to illuminate the abundance of accompanying technological innovations. The position of a CIO (Chief Information Officer) is focussed, who must be familiar with these technologies to assess their importance (Strickland, 2011).

An attempt is eighter undertaken to at least describe the impact of these technologies on the classic *business models* of *universal banks*.

Internet of Things.

Is considered being the future of technology. There are billions of connected devices – from industrial machines to smart cars to smart watches – use built-in sensors to gather data.

In case of financial industry billions of electronic devices like smart phones, tablets, ATMs (Automated Teller Machines), wearables could provide a database system with consumer specific data (Khanboubi et al., 2019).

This connectivity is already a new reality. Analytics and AI are the methodologies to bring to bear to transform this data into intelligence. The exciting question is how an industry that mainly deals with financial instruments (IFRS 9 A) in a broader sense could make use of physically backed data points.

The main idea found in recent contemporary literature is to improve customer interaction (Ramalingam et al., 2019). The aim is to gain deeper insights of customer behaviour e.g. in retail banking.

For this purpose, for example, the camera eyes of the ATM (Automated Teller Machine), which is distributed worldwide, can be used or data obtained by electronic means that the customers are willing to carry with them (tablet, smartphone, wearables).

In principle, a shocking scenario that leads to total surveillance in the sense of George Orwell (1984). The possible advantages of faster and more comprehensive insights must be weighed against a possible aversion of the customers.

Open API.

The technical term Open API (Application Programming Interfaces) is a means of data accessing by third parties deployers. Since 2015 they have been enabled to build banking service applications and to share them on a public interface. The banks' data accesses are since then no longer exclusive "private" accesses protected by the individual company. According to customer requirements, the data must now be shared.

Thus, open banking allows the networking of accounts and data across institutions. Open banking was accelerated in 2015 when the European Parliament passed the revised Payment Services Directive (PSD II) (Mock et al., 2015; Lademann, 2020).

Machine Learning.

Machine Learning (ML) is interpreted as a subset of Artificial Intelligence (AI). It is considered as computer algorithms improving without being explicitly programmed (Samuel, 1959). Based on sample data (training data), a mathematical model uses to be improved automatically in a way, that predictions and even decisions are possible.

ML is at the heart of autonomous driving. With a view to banking services, ML can better focus on the customer. This enables the banks to break through the previous one-way street of added value through customer-specific data extraction. Banks will be able to offer customers banking services that are specific to their life phases, for example, thanks to stringently used ML. This technique can also enable banks to make better autonomous decisions and even risk specific predictions (Gogas et al., 2018; Divasson, 2019).

Biometrics.

In principle, biometrics refers to a science dedicated to the measurement of living beings and the associated measurement methods. Christoph Bernoulli was one of the first scientists to use this term in his work in 1841 (Bernoulli, 1841). It is a statistical measurement of the life of living beings. Therefore, the term also includes two facets. This refers to biometric statistics and biometric recognition procedures. The latter is at issue in this work in connection with the impact analysis on banks' *business models*.

It is only today's information technology that can provide the computing power required for digital recognition processes.

The recognition of persons plays an increasing role in the banking services environment. The idea is to be able to make these available digitally 24/7 and thus enable customers to access their accounts in a unique way.

To this end, biometric characteristics must be identified which fulfil the conditions of uniqueness, constancy, measurability, and universality.

Common biometric characteristics include fingerprint, facial geometry, iris, signature, voice, typing behaviour. In this way, unique access codes can be identified that are more secure than, for example, knowledge-based access, which is still common today. Sometimes the way is chosen to combine different procedures. Knowledge-based queries of the access code, coupled with typing behaviour, are intended to increase the security of access. A powerful biometrics software is characterized by extremely low false acceptance rates and false rejection rates.

Even the combination of biometric identification techniques and AI increases efficiency from the current point of view. A threat to the overall *business models* of banks (in the sense of the superordinate hypothesis H5) is also not discernible by the combination of techniques. An extension of existing *business models* is possible through the possibility of reliable, fraud-proof onboarding of customers (KYC Know Yours Customer), which considers data protection guidelines. This with the background of providing reliable access to different nodes of the financial *ecosystem*.

Robotics.

RPA[26] is a software-based approach where robots mimic people in repetitive, rule-based processes. Located at the user interface, features the robot has the same work instructions and access rights to the programs as human beings.

In this way, it carries out the corresponding process steps just like an employee, without the need for additional interfaces or IT adjustments. Basically, robots work on virtual machines, they are scalable and can be used around the clock.

This enables the automation of both end-to-end processes and very much smaller activities. Human intervention is only required in exceptional cases or when there are intended control steps (e.g. 4-eye checks).

With the help of RPA, complete workflows can be determined through an existing IT infrastructure that has grown over decades. The machine is then able to perform the flow end-to-end.

An RPA solution is therefore able to independently extract data from source systems, process it, record, and send associated information by sending emails independently.

[26] Robotic Process Automation.

In addition, an RPA solution can carry out general ledger and subledger reconciliations, perform calculations and make decisions. Finally, it can perform performance monitoring for each business transaction and run reporting independently.

In this way, the advantages of the solution are more likely to be attributed to the strengthening of existing *business models* through massive cost-cutting.

Wearables.

Wearables be another external data provider that enables synchronization with the daily life of the owner (EY 2018). In combination with IoT, CC, AI, BD[27] predictions about potential customer behaviour could be made. A bank’s treasury department could, for example, derive a sudden increase in liquidity demand and anticipate it. This medium can also be used to gain greater insights into individual customer behaviour.

As a result, private customers practice external reporting, like companies. The main difference, however, is that the external reporting follows commercial law standards (IAS / IFRS). However, the evaluation and interpretation of the data streams obtained via wearables has so far only been subject to rudimentary legal regulations.

A negative example of the recent past is the publication of American military personnel's jogging trails on the Internet (Sly, 2018).

XR Extended reality.

Extended reality is a digital concept that comprises augmented reality (AR), virtual reality (VR) and mixed reality (RM) technologies. This term was created to cluster a variety of applications based on the same technological concept.

Banks assume that virtual bank branches can be set up, in which customers can be advised by chatbots, especially in the retail business. That will not work in the area of wealth management.

Furthermore, the digital affinity of customers in the retail business is not equally distributed. The wealthier older customers do not use the devices.

[27] IoT Internet of Things, CC Cloud Computing, AI Artificial Intelligence, BD Big Data.

Table 27: Impact of other technological drivers on classical *universal banks' business models*.

Component	Pro	Contra	Expected or actual impact
A IoT	Better and faster credit assessments through a deeper understanding of customer behaviour.	People are and remain different. The algorithms used can only be as good as the client's mindset. The operational risk potential is extremely high if the customers have been disappointed in the long term.	🡻 low impact on the banks' classic *business models*. Must be used with care. 🡺high potential in combination with other innovative technologies.
B Biometrics	Higher security => two-step authentication.	Cyberrisk and user protection (avoidance of disfigurement).	🡻 low impact because it is an additive access tool
C Open API	More competition => effective banking services possible.	Cyberrisk will rise.	🡹 high impact => door opener to external *ecosystems*
D Robotics	Cost cutting is possible by optimising internal processes e.g. in the so-called accounting factory.	What about an automated FX-position calculation and nobody can understand the real meaning of this position due to a lack of documentation.	🡻 low impact on the banks' classic *business models*. This is more an additive technology to optimize existing *business models* by cost cutting.
E Machine Learning	Customer focus and risk prediction.	Cost intensive process and at the end ML must avoid wrong acceptances and wrong rejections. Juridical consequences thinkable due to wrong decisions taken by a machine.	🡻low impact considered as an additive tool which is at the beginning of its development.
F Wearable	Deeper insights in customers' behaviour.	Acceptance of "24/7 monitoring".	🡻 low impact on the banks' classic *business models*. Only additive to other data sources. Customers can not be forced to wear a smart watch.
G XR	Cost cutting is possible due to virtual branches. No physical brick and mortar branches necessary.	Never underestimate digital affinity of the customers. A low acceptance is expectable.	🡻 low impact on the banks' classic *business model*. Only a supplement like video-based onboarding of customers.

Source: own elaboration based on the author's assumptions.

Interim conclusion towards overarching hypotheses.

None of the technologies mentioned in this chapter per se has the facilities, as the classic *business model* of *universal banks* in the sense of the overarching hypotheses question disruptively H3 or revolutionary H5.

On their own they can only have a complementary effect in the sense of H1 and contribute to enabling evolutionary changes to existing *business models*. This is done by gradually adapting to changing customer behaviour.

At most in combination with other technologies (e.g. AI), these technologies could contribute to a massive change.

An example of M2M (Machine-to-Machine) connectivity (Main Incubator and Mercedes Trucks) should be mentioned here. Tokenized central bank guaranteed EUR was made available to a freight forwarder. It posts these autonomously driving trucks in the black box, which can then autonomously manage their energy supply, tolls, and parking fees.

Against this background, for example, IoT in combination with other technologies offers the potential for developing new *business models*.

3.8 Use cases of the new technologies.

The use cases of the new digital technologies listed above were researched on the Internet. The name of the technology was entered via google with the addition "in banking". The individual source was selected discretionarily, based on the consulting companies identified by Forrester as the technology drivers.

The following tabular overview shows first impressions of dominant use cases of the described technologies, obtained from current literature. The use cases are subdivided into the supply (S) and demand (D) view.

Table 28: Technology use cases according to consultants.

No	Technology	Supply (S) or Demand (D)	Dominant use case	Source
1	DLT	S + D	Bitcoin as well as quick use of investing and funding alternatives: - Capital Markets - Trade Finance - Cash on Ledger - Identification.	(Sandner et al., 2020)
2	AI	S	Retail Banking.	(CBInsights, 2020)
3	BD	S	Risk assessment.	(S&P Global, 2020)
4	CC	S + D	Data storage and exchange.	(Murex, 2020)
5	QC	S	Quantum for speed and accuracy.	(IBM, 2019)
6	IoT	S	Tracking via IoT devices (payment trigger).	(SAS, 2019a)
7	Biometrics	S	Banking security.	(Venkatraman et al., 2008)
8	Open API	S + D	Partnership *ecosystems.*	(IBM, 2016)
9	Robotics	S	Documentation.	(comtechinfo, 2018)
10	ML	S	Customer focus, risk modelling, natural language.	(SAS, 2020)
11	Wearables	S	Accelerating the information value loop.	(Deloitte, 2016)
12	XR	S	Retail banking.	(BBVA, 2019)

Source: Own elaboration based on various sources of consultants.

This tabular overview can be read in conjunction with the graphic (Figure 27 on p.145).

Regarding the classification of the technologies in the context of the overarching hypothesis, the following picture emerges:

Table 29: Impact of new technologies on banks' *business models*.

Chapter	New disruptive technology	Observed impact on the entire banks' *business model*	Argumentation towards the overarching hypothesis (Figure 4 p.21)
3.2 BC	Blockchain	High impact => could become a "game changer" making incumbent banks as intermediaries redundant.	H3, H5
3.3 AI	Artificial Intelligence	High impact => *bigtechs* could offer better financial service products in the retail market.	H1, H3, H5
3.4 BD	Big Data	Low impact => The impact rises together with other technology (AI and CC). Better proactive customer service might be possible as well as predictive risk modelling.	H1, H3
3.5 CC	Cloud Computing	Medium impact => might reduce the need for data owning at 100%.	H1, H3
3.6 QC	Quantum Computing	High impact => high performing technology if robust => can threat the entire cryptography of an incumbent bank.	H3, H5
3.7 Oth1 IoT	Internet of Things	Low to medium impact: measuring of physical trigger events for granting a credit or emitting a bond is possible as well as high access security.	H1, H3
3.7 Oth2 Bio	Biometrics	Low impact => additional access security.	H1
3.7 Oth3 Open API	Open API	High Impact => potential game changing technology => door opener to non-financial *ecosystems* (Alexa, Siri, …).	H5
3.7 Oth4 Robotic	Robotics	Low impact: cost saving potential => documentation and creating of interfaces between archaic IT systems.	H1
3.7 Oth5 ML	Machine Learning	Medium impact: digital decisions as well as predictive answers possible.	H1
3.7 Oth6 Wear	Wearables	Plays only a subordinated role thus low impact.	H1
3.7 Oth7 XR	Extended Reality	Plays only a subordinated role thus low impact.	H1

Source: Own elaboration based on the insights of chapter 3.

The extremely versatile DLT clearly has the greatest potential to bring about change (cf. Annex XI. on page lxv: the example of a digital emission from a structured financial instrument). Even technological, network-specific restrictions (e.g. performance and high-power consumption) seem to be solved. The American provider [http://www.lightspeednt.com/www/clients.asp] is cited here.

In between conclusion: a tendency towards the main hypothesis H1 (supporting the incumbent *business model*) and H3 (disruption) is remarkable. Only few technologies bear the potential towards hypothesis H5 (revolution).

The technologies that have the potential to become a "*game changer*" are shown in the following graphic in red in the "House of Finance". Technologies with perceived low potential to change the *business model*, however, in grey colour. Yellow underlines the higher potential of becoming a game changer often in combination (e.g. AI + ML + BD + CC).

Furthermore, the following graph shows in a simple way the *business model* of an incumbent bank based on its group balance sheet (according to IAS/IFRS).

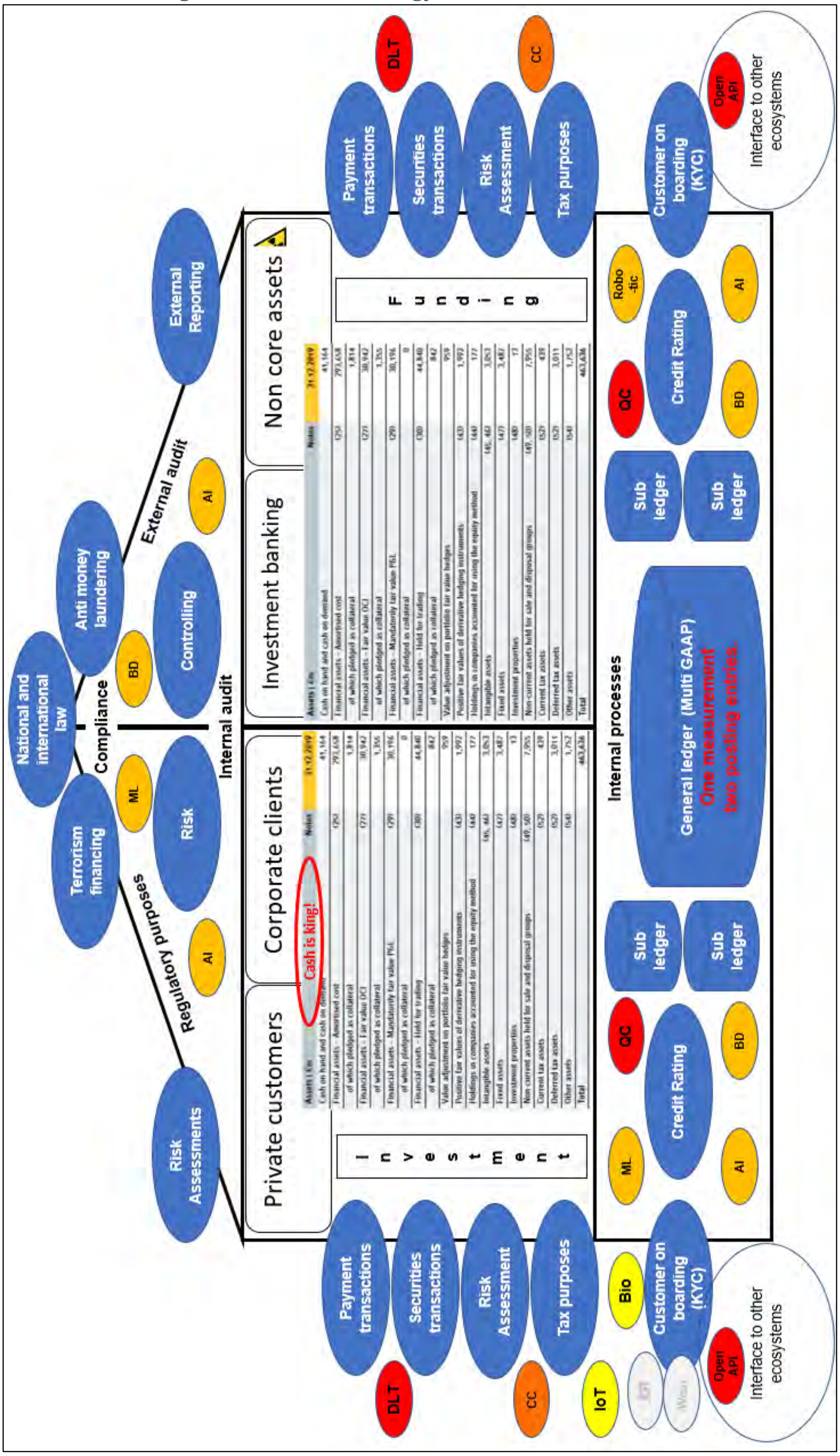
Cash is king => the cash desk represents the heart of a bank. Liquidity is the most important day-to-day ingredient of the *business model* of banking services. Assets and liabilities must be combined in an optimal way to run never out of liquidity and to earn surpluses (margins) on the delta between the investments posted on the active side and the funding posted on the passive side.

On top, a bank can participate in central banks liquidity tenders by providing eligible securities (e.g. TLTRO[28] due to COVID 19).

All these relationships can be supported, optimized, and developed in a cost-reducing manner through intelligent and stringent used technology. However, a company must have the will of the management and the resources to do this.

[28] ECB: targeted longer-term refinancing operations.

Figure 27: New technology in the house of finance.



Source: Own elaboration.

3.9 Cyberrisk.

On behalf of a pro & contra discussion on the individual technologies, the emerging cyber risk is highlighted here. For the purposes of this analyse, *cyber risk* is assigned to the canon of operational risks.

Cyber risk is therefore a key factor in this work, as the vulnerability of digital *business models* is increasing against this risk. It can mean a total loss of a complete company or several companies for a few hours or more.

According to a study of BIS (BIS Working Papers No 840 Operational and cyber risks in the financial sector) (Iñaki Aldasoro et al., 2020), up to 40% of the Institute's Risk Weighted Assets (RWA) are potentially exposed to operational risks. Still, claims have declined in recent years, after a spike in the post-GFC (Global financial crisis) period. The resulting reputational damage may not be assessable under certain circumstances. In this way, an existing and efficient *business model* can be endangered or abnegated. The more banks generate their revenues in a digital *ecosystem* linked to Open API, the higher the "transaction costs" of securing the underlying data streams will inevitably be.

Cyber risk is located in the context of bank-specific business risks in the “Glossary of definitions” under the term *Risk*. This assignment is carried out in analogy to the procedure of the BIS (BIS working paper no 840) (Iñaki Aldasoro et al., 2020).

Already in 1947, the term "cyber" was used by mathematician Norbert Wiener as "Cybernetics" on the control technology in relation to the automation of processes and systems (Wiener, 1947). An accurate definition of cyber risks from a risk management perspective will be used for this scientific Work in the 2016 Financial Stability Report of the Deutsche Bundesbank. This generally includes the risk that the "confidentiality" (risk of unauthorized data gain), the "reliability" (risk of unauthorized modification of the data) and the "availability" (risk of unauthorized impairment of functionality) of confidential business information and IT systems may be compromised due to cyber-attacks. They may even have the potential to jeopardize, among other things, the functioning and stability of the financial sector. Cyber-risks occur exclusively in connection with the so-called cyber-space (Könings, 2017). Cyber Space is defined by NIST as a global area within the information environment consisting of a network of information infrastructure.

Cloud computing is thus predestined for cyber-attacks. Financial systems connected via the cloud, equipped with Open API access could thus be vulnerable, e.g. for the impact of a malware attack. The phenomenon was so prevalent in 2014 that NIST (National Institute of Standards and Technology (U.S. Department of Commerce)) released a Cyberrisk

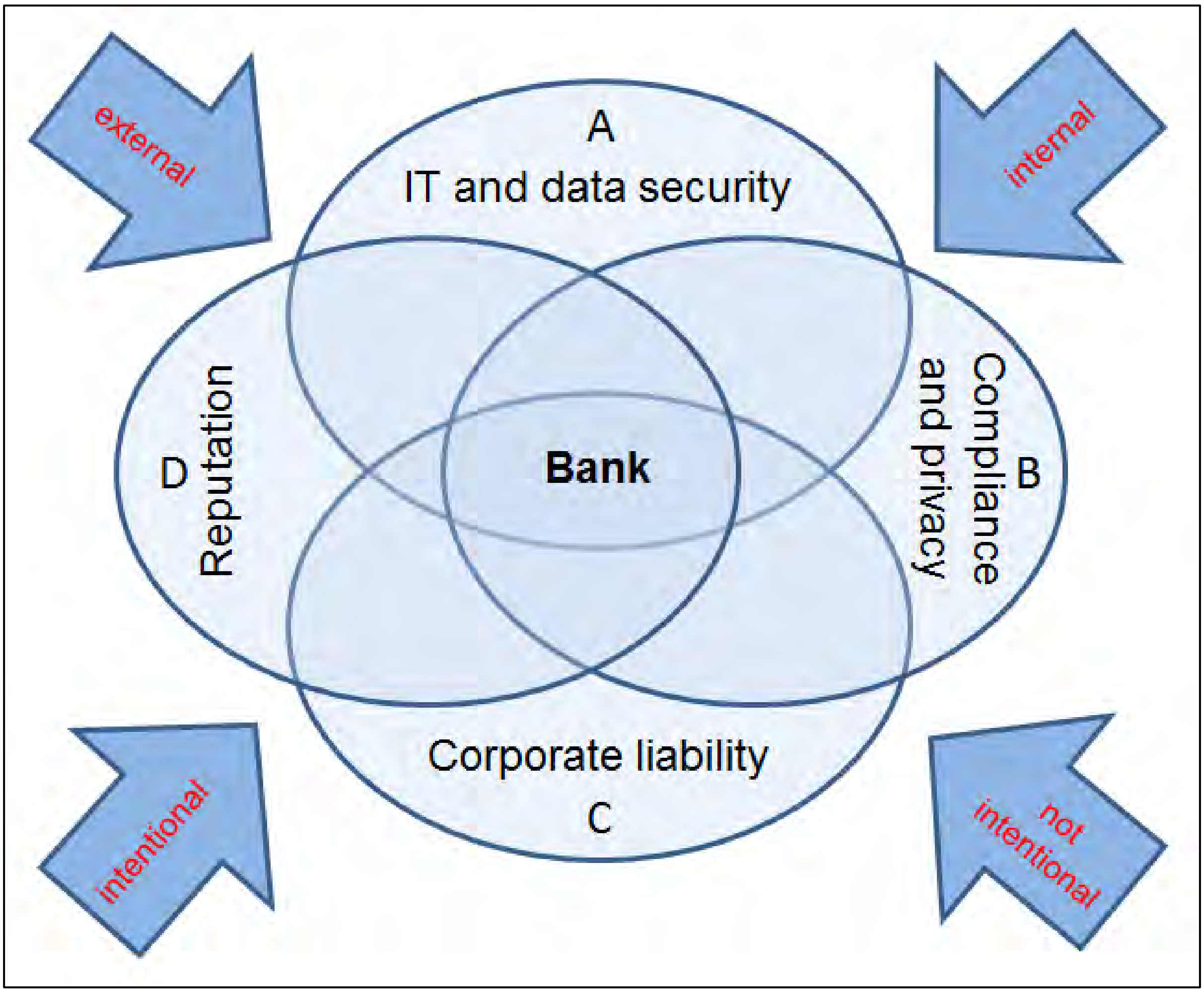
Framework, translated into a variety of languages. The purpose is to provide guidance to manage this relatively new risk (NIST, 2020).

Risk identification: Dimensions of cyber risk.

The following graphic shows the dimensions of cyber risk. In the inner area there are overlapping elements of a bank that can be affected. Visible active variables are removed in the outer area. The attacks themselves can take place from outside or from inside. This is done by former or current employees, on schedule or unintentionally.

External attacks are intentional, but internal attacks can also occur unintentionally, through careless handling of data. The compliance departments are working to counter this through continuous training measures. Another phenomenon e.g. is the ban on the use of USB sticks.

Figure 28: Dimensions of cyber risk.



Source: Own elaboration based on *Munich RE*, Cyberspace, 2013, S. 6 (Munich Re, 2013)

The attacks are often directed against A and B. Effects are represented by C and D.

A) IT and data security.

Refers to hacker attacks or data theft, which can also end in physical theft, e.g. via fictitious SWIFT[29] bookings. External attacks are usually shaped as denial of service (DoS) attacks. Its aim is to bring a sudden oversupply of queries to a halt server or an internet presence of a company.

B) Compliance and privacy.

These points relate to violations of often national privacy policies. The compliance activities of an organization must therefore also be geared toward ensuring data protection.

C) Corporate Liability.

If cyber-attacks have been successful, for example in payment transactions or in the area of credit card accounting or custody account management, liability issues arise for the companies.

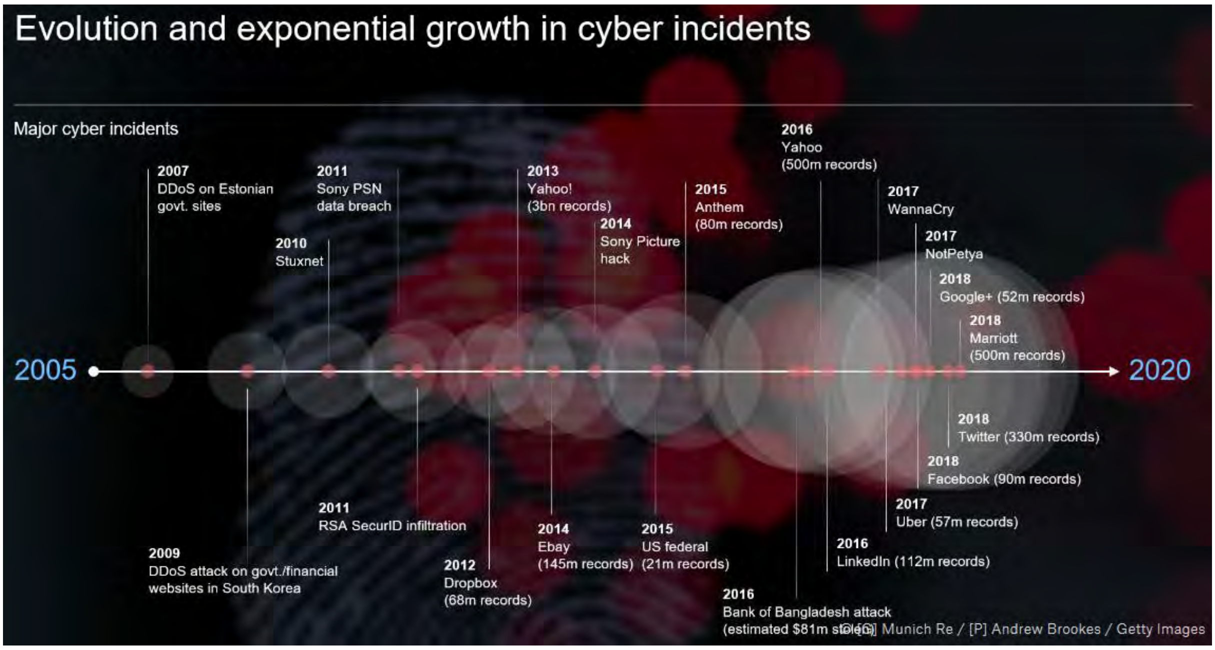
D) Reputation.

The effects of cyber-attacks can often lead to irreversible reputational damage. Loss of trust might lead to a catastrophic attack on the inner core of a *business model* that leaves customers. The result can be a serious deterioration in earnings, possibly even a massive loss of liquid assets.

Important targets of cyber-attacks at banks can be payment systems, accounting systems, corporate networks, customer interfaces and e-mail systems. Although the threat posed by cyber risks seems to be perceived only as a minor issue in the enterprise, their number and power has increased in the recent decade. In 2016, the Central Bank of Bangladesh became the victim of a targeted cyber-attack via 35 SWIFT orders. 30 SWIFT orders could be stopped. 5 have been settled. As a result, USD 81 million was stolen from the central bank, disguised by the Chinese New Year's Day.

[29] SWIFT: Society for Worldwide Interbank Financial Telecommunication.

Figure 29: Major cyber incidents of the last decades.



Source: Elaboration based on Munich RE, Cyberspace, 2013 (Munich Re, 2013).

Risk quantification.

The VaR[30] model (Operational VaR) has already been proposed to quantify cyber risk in analogy to the assessment of other operational risks (AMA[31]). In character, the probability of the occurrence of operational risks like those of the credit risks of fat tail are distributed. This means from a cost perspective that there are many limited cost events and a small exceptionally large incident. However, this group of small extreme events complicates quantification, but with potentially catastrophic effects due to their low frequency of occurrence.

Nevertheless, insurance companies have already begun to develop claims models and offer insurance for both corporate and private customers. Already in the retail sector, for example, identity insurance is offered, with psychological support for victims of cyberbullying.

Risk Management.

Credit institutions can manage cyberrisk through extreme measures such as risk avoidance or risk acceptance, based on established procedures. The latter, for example, within

[30] VaR: Value at Risk.
[31] AMA: Advanced Measurement Approach.

the framework of an internally determined percentage in relation to the balance sheet total. In addition, companies can react by means of targeted risk reduction or risk transfer without affecting their profitability.

Risk reduction entails a massive investment in the IT infrastructure, often coupled with internal training for all employees in the company. Risk transfer means taking out insurance against the occurrence of damage (Könings, 2017).

Privacy.

Trust in a legally careful use of the data is an unrelenting factor in the sustainable functioning of digital *business models*. If data is misused for business purposes without the user's knowledge, a catastrophic damage to reputation is inevitable.

The basic data protection regulation was put into effect by the European Commission on 25th May 2018 (DPR Data Protection Regulation).

Since then, companies have a completely different responsibility in the handling of the personal data entrusted to them. The rights of users have been strengthened. From now on, they have the right to be forgotten, to have access to their own data, to know whether their data has been hacked. They are also entitled to technical measures taken by companies to comply with the Data Protection Regulation.

In principle, there is no grace period. The new rules were adopted nearly two years ago, on 27th April 2016, and entered into force on 24th May 2016. After a two-year transitional period, the Regulation will now apply on 25th May 2018. Providing the companies with two years to prepare for the new rules.

Companies must fear criminal offensive consequences. This concerns companies that conceal data leaks and do not cooperate with the competent authorities. International cooperation between the competent authorities is also being stepped up (one-stop shop) (EU Commission, 2018a).

The importance of the data protection excursion lies in the fact that trust in the careful processing and use of personal data can in future be a unique selling proposition of a *business model*. This is an opportunity for the digital redesign of a bank if the data is kept virtually free of access from external third parties. Unless the customer expressly requests an exchange with another provider (Fend et al., 2020).

As an example of negative biometric data processing, here is the case of the Chinese female top manager Dong Mingzhu of the air conditioning manufacturer Gree. Her counterclaim as an advertisement on a bus was wrongly interpreted as crossing a red pedestrian traffic light and placed on the digital pranger (Holland, 2018).

Interim conclusion towards overarching hypotheses.

The more companies enter a digital dependency, protected by government agencies, the greater the risk of becoming victims of a cyber-attack.

Cyber risks are of profound importance to companies whose *business models* are digitally aligned. This means that, for the development or reorientation of a *business model*, a certain proportion of the revenues and project capacities must be planned from the outset in line with the growth of the company to combat these risks.

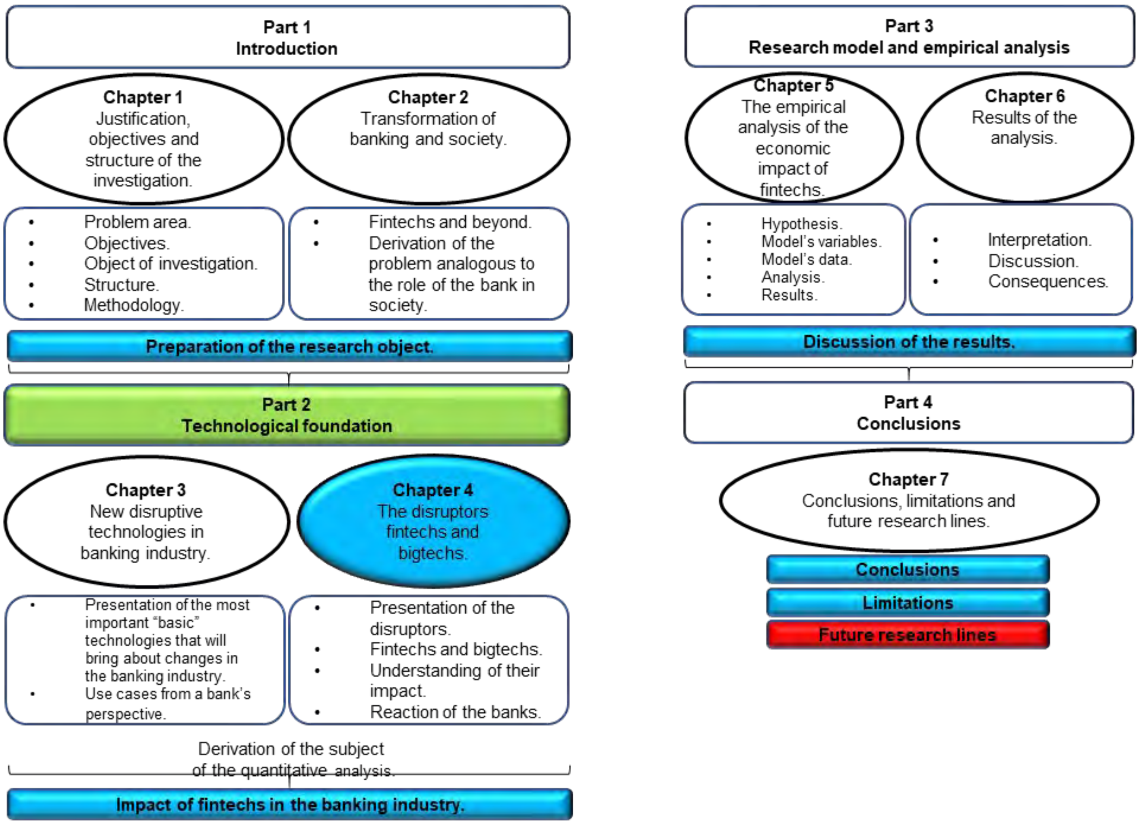
Cyber risks therefore constitute a massive obstacle in the sense of the overarching hypotheses, both for companies which, in the sense of H1, are changing their *business model* evolutionarily, disruptive in the sense of H3 or revolutionary in the sense of H5. One could say that cyber risks are equally responsible for a level playing field for all actors (banks, *fintechs*, universities and *bigtechs*) (BIS, 2018).

Chapter 4. The disruptors *fintechs* and *bigtechs*.

4.1 Disruptor *fintech*.

4.2 Disruptor *bigtech*.

4.3 Adaptation of the banks.



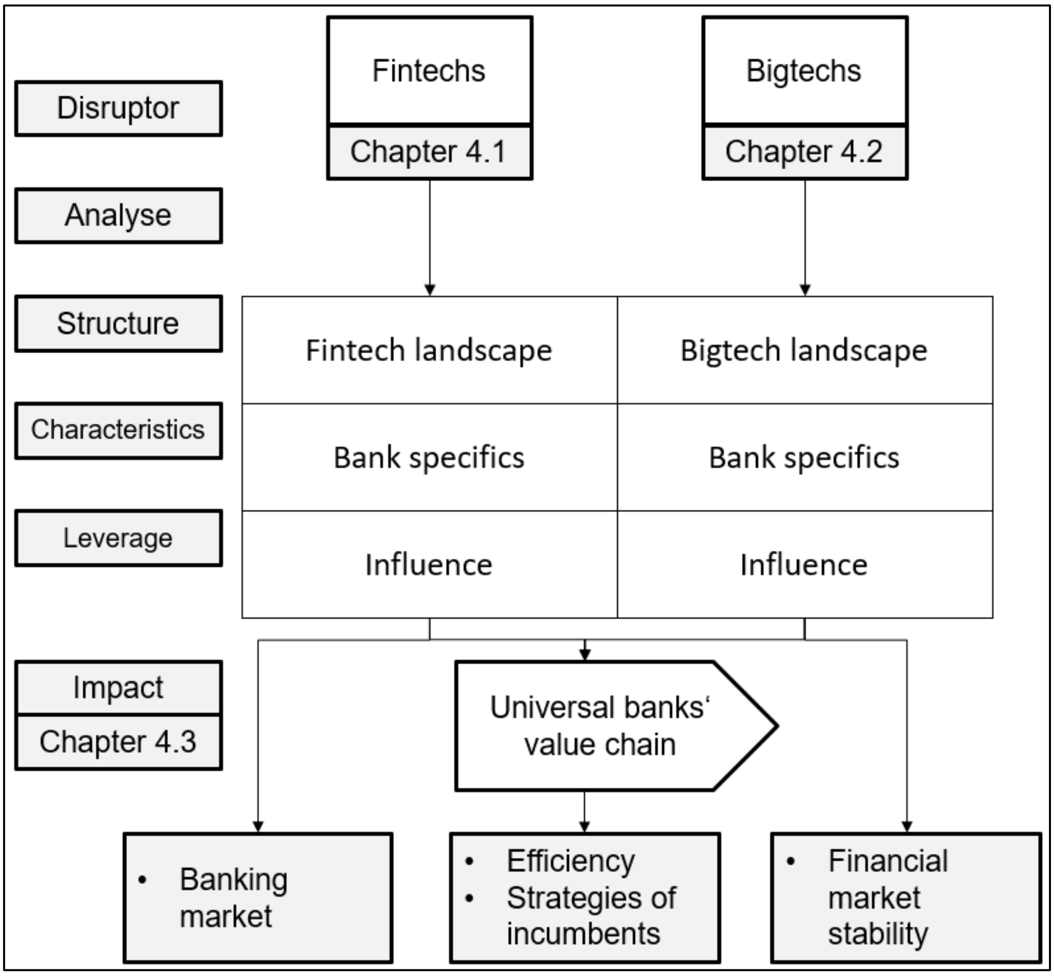
Now that the available technologies have been presented in the third main chapter, it is planned to show which transmission channels they could use to reach *universal banks*. Alternatively, they could force revolutionary changes instead of evolutionary cooperation.

The aim of chapter four in the context of this work is methodically to describe the possible either disruptive or revolutionary impact of *fintechs* and *bigtechs* on the *business model* of classic *universal banks*.

The following graphical representation outlines the structure of this chapter. To prepare a comparison, first a map regarding *fintechs* and *bigtechs* will be drawn. The bank-specific characteristics are then shown, and their efficiency is presented.

Afterwards the "lessons learned" are projected onto the banks' internal structure using Porter's value chain to identify possible effects.

Figure 30: Structure of chapter 4.



Source: Own elaboration.

For this purpose, both exogenous interferences *fintechs* and *bigtechs* are first mapped in Chapters 4.1 and 4.2 (as far as possible via publicly available literature). Finally, the effect is also represented qualitatively by means of the value chain model according to Porter. Which has already been introduced in Chapter 2.1 serving as a higher-level frame at this point.

A general definition of the terms *fintech* and *bigtech* as used in this work is given the "Glossary of definitions". At this point, an allegory of biology is borrowed to illustrate the potential impact.

Fintech's efficiency is comparable to ants, which can be very efficient, structured, and working far beyond their own weight. *Bigtechs* are more like elephants, which, although naturally careful, can severely damage an enemy with a single body movement (Average body weight approx. 5,000 - 6,000 kg) (Upali, 2020).

Ants, although much larger in number[32], therefore do not have the potential immediate destructive efficiency, like elephants. *Fintechs*, with an average of 25 employees (Findexable, 2019), therefore inevitably have a lower efficiency than *bigtechs*, with an average of 100,000 to 800,000 employees (Alphabet, Amazon) (cf. chapter 4.2 Table 35 on page 180).

Fintechs and *bigtechs* have moved into the focus of banking supervision for some time, against the backdrop of *financial stability*. Thus, the insights of the FSB's latest publications (FSB, 2019a, 2019b) are also involved in the structure of this chapter.

The fifth main chapter then serves to provide a quantitative basis for the knowledge gained in this way.

4.1 Disruptor *fintech*.

The introduction of the modern electronic communications media paved the way for the growth of companies known as *fintechs*. A collective term standing for technologically advanced financial innovations and technology that lead to new financial instruments, services or intermediaries (EU Commission, 2018b; Garvey et al., 2019). The expression is often equated with companies offering digital or technological finance innovations (Ozili, 2018).

Hardly any empirical studies are available on the topic of *fintech* and its impact on the profitability of traditional *universal banks*, seen as an entire system.

However, other scientific work examines the different *fintech* forms and their effects on the financial market or the profitability of banks (Thakor, 2019). Even their structuring is currently still a trade-off of different perspectives (Drasch et al., 2018).

[32] In a single nest of the African army ants can live more than 20 mn individuals (Schoning et al. (2005)).

Furthermore, it is difficult to find a uniform European map that, at least in relation to the EU_19 states, currently covers all economically active *fintechs*. A search for the term "fintech landscape Europe" with help of the internet search engine google resulted in a total number of 1,780,000 results on 11th April 2020. However, the findings systemically classified as the most important results do not concentrate on a uniform overview of Europe as a whole.

The focus is on individual member states of the European Union or economic priorities. Even a database of statistical material such as “statista” cannot provide a uniform overview (Fintech in Europe, statista). The following graphical demonstration, taken at random from the results, highlights a first impression of giving the abundance of unstructured data a structure.

Figure 31: Small overview of the economic *fintechs'* landscape.

Source: Elaboration based on (Menon, 2018).

Since none of the overviews guarantees a reliable list of the number of all fintech companies that are currently active, the focus of this subchapter must shift from the registration of all companies to the representation of a structure. A growing European common view could only be identified at the normative level (Dorfleitner et al., 2016; EBA, 2017).

Structure: Fintech landscape.

The core of this subchapter is the structure determination of the current fintech landscape in Europe. The entrepreneurial priorities of the *fintechs* are descriptively identified by their potential targets in the value chain of classic *universal banks*.

Due to the extreme heterogeneity of the *fintech* industry (cf. Figure 31 on page 157) presented previously, no uniform way was found through national surveys comprising the EU member states area. A three-stage selection process is therefore pursued.

Stage 1: Certification by authority argument.

Due to the lack of a uniform structure of actors in the economy, a state actor or the regulator is a suitable authority argument to find any robust structure. These stakeholders face the same challenge as necessary for the investigation in this work, but with different means.

Since the influence of the *fintechs* increased steadily (siau et al., 2018), the German. Federal Ministry of Finance commissioned a scientific study published in 2016.

In 2017, the EBA followed with a discussion paper with the same objective (different motivation) to survey European *fintechs* to analyse the core of their *business models*.

Stage 2: External verification.

The external verification of the perspectives gained in step one is carried out by economically shaped providers. Well-known external consulting firms, especially McKinsey, were examined for their grey literature on the fintech structure, supported by the internet.

Each of the companies analysed (cf. Table 30 on page 159) publishes insights on *fintechs* from different, complementary perspectives. Only McKinsey's study is suitable for verifying a structure. This consulting company markets clients' international knowledge through its "Panorama" database.

The approaches of all consulting companies have in common the perspective of the beginning development of a financial *ecosystem*. Thus, these findings have an impact on the conclusion or the outline of the future.

Table 30: Fintech structure.

No	Publication date	Titel	Authors	Research focus	Methodology	Comment	Recognizable fintech structure	Significance for this dissertation
A	17th October 2016	Fintech Markt in Deutschland Studie im Auftrag des Bundesministeriums der Finanzen.	Dorfleitner, Gregor; Hornuf, Lars	Collection of data on market volumes of fintechs from 2007 to 2015; Statement about future market prospects	Internet-based identification of German fintechs and assignment to market segments	Market segmentation initiative.	Cluster of financial services on page 11 (figure 2). Segment A: Funding Segment B: Payment Segment C: Investment Segment D: Others	↑
B	04th August 2017	Discussion Paper on the EBA's approach to financial technology (FinTech).	European Banking Authority	Key motivations (Art. 1(5) Founding regulation) are consumer protection, robust financial markets, equal competition.	Survey limited to 282 fintech firms.	First initiative to develop an overall view of the European fintech market. Various individual initiatives took place until 2017.	Cluster of financial services on page 18 (table 1). Cluster A: Funding Cluster B: Payment Cluster C: Investment Cluster D: Others	↑
C	Documentos Ocasionales. N.º 1916 2019	FINANCIAL INNOVATION FOR A SUSTAINABLE ECONOMY .	Andrés Alonso and José Manuel Marqués BANCO DE ESPAÑA	Funding means for a sustainable economy. Focus on climate change.	Support on 4 levels of verification (Secondary Party Opinion, External Verification, Rating, Certification)	Since no structures of existing fintechs are shown, but opportunities for business models of new fintechs, useful for the conclusion of this work.	No fintech structure, showing necessary financial innovations	→
D	2015/2016	The new picture in finance.	McKinsey	Survey of fintech activities; Analysis of the impact on banks.	Summary of various articles with different focuses, written by McKinsey employees: - Perspectives on Fintechs - Insights on technology trends - Implications for customer	The focus is on the banks as potential clients. Therefore, 14 articles focus on information consolidation towards changing the business model of traditional banks. Response patterns for	3 Dimensional cluster of financial services. (Exhibit 1 on page 7)	↑
E	06/2019	World Fintech Report 2019.	Cap Gemini	Financial Ecosystems	Global survey containing responses from 116 traditional companies and 40 FinTech companies.	Since no structures of existing fintechs are discussed but open banking as way into the futuer, this grey paper serves for the conclusion of this work.	No fintech structure is discussed. A collaboration towards a financial ecosystem (open bank) and its limits is discussed.	→
F	2019	Global Fintech Report 2019.	PWC	Comparison of financial services companies and telecommunication companies.	Worldwide survey among 500 responsibles driven by: - analysis and reporting - fieldwork - internal interviews - questionnaire	Since no structures of existing fintechs are discussed, but hints to deal with the digital transformation are given, this grey literature is rather important for chapters 4.3 and 7.	No fintech structure. Rather interesting opinion polls of up to date technologies and the recommendation for cross sector fusions.	↓
G	2019	Global Fintech Adoption Index 2019.	EY	Identification of consumer trends, adaptions trends with	Survey with 27.000 customers in 27 markets.	Fintech Adoption Initiative. This grey literature serves rather for conclusions in chap. 4.3 and 7.	No fintech structure but a trend analyse.	↓
H	31st June 2019	The pulse of Fintech.	KPMG	Global investment in the fintech market.	Analyse of the VC Market. Country by country view. Example trends in the US market: - Payments - Insurtechs - Cryptocurrencies	Through the analysis of the investment volume and the big deals worldwide, a conclusion towards a financial ecosystem might be possible.	No fintech structure but a structure of international investment hot spots.	↓

Source: Own elaboration.

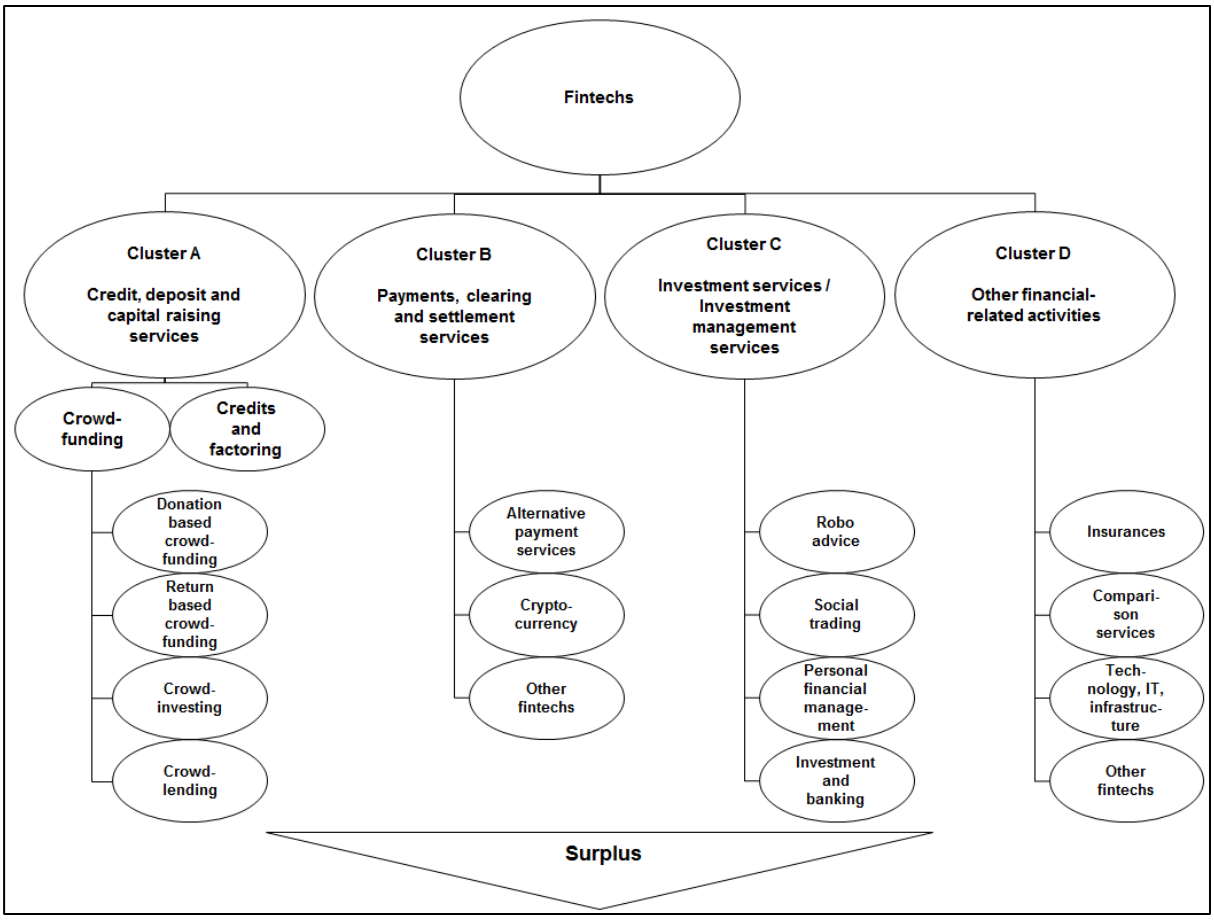
Stage 3: Comparison of the approaches.

Annex II (on page xliv) contains a coherent representation of the structural core of the three publications dominant for this work (A, B, and D of Table 30 on page 159).

The common characteristics of the three plots were marked with the letters A, ..., D in the graphic representation. As a result, the structure shown in the following graphic (cf. Figure 32 on page 160) is crystallized.

This view is supported by the 3 structural approaches analysed before.

Figure 32: Fintech categories.



Source: Own illustration based on the studies of (McKinsey&Company, 2016; Dorfleitner et al., 2016; EBA, 2017)

Fintechs' business model mainly focuses on one of the activities shown in the figure above. Initially, they are aiming on producing bank services in a more cost-effective and customer-oriented manner than a *universal bank* (Eickhoff et al., 2017).

Structure: Fintech innovations.

The *fintech* population has spawned several new individuals over the years. In this work, however, these are not subjected to any further analysis, since they cannot be assigned, or only very indirectly, to the original banking services (cf. Figure 11 on page 49). The *universal bank's business model* is not expanded to include so-called all-financial forms.

Insurtechs.

Insurtechs are young, technology-based companies with a focus on insurance (BaFin, 2018). These companies have a wide range of options for establishing *business models* along the insurance company's value chain.

Their concentration on sales and contract management of insurance products (P2P insurance, comparison portals) are currently observable in Germany (Kottmann et al., 2019).

In mid-2019, around 134 insurtechs were active on the German market. This number represents a 100% increase in individuals compared to 2016 (Kottmann et al., 2019).

Regtechs.

Regtech (regulatory + technology) is as with fintech about the use of innovative technology. Regtech's focus, however, is on the more effective and efficient mapping, fulfilment and documentation of regulatory and supervisory duties supported by innovative technologies (Bruhns, 2017).

Even if a Regtech could be relevant for a variety of economic sectors against this background, Regtechs should be understood as 'Regtech for the financial sector', in this case. It refers to companies that do offer regulators as well as non regulators detailed solutions for certain regulatory service needs.

Solutions are currently offered in compliance management, risk management, customer verification and fraud management (BaFin, 2019).

Regulatory sandboxes.

This is a term coined in 2015 by a publication by the British FCA (Financial Conduct Authority) (FCA, 2015). In this way, from a regulatory perspective, secure environments in the financial environment are referred to. Innovative ideas for new *business models* should be able to emerge here without being immediately overwhelmed by regulatory requirements. However, customer protection is still respected (BBVA, 2017).

Suptech.

Suptech applications support the work of regulators and can be seen as a counterpart to Regtechs (BaFin, 2019).

Comptech.

This is used to describe the support of compliance requirements (Fürstenwerth, 2019).

Proptechs.

This term (also referred to as property technology or real estate technology) is a set of cross-industry technologies optimizing and reorganizing the way of research, rent, buy, and manage property (CBInsights, 2019). The focus of the *business models* is observable regarding the acquisition, refinancing, maintenance, and sale of real estate.

In 2016, $ 1.8 bn were invested into Proptech companies worldwide. This amount corresponds to ten times the investment in 2011. Although the growth remained moderate, BNP, for example, identified Proptechs as the platform operator for the subsequent refinancing of property (JULIENNE, 2018).

Legaltechs.

This term refers to the digitization of legal work. Individual work processes, but also entire legal services, are to run more automatically to achieve an increase in efficiency and thus also to save costs.

A rough distinction can be made between:

- Supporting applications (document management)

- Automation applications (document analysis, contract generators)

- Communication platforms (collaboration networks)

- Online legal services.

Smart contracts are a remarkably interesting aspect of this form in connection with block chain technology. These are computer protocols that can map or review contracts or provide technical support for negotiating or executing a contract. Individual contract clauses can be carried out automatically using this technology.

Characteristics: Bank specifics of fintechs.

This subsection shows how close *fintechs* are to the *universal banks* with their *business models*. Here it is assumed that only companies of a certain size class (unicorn[33]) can threaten materially incumbent banking service providers or the financial system as a whole. From the biological allegory elephant and ant, the picture of the elephant is first tried before the ants are looked at.

The biggest challenge in capturing *fintechs* is that often they still are not capital market oriented. This means that, depending on their legal form, many companies are not obliged to publish externally financial reports.

Popular legal forms of a startup in Germany are the limited company (GmbH Gesellschaft mit beschränkter Haftung; S.L. Sociedad de responsibilidad limitada) or a UG (Unternehmergesellschaft (haftungsbeschränkt)), a German limited specialty (PWC, 2017).

From the multitude of all companies, those are to be examined that could disruptively affect the *business models* of classic *universal banks*. Therefore, information from startups in Europe must be examined about their technological orientation.

Applying for a banking license is a sure indicator of proximity to financial services. Regarding the size of the company, the term "unicorn" can be a company's value indication enabling a lever against traditional *universal banks*.

The search for unicorns in Europe resulted in a list of 21 companies that were raised in 2019. At first glance, only the Berlin companies N26 are recognizable as *fintech* and Wefox as insurtech. Furthermore, the companies (Checkout (UK); Revolut (UK); Monzo (UK); Rapyd (UK); Deposit Solution (GER); Ivalua (FR); Numbrs (CH)) are listed under the description “financial services”.

The question in this section is how close are the *fintechs* to the classic *universal banks* to endanger their *business model*. The following table shows a comparison of 8 European “unicorns” with bank hospitality and Commerzbank AG for a superficial qualitative answer to the question. They have been chosen regarding their total equity funding amount.

[33] A unicorn is a privately held start-up company with a current valuation of US$1 billion or more.

Table 31: Fintech unicorns vs *universal bank*.

No	Organization Name	Description	Total Equity Funding Amount ($mn)	Last Private Valuation ($bn)	Headquarters Location	Industries	Bank License
1	N26	N26 offers mobile banking solutions to customers in the European Union through its subsidiary.	683,0	3,5	Berlin, Germany	Banking, Finance, Financial Services, FinTech	Full Bank License from ECB 18/07/2016
2	Checkout	Checkout helps companies accept more payments around the world through one integration.	230,0	2,0	London, Great Britain	Banking, Finance, Financial Services, FinTech	Checkout Ltd is licenced by the UK FCA as an authorised electronic money institution.
3	Revolut	British digital payment firm. Range of current accounts, consumer lending and commission-free share trading.	250,0	1,5	London, Great Britain	Banking, Finance, Financial Services, FinTech	European Bank Licence from Lithuania 17/12/2018
4	Monzo	Monzo is a London-based digital-only bank platform.	405,6	n/a	London, Great Britain	Banking, Finance, Financial Services, FinTech	Bank Licence
5	Rapyd	Rapyd is a platform that creates a card-less financial network.	170,0	1,2	London, Great Britain	Banking, Finance, Financial Services, FinTech	n/a
6	Deposit Solutions	Deposit Solutions is an open banking platform for deposits connecting banks and depositors.	200,0	1,1	Hamburg, Germany	Banking, Finance, Financial Services, FinTech	indirect via Deutsche Bank
7	Ivalua	Ivalua provides web-based spend management solutions that offer a modular suite covering the spend management spectrum. Source-to-Pay Suite.	135,0	1,0	Orsay, France	Banking, Finance, Financial Services, FinTech	n/a
8	Numbrs	Numbrs is a customer-centric financial services company, allowing its customers to manage existing accounts and purchase competing financial products.	80,0	1,0	Zürich, Switzerland	Banking, Finance, Financial Services, FinTech	no Bank License
		Sum	2.153,6	11,3			
9	Commerzbank AG	Universal Bank	33.426,2	5,6	Frankfurt, Germany	Banking, Finance	Full Bank License from BaFin and ECB

Source: Own elaboration based on (Dillet, 2016, 2018).

Characteristics: Bank specifics of fintechs the elephantlike perspective.

One approach to allocate the potential threat of classic banks' *business model* by *fintechs* is to interpret them as potential "elephants".

However, the biological picture can only refer to those who, with the estimated company value of a "unicorn", may be close to a market capitalization (IPO Initial Public Offering). A banking license (on an EEA level with a European banking license) might lever up the threat.

The previous table (Table 31) compares eight European "unicorns" owning a banking license with a European *universal bank*, the Commerzbank Group. Compared are equity volume (2019) and the last estimated company value. Knowing this well, that the "unicorns" are not yet capital market oriented (private equity or venture capital), whereas the Commerzbank AG is a listed company.

To calculate the market capitalization of Commerzbank AG as of April 17, 2020, the statutory number of shares issued (calculated value, no unit value) was valued at the market price. The official ECB reference rate (middle rate) as of April 17, 2020 was used to convert into USD. The result shows that the 8 Unicorns add up to $ 11.3 bn, twice the company value than Commerzbank AG. However, the equity of the latter, at $ 33.4 bn, exceeds the total equity of the 8 *fintechs* by 15 times.

As first conclusion can be drawn intuitively from this without further investigation that even unicorns together would not be able to achieve the investment volume of a single *universal bank*.

Another intuitive indication that the "unicorns" cannot yet compete with a *universal bank* on an equal footing is the simple comparison of the banking licenses from N26 and Commerzbank AG (cf. annexes III. and IV. on pages xlv-xlvii).

The components of banking business that have developed over many decades since the Second World War cannot easily be replaced by a new 2016 license, e.g. for N26. Which is extremely limited in its effect (private customer banking services).

In this example, N26 likes to appear externally with a European full banking license but can currently only cover a fraction of the incumbent banking business.

Characteristics: Bank specifics of fintechs the antlike perspective.

Fintechs cannot meet an exogenous opponent in a coordinated manner, like an ant colony. Although ants are called predators, inside a population they are eusocial and altruistic, oriented towards the queen and thus the population's survival (Agosti et al., 1998).

This coordinated, rational behaviour of an entire population will be difficult for *fintechs* to demonstrate. The companies' owners often have founded with their own equity (savings) and they are often highly talented alpha animals (Bhide, 1999).

Self-fulfilment is said to be the main satisfaction of such a risky start-up (PWC, 2017).

Characteristics: Interim conclusion.

The answer to the question of how close the *fintechs* are to the *business model* of classic *universal banks* was brought to the point in 2019 by the FSB (Financial Stability Board) (FSB, 2019a).

Already in the introductory summary, the key finding is that *fintech's* expected success has so far been denied. These generally did not have enough access to cheap refinancing and even a sufficiently large number of customers. Both would have been necessary to threaten the *business model* of the long-established financial industry.

Hence the statement points out, *fintechs* in turn are looking for the solution in partnerships with incumbents. This offers them the opportunity to continue to focus on their specific *business model*, to remain small and to have the necessary access to customers.

An analysis (cf. Annex V. on page xlviii) clearly shows that in 2019 nearly each of the *universal banks* analysed had already entered a partnership or minimum an investment with a *fintech*. The presentation is based on an evaluation of the companies' IFRS consolidated annual reports as of December 31, 2019. The end of the *fintech* hype on the contrary predicted in 2016 has therefore even not materialized (Online, 2016).

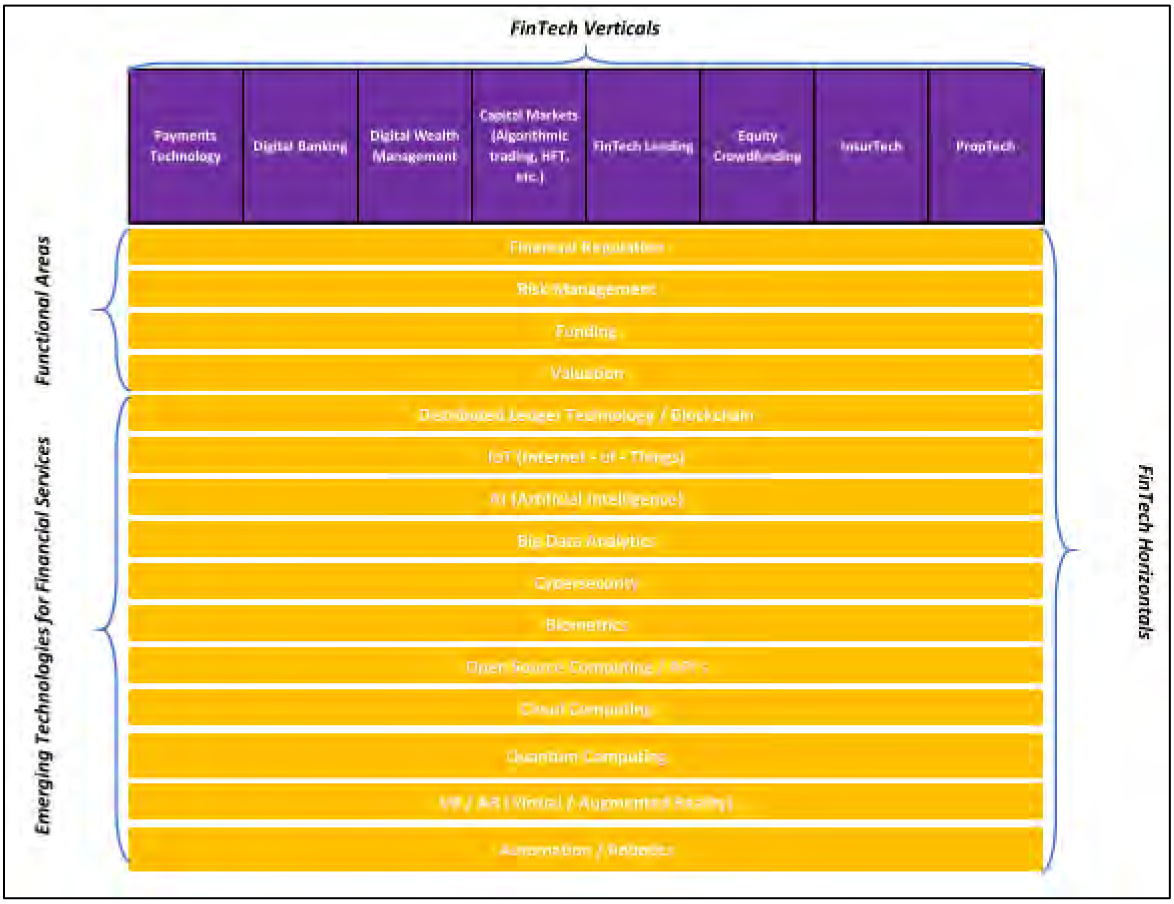
Already in this study by the FSB, the clear statement is made that the effects of *bigtechs* on competition and market stability could be much greater than those of *fintechs* (FSB, 2019a). Thus, further investigations in Chapter 4.2 are dedicated to the impact of *bigtechs*.

Leverage of fintechs.

The following graphic representation aptly shows an overview of the current *fintech ecosystem*. In this way, the current or potential impact of the *fintechs* with their core competencies on the *business models* of classic *universal banks* can be guessed.

The superficial presentation brings together the findings of chapters 3 and 4. Currently recognizable *business models*, which *fintechs'* focus has adopted, are shown vertically. The emerging technologies are used horizontally, which *fintechs* use. Lines 1-4 represent the thematic priorities in which *fintechs* have already successfully established themselves.

Figure 33: Fintech *ecosystem*.



Source: Elaboration based on (Imerman et al., 2020).

This theoretical representation is substantiated by ongoing investigations by the provider Crunchbase (CB). Annex VI. (on page I) contains an overview of some European credit institutions and their fintech partnerships. The overview vertically contains the functional focal points in which alliances have developed. This shows that the focus is on blockchain technology, capital markets software and regtech. Means the banks' investment in new products, digital risk management and cost reducing of regulatory requirements.

Interim conclusion towards overarching hypotheses.

To round off the section on *fintechs*, considerations about the overarching hypotheses H2 and H5 are made. A quantitative assessment of opportunistic innovations turns out to be challenging. So, there can be innovations maybe with a successful future, but they are still in the backyard garage. Innovations can still fail. But they can also be on the way to a partnership.

Positive example.

Commerzbank AG participates in the *fintech* 21 Strategies (FX Fintech) in April 2020. Its *business model* consists of digitally hedging a company's FX positions. The participation in the start-up founded on 9th April 2020 took place via the early stage investor Main incubator and the venture capital company Forest Capital. The three founders of the machine-learning focused start-up remain main shareholders.

Negative example.

PWC recorded the failed *fintechs* in Germany from 2011 to 2019 and their anatomy for the first time in its 2019 cooperation radar. 233 start-ups have already failed in this period. Most of them in Berlin with an average lifespan of 4 years (PWC, 2019).

Fintechs and universities unaligned innovation (H4).

From any perspective in time, it is difficult to recognize whether a university in the world is already working on a new basic technology that will cause disruptive or revolutionary changes in the financial world in the future (e.g. Internet).

Therefore, another aspect should be mentioned here. Business schools have already perceived the current transformation process and are offering degrees enabling students to work better in the new financial *ecosystem* (Masterstudies, 2020).

One indication that might confirm the overarching hypothesis H4 is the organization of so-called hackatons[34], sometimes also digital competitions of a military nature (Volkswagen, 2018). Hackatons are digital themed sprint events (with physical or non-physical presence) aiming at the creation of functioning software or hardware. Potential game changers worldwide should be attracted to participate in the events organised by universities often sponsored by industry or vice versa (2020a; 2020b).

[34] a portmanteau of “hack” + “marathon” in use since 1999 (SunMicrosystems)

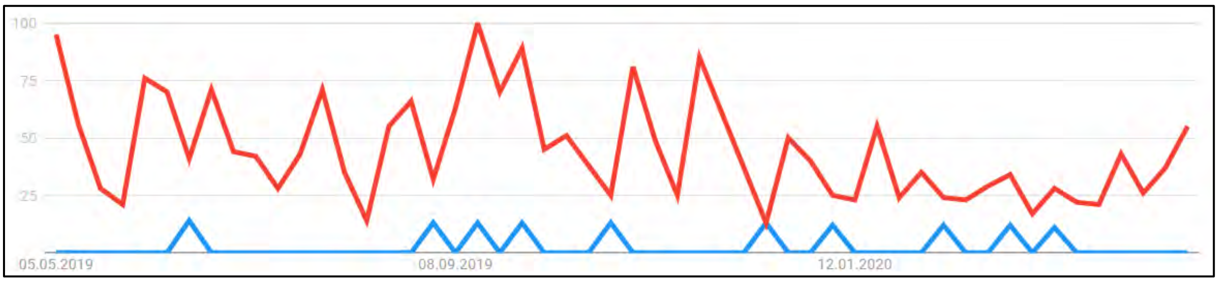
4.2 Disruptor *bigtech*.

The contribution of this sub-chapter is to analyse the impact of *bigtechs* on the finance incumbents' *business model*. For this, first the *bigtechs* included must be identified.

Bigtech as term is used in contemporary journalism along with tech giants to describe technology companies of overwhelming size (Tett, 2018). Such terms have already been used in the past for large corporations in other industries (Big Oil, Big Tobacco, Big Pharma, Big Four, Big Three, Big Media, "The four horsemen"[35],). These new technology giants have displaced incumbent industry giants and energy giants of past decades from their top position.

Although the search term "tech giants" seems to be more stringent than the term "bigtech", the latter has become synonym of such companies in Europe. The following graphic shows the frequency of the search (interpreted as popularity) of both terms (tech giants marked in red and *big tech* marked in blue).

Figure 34: Google trends *bigtech* vs. tech giants.



Source: Elaboration based on Google Trends (aof 05th May 2020).

Bigtechs operate worldwide via internet. They are attested to an oligopolist formation with the geographic centres USA and China. Common to all companies is the profitability of their *business models*. Vertically it is based on the six pillars of power, data centres, internet connectivity, computer hardware including smartphones, operating systems, web browsers, other user-level software, and online services. The horizontal concentration of power comprises diverse services such as email, instant messaging, online searching, downloading and streaming (Smyrnaios, 2018).

In some jurisdictions, large, well-established technology firms have recently entered financial services markets. These firms can provide financial services as part of the products or services that they normally offer. Alternatively, their access to a large quantity of client data could allow them to carry out financial market specific product decisions.

[35] The four horsemen of big tech: Apple, Alphabet, Facebook, Amazon (Stross (2017)).

Table 32: Bigtech structure.

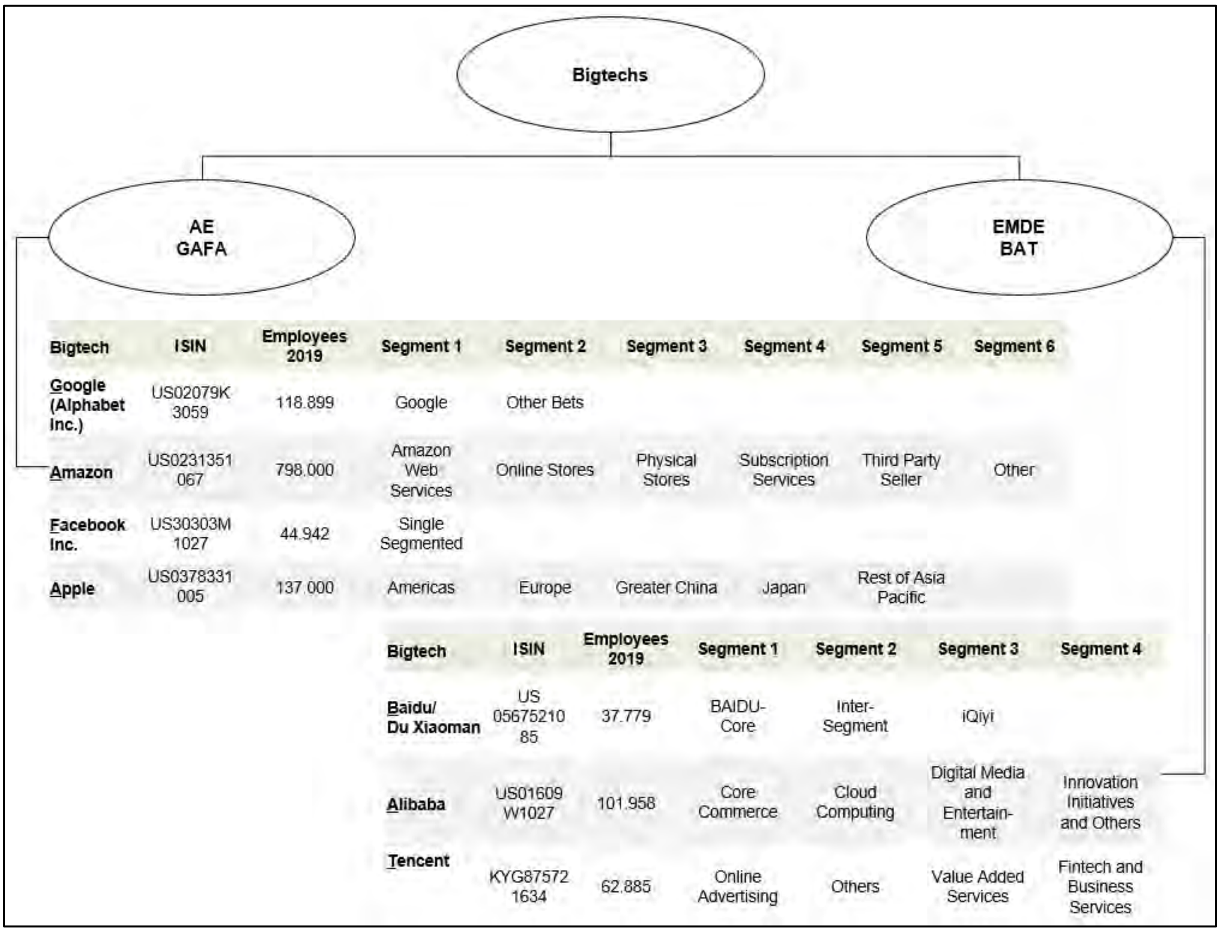
No	Publication date	Titel	Authors	Research focus	Methodology	Comment	Recognizable BigTech structure	Significance for this dissertation
A	April 2019	BigTech and the changing structure of financial intermediation	BIS	Analyse of Bigtechs advances into the provision of financial services.	generic approach => tracing the line of providing financial services	providing financial services as trends for growth of bigtechs	no clear structure provided but initial argumentation with geographical separation.	→
B	05th June 2019	Digital Disruption in financial markets	OECD	Understatement of the substancial financial changes posed by fintechs and bigtechs.	literature orientated (e.g. Fintech research by FSB)	Bigtechs are only mentioned in passing but are already taken seriously.	no structure provided. Big techs are something big.	↓
C	09th December 2019	BigTech in finance	FSB with various international NCB contributions	This report examines recent developments in the provision of financial services by BigTech firms, and the resulting benefits and risks to financial stability.	First, BigTech firms are globally identified and analyzed. Second, the potential reaction of incumbents is highlighted.	Investigation of the proximity to the business model of classic universal banks	geographical separation as a basis (AE Advanced economies) and (EMDE Emerging markets and developing economies). (GAFA and BAT Structure mentionned).	↑
D	11th November 2019	Blog post on - How banks can react on bigtechs entry into financial services	McKinsey	Focus on incumbents' answers.	Structure and lighting of a 2x2 response matrix.	Bigtechs were perceived on a strategic and tactical level. Source might be important for chapter 4.3!	no structure provided. Big techs are something big.	→
E	11th April 2019	BigTech challenges to traditional banking are on the rise	Cap Gemini	targeted elaboration of bigtechs' financial activities in the private customer area.	Analyzs of the private customer segment, transfer of customer demand and supply of financial products in a matrix	Representation of the Bigtechs as possible cooperation partners.	structure only indirectly given with geographical separation (GAFA and BAT).	↓
F	16th March 2020	How retail banks can tackle a rising threat from big tech	PWC	Identification of a direct intervention point for incumbents => retail banking customers at the POS (point of sale).	only descriptive neighter qualitative nor quantitative approach.	This article is only an indirect mirror of PWC's London Strategic think tank due to the fact that both authors are PWC coworkers. It seems to be a first sounding of an idea.	no structure provided.	↓
G	January 2020	EY Bankenbarometer 2020	EY	Swiss banks	Questionnaire containing 100 Swiss banks.	Bigtechs are only perceived in passing, in addition to fintechs and general economic conditions.	no structure provided. But interesting insights for chapter 4.3. Containing interesting ideas for comparison of bank specific figures.	↓
H	January 2018	Tech giants in financial services	KPMG	Adaptation behaviour of incumbents	Propose advice.	Recommendation of cooperations. KPMG seems to be more concentrated on fintechs.	no structure provided. Big techs are something big.	↓

Source: Own elaboration based on (BIS, 2019a; Dietz et al., 2019; Krishnan, 2019; OECD, 2019; Ruddenklau, 2019; EY, 2020).

Contemporary literature (cf. Table 32 on previous page) was analysed for the identification of a structure of *bigtechs*. The literature review is organized analogous to the cascaded procedure in Chapter 4.1.

Only sources A and D indicate a formation. The geographical distinction between advanced economies (AE) and emerging markets and developing economies (EMDE) with their epicentres USA and China is identified. Basis of this work is the regulatory-influenced investigation regarding the financial market stability of source A. It is supported by the view of source D and contemporary professional literature (Smyrnaios, 2018).

Figure 35: Selected *bigtechs*.



Bigtech	ISIN	Employees 2019	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Google (Alphabet Inc.)	US02079K3059	118.899	Google	Other Bets				
Amazon	US0231351067	798.000	Amazon Web Services	Online Stores	Physical Stores	Subscription Services	Third Party Seller	Other
Facebook Inc.	US30303M1027	44.942	Single Segmented					
Apple	US0378331005	137.000	Americas	Europe	Greater China	Japan	Rest of Asia Pacific	

Bigtech	ISIN	Employees 2019	Segment 1	Segment 2	Segment 3	Segment 4
Baidu/ Du Xiaoman	US 05675210 85	37.779	BAIDU-Core	Inter-Segment	iQiyi	
Alibaba	US01609W1027	101.958	Core Commerce	Cloud Computing	Digital Media and Entertain-ment	Innovation Initiatives and Others
Tencent	KYG875721634	62.885	Online Advertising	Others	Value Added Services	Fintech and Business Services

Source: Own elaboration based on Refinitiv (aof 05th May 2020).

Due to the agreement of the proposed structures, the GAFA (Apple, Google (Alphabet), Facebook and Amazon) was selected for the western hemisphere as a representative from the set of all companies. For the eastern hemisphere, the BAT (Baidu, Alibaba, Tencent) was selected as a representative from the set of companies. The common denominator of all companies beyond the same *business model* is the stock exchange listing in the USA. This requires external reporting in accordance with US-GAAP.

Bigtech landscape: A companies' brief description.

For each company, the EBITDA[36] achieved in the fiscal year 2019 is set in relation to the GDP of the country in which the headquarters are located. This takes place regardless of their tax-specific settlement (e.g. Amazon in Ireland, Facebook in Delaware, or Baidu in the Cayman Islands).

GAFA Google (cf. Annex VII. on pages li).

Google, a search advertising provider with 118.899 employees in 2019, carried out the IPO on 19th August 2004. The company generated an EBITDA of 2.2 % of the American GDP in the fiscal year 2019. From the management point of view, the group is divided into two segments.

The "Other Bets" segment includes activities that could have a disruptive or revolutionary impact on traditional banks.

The Group subsidiary CapitalG (Venture Capital), founded in 2013, invests amongst other things in fintech activities.

GAFA Amazon (cf. Annex VI.I on pages li).

Amazon, a goods retailer with 798.000 employees in 2019, carried out the IPO on 01st May 1997. The company generated an EBITDA of 1.4 % of the American GDP in the fiscal year 2019. From the management point of view, the group is divided into six segments (Refinitiv). According to the current US-GAAP (form 10-K) group financial statement as of 31st December 2019 the group is only divided into 3 operational segments.

Amazon Payments Europe S.C.A. appears to be an independent unit operating from Luxembourg. It stands for amazon pay.

GAFA Facebook (cf. Annex VII. on pages li).

Facebook, an advertising provider based on social media with 44.942 employees in 2019, carried out the IPO on 18th May 2012. The company generated an EBITDA of 1.6 % of the American GDP in the fiscal year 2019. Concerning the management approach, the group comprises only one single segment (see SEC form 10-K aof 31st December 2019). All the Group's operational activities are allocated to this segment. The annual report provides no further information about investments in the financial *ecosystem*.

[36] EBITDA: Earnings before Interest Taxes Depreciation and Amortisation.

It is striking that the rating agency Moody's has not yet given a rating for the company. The step is justified with the fact that Facebook would not have sufficient debt.

GAFA Apple (cf. Annex VII. on pages li).

Apple, an electronic hardware provider with 137.000 employees in 2019, carried out the IPO on 12th December 1980. The company generated an EBITDA of 3.6% of the American GDP in the fiscal year 2019. From the management point of view, the company is geographically segmented into five operative regions. The segment "America" is the company's most important field of activity.

The company differs from other *bigtechs* by offering hardware (tangible assets) in addition to its own software products (intangible assets). Furthermore, the early IPO is a delimitation criterion and the accurate external reporting. This seems more transparent than that of the competition. Apple Pay is reported openly, but there is no segment allocation for this service.

BAT Baidu (cf. Annex VII. on pages li).

Baidu, like Alphabet a search advertising provider headquartered in Peking with 37.779 employees in 2019, carried out the IPO on 5th August 2005. The company generated an EBITDA of 1.8% of the Chinese GDP in the fiscal year 2019. The company is organized in three segments. IQiyi is a video-on-demand provider that was founded on April 22, 2010.

The Chinese *bigtechs* are all characterized by the fact that they have founded their own banks. In this way, banking services can be offered regardless of the existing financial infrastructure.

Baidu founded in 2015 jointly with CITIC (China International Trust and Investment Corporation) Baixin Bank which was approved by CBRC (China Banking Regulatory Commission) in 2017.

BAT Alibaba (cf. Annex VII. on pages li).

Alibaba, a holding company providing technology infrastructure to bring together supply and demand in a most effective way, head on earning selling fees. With a staff of 101.958 co-workers, the holding reached an EBITDA of 1% of the Chinese GDP in the fiscal year 2019.

Headquartered in Hangzhou (China) it is interesting that the company is also registered in the Cayman Islands, for tax purposes.

Through the ANT Financial Service Company, founded on October 16, 2014, Alibaba is represented in all fintech clusters. With 9,000 employees, the subsidiary of Alibaba is the most valuable financial technology unicorn worldwide ($ 150-200 bn). ANT Financial includes the brands Alipay; Ant Fortune; Ant Financial; Sesame credit; Ant Financial Cloud; Koubei; Huabei; ZOLOZ.

BAT Tencent (cf. Annex VII. on pages li).

Tencent (online advertising) is headquartered in Shenzhen, near Hong Kong Special Administrative Region. Its IPO took place on 16th June 2004. The online platform provider (initially for computer games) is listed in the Hang Seng Index (Hong Kong). Therefore, the company must publish its financial statement not only according to US-GAAP but also according to IAS/IFRS.

With a staff of 62.885 employees the company also reached an EBITDA of 1% of the Chinese GDP in the fiscal year 2019.

This group is also represented in all fintech clusters, with self-founded companies, without cooperation with traditional credit institutions. The neobank WeBank was founded in 2014, together with other non-financial companies. The bank is specialized in loans and micro-loans based on biometric algorithms.

In 2019 WeBank headed to disrupt the Australian banking industry (Frost, 2019).

Characteristics: Bank specifics of bigtechs.

How close are *bigtechs* and banks to each other? To answer this question, the following graphic (Figure 36) and tabular representation (Table 33) give an impression of how far the *bigtechs* analysed have already found their way into the financial *ecosystem*.

Combined with the *fintech* cluster approach (EBA) of Chapter 4.1, Figure 33 shows that all bank service fields are already occupied by *bigtechs*.

The difference between GAFA and BAT is that Anglo-Saxon companies tend to seek cooperation with the incumbent banking world (shown in blue letters). Asian companies, on the contrary, immediately took the step of setting up their own business (shown in black letters).

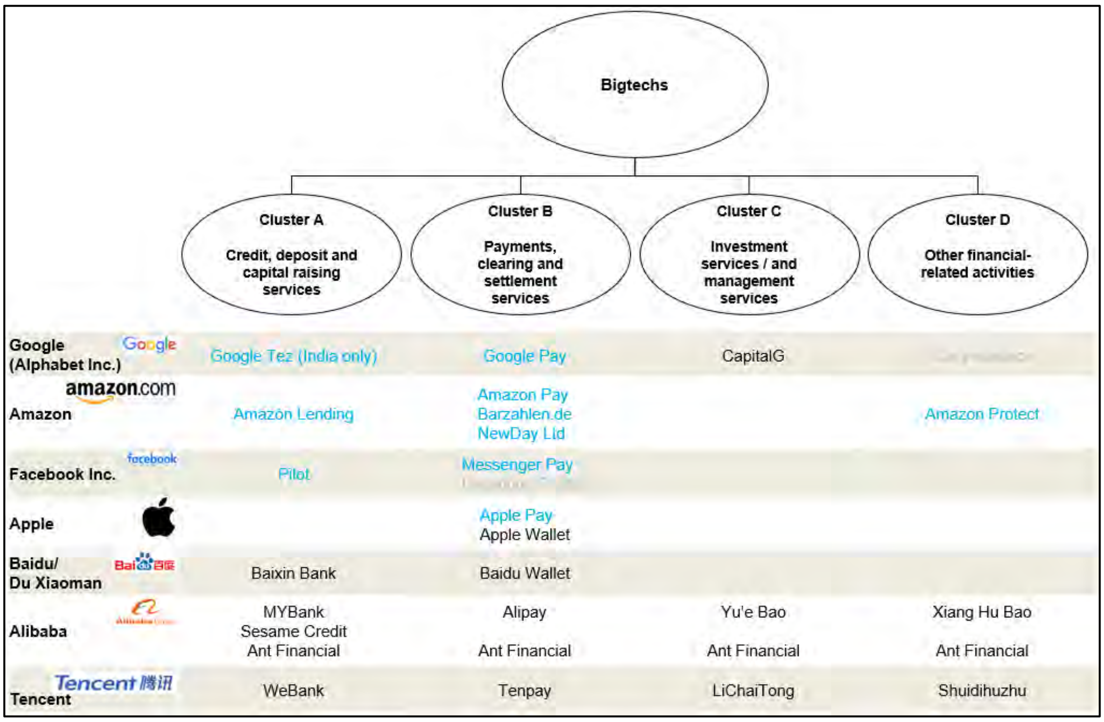
Marked in grey letters, fintech initiatives are shown which already reached unsuccessful the end of their life cycle. The table (Table 33) highlights that each *bigtech* already owns a bank license eighter in Europe (GAFA) or in China (BAT). The evaluation is based on the PSD II[37] register EUCLID[38] of the EBA. Chinese banks do not have European banking licenses.

[37] PSD II: Payment Services Directive II.
[38] EUCLID: European Centralised Infrastructure for Supervisory Data.

These have been authorized by state regulators (CBRC: China Banking Regulatory Commission). Surprising is the observation that Amazon has held a European banking license for 10 years.

However, no bank based on the Chinese model was created. This gives the impression that the financial services offered with the help of the named banking licenses only serve to support its core business.

Figure 36: Bigtechs and financial categories.



Source: Own elaboration based on (EBA, 2017; BIS, 2019a) Financial Statements 2019.

Characteristics: Interim Conclusion.

Investments of *Bigtechs* at the very moment might not head to enter deeply the financial *ecosystem*. They seem to focus on the automotive sector (Busse, 2020). This due to the fact, that cars and later-on people carrying autonomous multicopters (Volocopter) might be the most expensive electronic internet devices (Leichsenring, 2017). Which represents a tremendous market in the nearer future even connected to financial services (tokenization). Furthermore, investments in the international connectivity are actually enforced (FAZ, 2020).

Table 33: Bigtechs and their bank licences.

Metacode	Country	Bigtech name	Commercial Name	Type	Authorised	EEA National Competent Authority
GAFA	USA Mountanview, California	Alphabet Inc. (ex Google)	Google Payment Lithuania UAB	Electronic-money institution	20.12.2018	Lietuvos Bankas (Lithuania)
			Google Payment Limited	Electronic-money institution	26.04.2018	FCA (United Kingdom)
			Google Payment Ireland Limited	Payments institution	24.12.2018	Central Bank of Ireland (Ireland)
GAFA	USA Seattle, Washington	Amazon	Amazon Payments Europe S.C.A.	Electronic-money institution	24.09.2010	CSSF (Luxembourg)
			NewDay Ltd	Payments institution	19.02.2018	FCA (United Kingdom)
			Amazon Payments UK Limited	Payments institution	02.05.2019	FCA (United Kingdom)
GAFA	USA Menlo Park, California	Facebook Inc.	Facebook Payments International Limited	Electronic-money institution	09.07.2018	Central Bank of Ireland (Ireland)
			Facebook Payments International Limited	Service Provider Excluded from Scope of PSD2	27.11.2019	Sveriges Riksbank (Sweden)
			Facebook Payments International Limited	Service Provider Excluded from Scope of PSD2	13.02.2019	Central Bank of Ireland (Ireland)
GAFA	USA	Apple	Red Apple Finance Limited	Exempted Payments institution	07.03.2019	FCA (United Kingdom)
			Apple Distribution International Limited	Service Provider Excluded from Scope of PSD2	13.02.2019	Central Bank of Ireland (Ireland)
BAT	China Peking	Baidu	no results found in the EBA PSD II Register		17.11.2015	Start-up Baixin Bank
BAT	China Hangzhou	Alibaba			16.10.2014	Foundation of Ant Financial
BAT	China Shenzen	Tencent			01.12.2014	WeBank approved by Chinese Regulatory Authorities

Source: Own elaboration based on EUCLID[39] and internet research.

The data of the authorization are taken up again for investigations in chapter 5.6.

[39] EUCLID: European Centralised Infrastructure for Supervisory Data.

4.3 Adaptation of the banks.

The reaction of incumbent financial institutions to the current challenge of financial and non-financial *ecosystems* is analysed in the subchapter. Incumbents realized that their classic liquidity transformation functions are increasingly being challenged minimum in an evolutive way up to a revolutionary way by *fintechs* and *bigtechs*.

In addition to a graphic representation of where *fintechs* can implement in the value chain of classic *universal banks*, the change in the *business model* of classic banks is briefly discussed from a regulatory perspective. This is followed by a discretionary review of contemporary literature to answer the question asked above about the reaction of incumbent banks. The subsection closes with a presentation of the meaning of the knowledge gained regarding the overarching hypotheses (cf. Figure 4 on page 21).

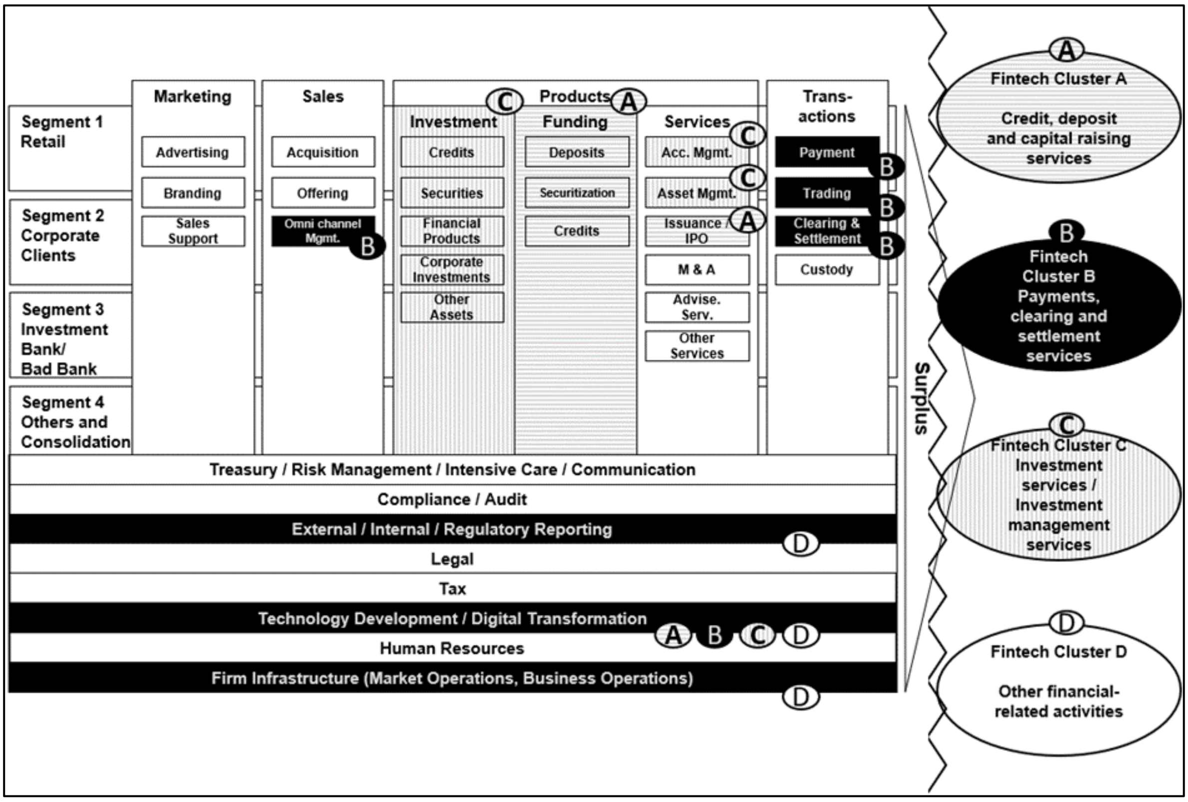
The reaction often consists of connecting with *fintechs* via incubators to be able to form a technological antipole against the capabilities of the *bigtechs*. The goal of such alliances, which are often initiated via venture capital, is to transfer the knowledge of *fintechs* and implement them into the organization of an incumbent bank.

This statement is supported by Annex V. (on page xlviii), which shows that every European *universal bank* examined had already entered a partnership with one or more *fintechs* in 2019. The study is based on the evaluation of the IAS / IFRS annual reports 2019.

The following overview (Figure 37) shows by segment (but surely not conclusively) the points in the value chain of incumbent *universal banks* that could be supported or optimized by *fintechs*. The presentation combines the generally valid model of added value (cf. chapter 2.1 on p.49) according to Porter (Porter, 1996) with the view of the fintech cluster formation according to EBA (EBA, 2018).

Fintechs as stand-alone companies, however (without cooperation) does not seem to have been granted the expected success over the years (Friedman et al., 2018). *Bigtechs*, on the other hand, would be able to replace entire segments of the financial *ecosystem* (CAPGEMINI et al., 2018).

Figure 37: Banks' value chain and the impact of *fintechs*.



Source: Own elaboration based on (Porter, 1996).

Change in business model from a regulatory perspective.

In 2006/2007, the global financial crisis (GFC) abruptly ended the previously recognizable growth of the assets of international *universal banks*, some of which were highly risky. Incumbent *universal banks* then changed their *business model* by largely turning away from risk transformation.

Recognizable from the outside, this transformation was accompanied by less complexity in the products offered, a reduction in total assets, a reduction in capital intensity and better maintenance of the liquidity situation. Furthermore, the segments were reshaped in such a way that a still profitable part of so-called core assets was separated from a toxic part, the non-core assets.

The externally measurable bank performance (e.g. measured in RoE) still suffers from these events (Buch, 2018).

The following table (Table 34), representing the core of the *business models* of the actors analysed, is interesting for further considerations. From this it can already be seen that the actors often do not have the comprehensive, historically grown know-how of each other.

Table 34: Comparison of *business models*.

Company	Core business model	Asset class	Key features	Source of revenues	Final decision maker
Universal bank	intermediation of liquidity	financials	combination of: customers with liquidity surplus and granting loans to business and consumers enriched by trust	net interest margins and fees cross-selling (e.g. insurance)	Private Client: Algorithms Wealth Mgmt.: Human being Corporates: Human being
Bigtech	e-commerce	tangibles and intangibles	combination of: network effects (e-commerce platforms, messaging applications, search engines) technology (AI and big data)	fees by supporting customer satisfaction; providing solutions; digital applications	Algorithms
Fintech	software solution	intangibles	focus on development gaps in incumbents' value chain	fees raised by servicing development gaps liquidation of the company (one-off)	Algorithms

Source: Own elaboration based on (Frost et al., 2019b; FSB, 2019a).

Adaptation process compared to fintechs.

From contemporary specialist literature can be concluded that *fintechs* does not seem to have had the disruptive success that was expected and often certified in the past (skumar, 2020). For a while, their disruptive character seemed to dominate, but this wave was smoothed into evolutionary behaviour (Krahnen et al., 2020).

Incumbent banks are often looking for a way to grant venture capital through their incubators. The long-term goal is to absorb good ideas and integrate them into the own organization (Mainincubator, 2018).

This is underlined by the fact that the incumbent banks analysed already entered in externally recognizable cooperation with *fintechs*. This insight was added by analysing the notes of its 2019 annual group reports (cf. Annex V. on pages xlviii).

Table 35 next page contains a discretionary compilation of current, contemporary subject-specific literature (10 examples). The trend towards cooperation with *fintechs* can already be observed for the years 2019/2020. Seven out of ten different literature sources act the same cooperative idea.

Source 3 goes one step further and anticipates potential reactions of the non-financial industry to the trend of the current formation of a financial *ecosystem* by incumbent banks and *fintechs*. At this point, revolutionary potential can be supposed, starting from the non-financial industry (*bigtechs*).

Table 35: Incumbent banks dealing with *fintechs* and *bigtechs*.

No	Publication date	Titel	Authors	Research focus	Methodology	Comment	Character of detected activity	Significance for this dissertation
1	07/2020	IT-Partner: Google und Deutsche Bank wollen gemeinsam Finanzprodukte anbieten	reuters/dpa	Direct access to data management, artificial intelligence and machine learning as well as the Google Cloud	descriptive	quantum leap towards disruption => DB does not need to own at 100% all IT processes.	bigtech cooperation	**H1, H3**
2	2018	Why Fintechs Cooperate with Banks - Evidence from Germany	Bömer, Max; Maxin, Hannes	Cooperations between incumbent banks and fintechs	study of 14 cases	rather a sign of evolution than disruption	fintech cooperation	**H1**
3	06/2019	World FinTech Report 2019	CAPGEMINI; EFMA	Reaction of the industry towards cooperations between incumbent banks and fintechs => concentration on Open API	global survey encompassing responses from 116 traditional financial services firms and 40 FinTech firms including banking and lending, payments and transfers, and investment management.	a sign of a silent revolution => connection of financial and non-financial ecosystems will be possible	fintech cooperation and the potential reaction of the industry	**H1, H3, H5**
4	2019	How banks can react to big tech's entry into financial services	McKinsey; Dietz, Miklos; Yasenovets, Igor	Reaction scheme of incumbent banks to bigtechs which might focus on the intesivation of their financial services. Mention of the western (cooporation) and the eastern world (revolution).	development of a game theory based action and reaction scheme	a sign of disruption of revolution	reaction to bigtechs movements	**H3, H5**
5	2018	Integrating the 'Troublemakers': A taxonomy for cooperation between banks and fintechs	Drasch, Benedict J.; Schweizer, André; Urbach, Nils	Based on the literature, 136 real-world cases, and 12 expert interviews, our results suggest structuring and describing bank-fintech cooperation through 13 dimensions.	propose a theoretically founded and empirically proven taxonomy	Back to the roots by integration!	fintech cooperation	**H1**
6	03/2020	Why Are Banks Working With Big Tech?	Edwards-pritchard, Ryan	Incumbent banks collaborating with Big Tech companies are striking a difficult balance between partnership and competition...	descriptive	eighter cooperation or competition => but bigtechs tend to enforce their core business	bigtech cooporation	**H3, H5**
7	2019	Bank Strategies in the Light of the Digitalisation of Financial Activities	Tanda, Alessandra; Schena, Cristiana-Maria	Reaction of banks towards digitisation	qualitative approach	Reaction of incumbent banks	fintech cooperation and bigtech cooperation	**H1**
8	2020	Synergy and disruption: Ten trends shaping fintech	McKinsey; Galvin, Jeff; Han, Feng; Hynes, Sarah; Qu, John; Rajgopal, Kausik; Shek, Arthur	10 trends all over the world (China, USA, Europe offices)	descriptive	merging of ecosystems possible	banks fintech and bigtech cooperation	**H1, H3, H5**
9	2019	Modern Types of Financial Innovations in the Conditions of Digitalization of the Global Banking System	Travkina, Elena; Alexander, Molokanov	description of the transformation process of incumbent banks	descriptive	transformation of the old world	adoption process of banks	**H1**
10	2020	189 Of The Biggest, Costliest Startup Failures Of All Time	CB Insight	Screening of the startup database => failures from fraud to running out of liquidity	descriptive	new ideas ≠ sustainable ideas	robustness of incumbent banks	**H1**

Source: Own elaboration.

Adaptation process compared to bigtechs.

Regarding the handling of *bigtechs*, two trends are emerging worldwide (cf. chapter 4.2 Figure 35 on page 171). In the western world, banks and *bigtechs* are increasingly looking for partnerships (Manager Magazin, 2020). Officially for better use of data in the interests of bank customers. Unofficially, the banks are looking for these alliances to get rid of a large block of costs and thus achieve a CIR (Cost-Income-Ratio) improvement. In cooperation with Google (Alphabet Inc.), Deutsche Bank also has access to the Google Cloud. This frees the bank from the requirement of 100% data ownership in the sense of maintaining a cost-intensive, redundant hardware infrastructure (Arons et al., 2020).

In the eastern world, the trend is observable that the *bigtechs* founded banks without further ado (cf. chapter 4.2 Figure 36 on page 175). For example, banks with a nationwide supply of highly digital-savvy Asian customers were not available in the past, which is why *bigtechs* simply closed this gap with their digital infrastructure to support their core business (Feliciano-Wendleken, 2018).

Interim conclusion towards overarching hypotheses.

The following development-specific indications can be highlighted as arguments in sense of the overarching hypotheses (Figure 4 on page 21) of the work:

Table 36: Indications of chap. 4 insights towards overarching hypotheses.

Chapter	Key words	Indication for hypothesis	Transformation of *business model*	Argument
4.1	*fintechs*	H2 + H3	Disruptive innovation offers	Bundling innovations of the next decade bringing together banking services.
4.2	*bigtechs*	H3 + H5	Revolutionary innovation	In the western world they cooperate. In the eastern world they rather founded banks by themselves.
4.3	Incumbent banks' reaction	H1 + H3 + H5	Evolutionary and disruptive innovation	Enrichment of the old *business model* but revolution by ignorance.

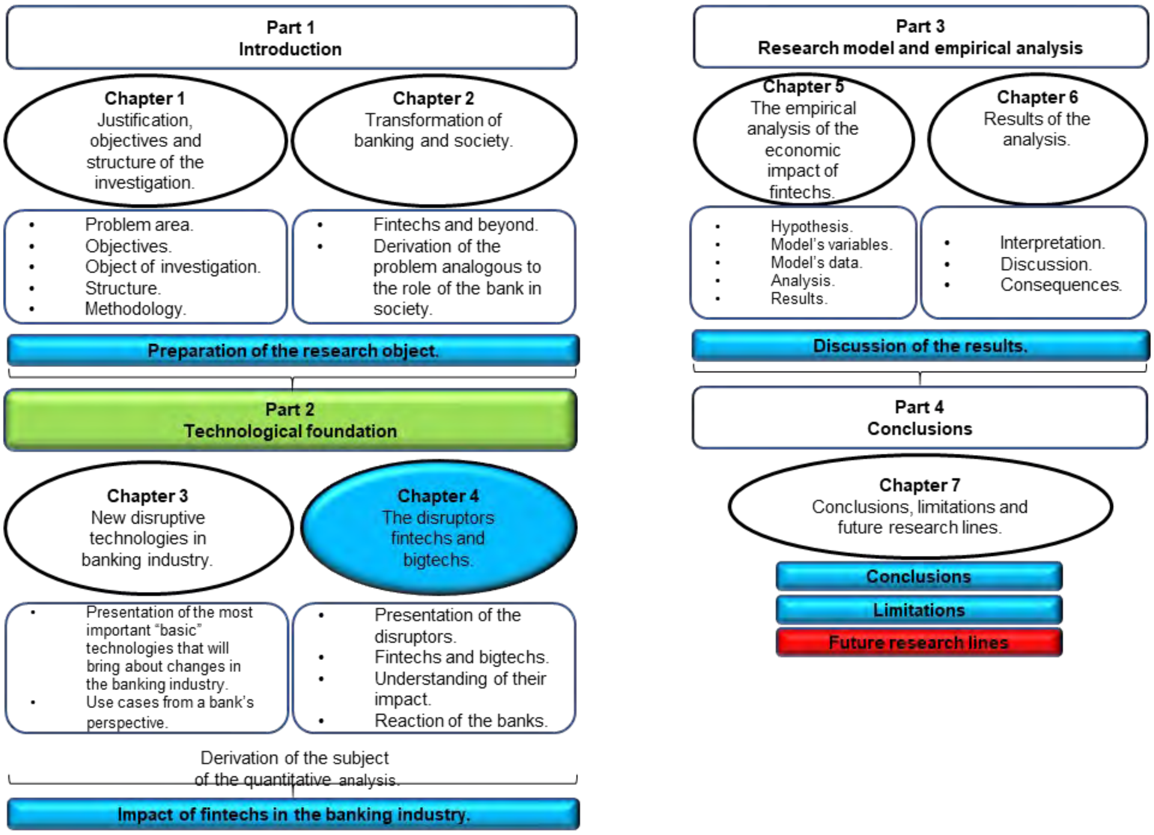
Source: Own elaboration.

Despite increasing statements about cooperation between banks and *fintechs*, which inevitably lead to the formation of a financial *ecosystem*, there is still room for the foundation of stand-alone *fintechs* in 2020 (cf. H2 of overarching hypothesis). Sometimes also banks award scholarships (e.g. Banco Santander 2016), including to support research. This is attributed to the confirmation of hypothesis H4 (unaligned research).

Part III. Research model and empirical analysis

Chapter 5. The empirical analysis of the economic impact of *fintechs*.

5.1 Variables of the model.
5.2 Derivation of the hypothesis.
5.3 Data of the model.
5.4 Regression analysis.
5.5 Regression diagnostics and results.
5.6 *Bigtech* litmus test.
5.7 A qualitative approach by questionnaire.

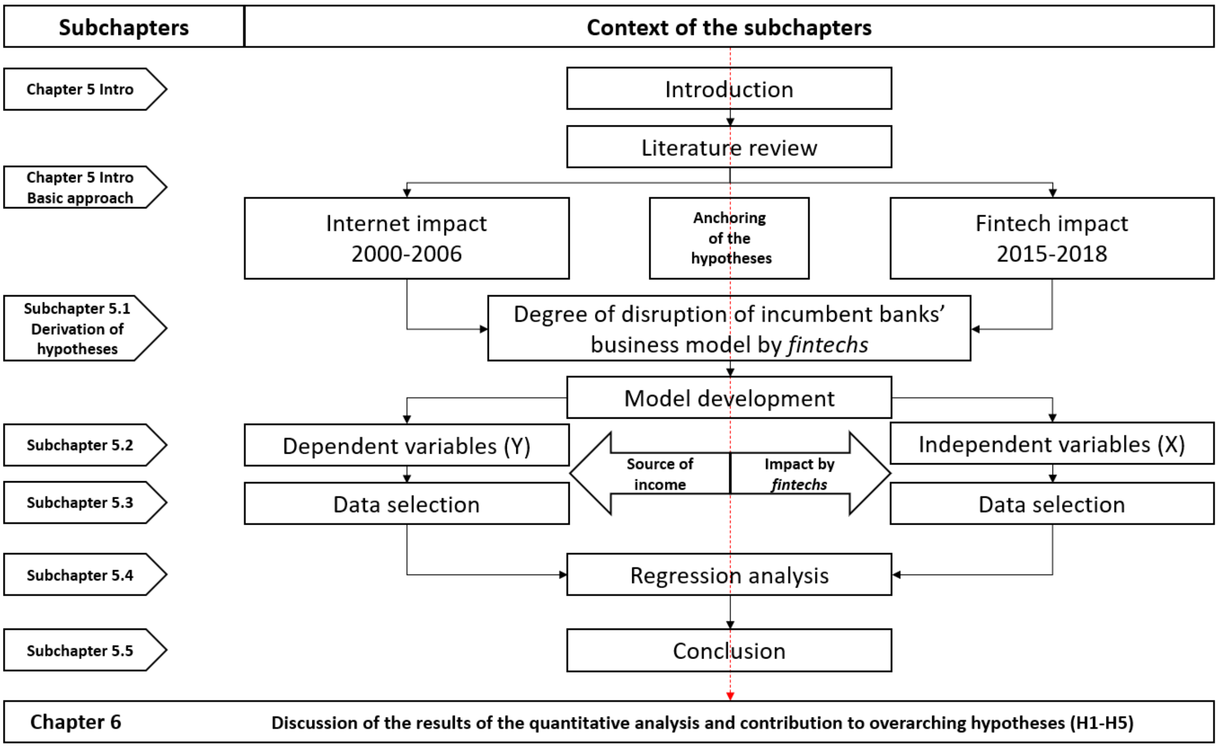


This chapter quantitatively outlines the effects of digitization on the *business models* of the incumbent banks analysed. Thus, the overarching hypothesis H3 (degree of disruptive change in the *business model* due to *fintechs*) is analysed in detail.

A multivariate linear regression model is employed as a tool of descriptive statistics. Carefully chosen explanatory variables (X regressors) are used to explain bank-specific variables (Y regressands) over the years.

The basis of the study is externally accessible data from the IAS / IFRS Group Annual Reports 2010 - 2017.

Figure 38: Structure of chapter 5.



Source: Own elaboration.

For the quantitative determination of the impact of *fintechs* on the *business model* of incumbent banks, measured by performance indicators, the thread of the chapter follows 5 steps (subchapter).

Already in the introduction the basic approach is demonstrated to the development of the quantitative model. This consists of 2 steps of the literature review. First, as an analogy, scientific articles were selected that deal with the impact of the emergence of the Internet on the *business model* of banks in the period 2000-2006.

The overview of the articles with the greatest influence on this work can be found in Table 37 (on page 189). Based on this, conclusions were drawn for the identification of the key performance indicators, on which the formation of *fintechs* could have an observable disruptive effect over a time series. The idea is: The more disruptive the existence of *fintechs*, the worse some indicators (competition) or the better (cooperation) of incumbent banks would have to become over time.

Based on the insights of the literature review, three quantitative hypotheses (H_A-H_C) to be analysed are derived in Subchapter 5.1.

Section 5.2 is devoted to the determination of the dependent and independent variables of the statistical model.

The selection of the data and its discussion is offered in subchapter 5.3. Core aspects like the term "*business model*" itself are discussed in the “Glossary of definitions”. An attempt to structure the term "*fintech*" is made in chapter 4.1.

The regression analysis is shown section 5.4. The results are presented in section 5.5. The knowledge gained in this way of the interaction between *fintechs* and *universal banks* culminates in an in-depth discussion in main chapter 6.

Scientific Literature.

This chapter uses at first the published findings as analogies examining the impact of the internet on the classic *business model* of *universal banks* of the 1990s in the search for a quantitative model. The current literature is then analysed for articles that examine the effect of *fintechs* on the *business models* of incumbent banks. *Fintech’s* history is divided in 3 epochs (Fintech 1.0 to 3.0: (1866-1967), (1967-2008), (2008 – now)) (Arner et al., 2015).

Of special interest in this chapter is the last (post-financial crisis) epoch when credit institutions begin to recognize the benefits of *fintechs*. According to the mention in the group annual reports, this awareness matured in the last two years of the term 2010 - 2017. The focus of these publications, written prior to the global financial crisis of 2008, are the determinants of internet usage and the performance of financial institutions.

Table 37: Academic literature on the impact of the internet.

Authors	Time frame	Subjects of analyses’	Empirical approach	Key findings	WoS citation report 2007 - 2017
(Emilia Bonaccorsi di Patti et al., 2004)	1998-2001	average of 800 multichannel banks in Italy with focus on private households	multivariate analysis	- no significant consumer surplus	n/a
(Hernando and Nieto)(Hernando and Nieto)	1994-2002	72 commercial banks operating in Spain	multivariate analysis	+higher profitability	664
(Ciciretti et al., 2009)(Ciciretti et al., 2009)	1993-2001	105 commercial banks operating in Italy	multivariate analysis	+positive correlation between internet adoption and profitability (RoA, RoE)	16
(DeYoung et al.)(DeYoung et al.)	1999-2000	performance of 5175 branching-only community banks in the US and internet adoption	bivariate analysis and multivariate analysis	+higher profitability of multichannel banks	209

Source: Own Elaboration.

All authors obtained positive correlations between the use of the internet and the performance of the examined banks. Unlike the other authors (Emilia Bonaccorsi di Patti et al., 2004) were unable to identify a positive correlation relative to Italian *Universal Banks* but despite all they recognized a complementarity between classic brick and mortar banks and the use of electronic delivery channels.

All authors examined the relationship between the use of the internet and key performance indicators of the analysed banks. This represents the basis of the quantitative model (cf. subchapter 5.4) for which the dependent and the independent (explanatory) variables are to be identified (cf. subchapter 5.2) according to the hypotheses (cf. chapter 5.1). These address the disruptive impact of *fintechs* on banks' traditional *business models*.

5.1 Derivation of the quantitative hypothesis.

The insights achieved from the literature review regarding the measurability of the change in the profitability of the *business models* of incumbent banks has been incorporated into the design of the 3 quantitative hypotheses (H_A-H_C). These are shown in the table below.

It is framed in such a way that line by line the hypotheses are exposed standing for measuring the degree of disruption that has already occurred.

In addition to the degree of disruption, the explanatory variables (X) of the model are displayed in columns. These are discussed in subchapter 5.2.

Table 38: Hypothesis and X variables.

Hypothesis	Disruption	Fintech experience time [FT]	Reinvest-ment Rate [BM]	Price to book ratio [SP]	Non-performing loans [NPL]	Customers' digital accessibility [CDA]
H_A	high	high	high	high	low	high
H_B	medium	neutral	neutral	neutral	neutral	neutral
H_C	low	low	low	low	high	low

Source: Own elaboration.

It is assumed that the *business models* of listed *universal banks* must change to remain profitable for the shareholder (Roengpitya et al., 2017). This increases the pressure to publish accurate external reporting. The IAS/IFRS framework describes this as "decision useful financial information for the current and future investor" (IASB, 2018).

Quantitative hypothesis A.

The disruptive nature of *fintechs* on the *business model* is already high. Necessary changes have been made and this has a positive effect on the earnings and cost situation. The explanatory X variables would have to exert a high influence on the Y variables to be explained with a high statistical acceptance of the model.

Quantitative hypothesis B.

Although the disruptive nature of *fintechs* on the *business model* is evident, the earnings and cost situation evolve sideways. The explanatory X variables would have to exert a neutral influence on the Y variables to be explained with a medium statistical acceptance of the model.

Quantitative hypothesis C.

The disruptive nature of *fintechs* on the *business model* is not yet apparent. Necessary changes may not have been addressed, the earnings and cost situation develop negatively. The explanatory X variables would have to exert a low influence on the Y variables to be explained with a low statistical acceptance of the model.

The disruptive potential of the *fintechs* in this context is not understood in the sense of the destruction of classic *universal banks* that has already taken place, but in the sense of a positive transformation of its *business model*.

The values high, neutral, and low (cf. Table 38 on page 190) are interpreted in chapter 6 with reference to the p-values of the regression analysis.

The p-values obtained by the Excel Anova program provide an overview of the level of significance of the individual explanatory X variables in relation to the dependent Y variables.

High means that the X variables have a strong explanatory influence on the Y variables (p-value ≤ 0.05); medium means that X variables tend to be indifferent (neutral) explanatory to Y variables, and low means that the chosen X variables have little explanatory influence to the Y variables (p-value > 0.05).

The inherent weakness of this approach is to identify clearly from an external perspective the separate effects on performance caused by growing regulatory requirements, *fintechs* and changing customer behaviour.

5.2 Variables of the model.

For a quantitative model both Y variables (dependent variables) must be identified as well as the X variables (independent variables) which shall be used to explain the dependent variables.

Y variables (dependent variables).

Based on the above evaluation both performance-specific and risk specific-ratios were selected with the intention to express the banks' *business models*. Among other things, they are expressed through the design of the 4 typical yield pillars: net interest income, commission income, trading income, other income (Poppensieker, 2017)(cf. chap. 2.1 Figure 10 page 47).

As performance is usually generated with the asset side (Richard J. Gentry et al., 2010), indicators were selected so that reflect the asset side's relation of the balance sheet with the revenue development. Return to equity, on the contrary, reflects a part of the banks' funding (liability side of the balance sheet) in relation to income.

Mixed indicators were used, considering the balance sheet and the income statement.

The employment of the cost-income ratio reflects the expectation that the revenue situation would be reduced by lower cost pressure and increased integration of *fintechs'* optimization contribution on the value chain.

Among others, one of the strongest cost drivers is the current workforce (Messenbock, 2017). This involves the fact that the analysed banks continuously reduced full-time positions in the years of the study period (2010 - 2017) (around 300,000 in Europe).

The trigger here could also be an increased use of new technologies by *fintechs*.

Last but not least the risk appetite of the banks is considered by the loan loss provisions (Foos et al., 2010) with the idea that new technologies could help to reduce the riskiness of the core business (interest bearing loans).

Table 39: Y variables.

Y dependent variables	Character	Intention
Financial performance		
RoA (Return on assets)	mixed	Overall view: yield in relation to assets employed and equity funding needed
RoE (Return on equity)	mixed	
NII (Net interest income)/total assets	mixed	Revenue pillars: income in relation to assets employed reflecting the alignment of the respective *business model*
CFI (Commission & fee income)/total assets	mixed	
Trading income/total assets	mixed	
Other income/total assets	mixed	
CIR(Cost-income-ratio)	revenue	Revenue: involves the current overall cost situation and the banks' main cost driver (workforce)
Workforce (Income/full time equivalents)	revenue	
Riskiness		
LLP (Loan loss provision)	revenue	

Source: Own elaboration.

Both *universal banks* and consulting firms use these indicators for comparative statements about the analysed companies (Poppensieker, 2017).

X variables (independent variables).

The new technologies have enabled *universal banks* to break up their traditional value chains and reorganize them component wise in terms of profit and cost. Elements of the value chains are no longer created by the banks themselves but can be requested from service providers (e.g. *fintechs*) (Brad B. Wallace et al., 2017).

The explanatory variables (cf. Table 40 on page 193) have been chosen to represent a *business model* that is subject to a disruption process. Internal indicators can be influenced by the companies themselves. [FT] (*Fintech* adoption time) It is up to the companies to adopt the new technologies (*fintechs*).

Often a so-called incubator route is chosen, in which good ideas of the *fintechs* are identified and catalysed, with the aim of integrating them into the existing value chain.

The model employs a simple linear learning curve. An approach based on the beginnings of this branch of research (triggered by aircraft construction (Wright, 1936)).

[BM] (*Business model* in sense of reinvestment rate) The reinvestment rate expresses how much of the income after tax has been reinvested in the companies by themselves. Depending on the design of the national stock corporation laws, the management can without the consent of the shareholders retain up to 50% of the earnings (eg. §58(2) German Stock Corporation Act).

[NPL] (Non-performing loans) By allocating the reinvested funds into the digital design of, for example, the core banking business, the NPLs would have to be reduced.

The external view of the listed companies is best expressed by the evolution of the stock price (Demirgüç-Kunt and Huizinga, 2013). [SP] (Share price) and eventually, the market is always right (Schredelseker, 2015). The price-to-book ratio was chosen as an indicator illustrating very well the interaction between a company's own view on share value based on external reporting figures and market acceptance. At a price-to-book ratio below 1, the market expresses that it does not believe in profitability (ie. the *business model* fails or is likely to fail). If the price-to-book ratio is above 1, the market is still convinced by the performance of the company. There are only a few European bank stocks whose price-to-book ratio is above 1.

[CDA] (Digital accessibility of the customer) This indicator is an attempt to account for changing customer behaviour. Statistics on the digital development status of a country are provided by the European Commission (EU Commission, 2020).

Table 40: X variables.

X independent variables	Character	Intention
Variable internally manageable by incumbent banks		
[FT] Fintech adoption time	Learning curve effect based on a simple linear approach (Wright 1936)	Leverage effect: reflecting the time banks are already cooperating with *fintechs*. Figures based on the evaluation of the annual financial group reports (IFRS)
[BM] Reinvestment rate	Employment of revenue	Percentage of revenue the banks reinvested by themselves in their business (and the supposed change of their *business model*)
[NPL] Non-performing loans	Risk aspect	By investing in the core bank's business (interest driven loans) NPL should decline)
Variable externally unmanageable in a direct way by incumbent banks		
[SP] Share price	Price-to-book ratio	Neutral external investors' expectation of rising company value and dividends => Reflection on earnings expectations and thus the future viability of the *business model*
[CDA] Customers' digital accessibility	Use of internet access for online banking/population	Consideration of the change of customer behaviour (2020 accelerated by COVID-19)

Source: Own elaboration.

5.3 Data of the model.

Quarterly bank specific performance and cost data are used from Refinitiv (former Thomson Reuters Eikon) (key ratios, income, balance, segment) and market specific data from Bloomberg from 2010 to the end of 2017 (cf. Table 42 and Table 43 on pp.196).

The choice of the period (post subprime crisis to today) is justified by data availability and the search for relative calm before economic exogenous shocks (e.g. subprime with subsequent sovereign debt crisis).

In addition, the external annual group reports (IFRS) from 2010 to 2017 have been screened for the key word *fintech* (248 IFRS group financial statements in total). Concerning the customers' accessibility statistical data from the EU commission's homepage are added.

The data sets were mainly exported in EUR, except for the Refinitiv (former Thomson Reuters Eikon) data (balance, income) of the following 9 banks:

Table 41: Data of the model Banks with FX conversion.

Bank	Bloomberg Code	Currency
Komercni Banka as	KOMB CP	CZK
UBS and Credit Swiss First Boston	UBSG SW and CSGN SW	CHF
Danske Bank	DANSKE DC	DKK
Barclays	BARC LN	GBP
DNB Bank	DNB NO	NOK
SEB Bank and Swedbank	SEBA SS and SWEDA SS	SEK
HSBC	HSBA LN	USD

Source: Own elaboration.

Official quarterly ECB reference rates (CET 16.00) loaded as .csv files in Excel were used for the conversion.

The combined data set is an unbalanced panel observation of 31 banks over an eight years' period on a quarterly basis starting from the beginning of 2010 (cf. Annex XII. on page lxvi). The data panel is unbalanced since the banks did not start at the same time their digital transformation process. In 2017, the observed average *fintech* experience was one year.

Following (cf. Table 42 and Table 43 on pp.196) provide an overview of the data used, their sources and the difficulties with data quality.

If an incomplete time series was delivered, the oldest values were permanently updated to fill the data gap up to the next data available (e.g. Refinitiv Commission & fee income, Dealer trading account profit & loss, Bloomberg Non Performing Loans) (source Bloomberg).

Concerning the data quality of the sources ECB and EU commission, decimal places had to be added caused by the .csv data import.

A special feature of the external reporting was provided by Danske Bank, which does not appear to report any trading results.

UBS used the term *fintech* in 2015 in a negative way in the annual group report as per 31st December 2014 but at nearly the same time in February 2015 its *fintech* learning curve started by founding a *fintech* platform (innovation lab) (Bovey, 2015).

Table 42: Y dependent variables sources and challenges.

Y dependent variables Indicator	Own calculation	Data source	Data errors and gaps
Financial performance			
RoA (Return on assets)	no	key ratios	gaps in the time series
RoE (Return on equity)	no	key ratios	gaps in the time series
Net interest income/total assets	yes	income + balance sheet	gaps in the time series
Commission & fee income/total assets	yes	income + balance sheet	gaps in the time series
Trading income/total assets	yes	income + balance sheet	gaps in the time series DANSKE is not reporting trading income net result versus brut result
Other income/total assets	yes	income + balance sheet	gaps in the time series
CIR (Cost-income-ratio)	yes	income	gaps in the time series
Workforce: Income/full time equivalents	yes	income and annual external financial group reports (IFRS)	gaps in the time series
Riskiness			
LLP (Loan Loss Provision)	no	income	gaps in the time series
FX-Rates			
FX reference rates (16.00 CET)	no	ECB	import .csv file in excel + decimal places

Source: Own elaboration.

Table 43: X independent variables sources and challenges.

X independent variables Indicator	Own calculation	Data source	data errors and gaps
Variable internally influencable by banks			
[FT] Fintech adoption time	yes	annual external financial group reports (IFRS).	only negative remarks in annual report (e.g. UBS 2015) but published newspaper articles with positive remarks.
[BM] Reinvestment rate	no	Refinitiv (Thomson Reuters Eikon) (key ratios).	gaps in the time series.
[NPL] Non-Performing loans	no	Bloomberg.	gaps in the time series.
Variable externally not influencable by banks			
[SP] Share price	no	Bloomberg.	gaps in the time series.
[CDA] Customers' digital accessibility	no	EU commission.	gaps in the time series (CH most affected) + decimal places.

Source: Own elaboration.

Financial analysis of the data.

Dependent variables.

The analysis of the 31 *universal banks* is based on 9 ratios reflecting its performance, the cost situation and the riskiness of the loans, the banks' core business.

Six profitability ratios contain, besides RoE and RoA after taxes, the four pillars of the yield as a percentage of total assets (net interest income, loan loss provisions, net commission income, net trading income and other net incomes).

The operational performance is expressed by the cost income ratio and the total revenue per employee and the riskiness by LLP (loan loss provisions). The more efficiently the core banking business (retail banking as bulk business) based on *fintechs* can work, the lower the LLP would have to be.

For this study, performance in the wider sense is understood as a set of dependent variables that are regressed by a combination of independent variables reflecting the particular *business model* and its transformation (cf. Annex XIV. on page lxviii).

Independent (explanatory) variables (cf. Annex XIII. on page lxvii).

The dependent variables are modelled by a set of 5 independent variables:

- [FT] as a dummy variable indicates the time from which the banks have announced their digitization,
- [BM] the reinvestment rate per total assets as a sign of the banks’ will to transform,
- [SP] the market opinion, a reliable value expressed by the price-to-book ratio,
- [NPL] the volume of non-performing loans represents a view of the risk aspect,
- [CDA] the customers’ digital accessibility marked using the internet for online banking.

The objective is to model the banks' KPIs through a mix of neutral external and internal values, all of which are related to the activities of *fintechs*.

[FT] A simple linear construction of the learning curve is based on the findings of the early American aviation industry (Wright, 1936), which was the first to associate positive learning effects with the reduction of costs.

[BM] Reinvestment is to be understood as a kind of degree of freedom of the banks to start independently new investment projects in order to ensure the future (PWC Kashyap, 2017).

[SP] The market partially compensates or penalizes entrepreneurial decisions, often in anticipation of changes in share prices (Schredelseker, 2015).

[NPL] If banks already renewed (disrupted) their retail banking units with *fintech* experience, this aspect of riskiness of the banks’ *business model* would have eased. Thus, the potential for the explanation of the Y variables is therefore considered high (Schmidtke, 2018).

[CDA] fintechs reach faster customers digitally, via internet, be it through using their smartphones, tablets or PCs (Acquaro, 2017) (cf. Annex XV. on page lxix).

To prepare the data for the multivariate regression analysis with Excel Anova (Roland Pfister et al., 2013), all X and Y variables were represented as percentages.

Annex XVIII (on page lxvii) shows the result of examining the X variables‘ multicollinearity by a simple correlation matrix. For this purpose, the average of all explanatory variables of all 31 banks was calculated. Most X variables show zero to low multicollinearity, one variable shows average multicollinearity and one variable medium to high multicollinearity.

Thus, no limitation on the accuracy of the model can be seen at this point except in terms of the variable combination [FT] to [CDA]. Both are highly positively correlated with 0.75.

Both variables might rise at a similar rate since the digital learning curves of the analysed banks and the population of a country are growing at a similar rate.

The average negative correlation of -0.52 between the variables [FT] and [NPL] could underline the fact that, as technology advances, the core business of banks is less risky. Bank regulation also has a strong effect on this position [NPL] (CRR, CRD IV, Basle IV).

5.4 Panel regression analysis.

The multivariate regression analysis is chosen as a method to test the common linear relationship between metric multiple independent variables and one metric dependent variable.

This analysis examines the impact of *fintechs* on the income and cost situation of the *universal banks* surveyed. The calculations are made out for the entire set of banks, all over all observation points in time.

The aim is to identify possible relationships between the cooperation with *fintechs* and the banks‘ overall performance. The following equation shows the multivariate regression equation with 5 regressors.

Equation 1:Applied multivariate regression equation.

Equation[40]	
$y_n = \alpha + \sum_{t=1}^{33} \beta_J\, FT_{i,t}^{J} + \sum_{t=1}^{33} \gamma_t\, BM_{i,t} + \sum_{t=1}^{33} \delta_t\, SP_{i,t} + \sum_{t=1}^{33} \theta_t\, NPL_{i,t} + \sum_{t=1}^{33} \omega_t\, CDA_{i,t} + \varepsilon_{i,t}$	
y dependent variables	**x independent variables**
profitability ratios	α regression constant
Pre-Tax RoE	β slope coefficient of characteristic FT
Pre-Tax RoA	FT internal characteristic: *fintech* adoption time
Net interest income/Total assets	γ slope coefficient of characteristic BM
Loan loss provisions/Total assets	BM internal characteristic: transformation of *business model* by reinvestment rate
Net commission income/Total assets	δ slope coefficient of characteristic SP
Net trading income/Total assets	SP external characteristic: share prices expressed by book-to-market-ratio
Other net income/Total assets	θ slope coefficient of characteristic NPL
operational performance ratios	NPL internal characteristic: A high degree of disruption by *fintechs* should enable a low NPL volume
Cost income ratio	ω slope coefficient of characteristic CDA
Total revenue/Employee	CDA external characteristic: customers’ digital accessibility
	ε random disturbance term

Source: Own elaboration.

[40] The subscripts i and t are indexing banks and time in quarters.

Excel Anova is employed for its simple and almost intuitive use. Its reliability towards R or SPSS has been positively analysed (Keeling et al., 2007).

The study is structured in such a way that 9 Y variables per each bank were modelled by the 5 X variables. The model was thus calculated 279 times (minus a rejected calculation), with a 95% confidence level (Schira, 2016). The choice of the confidence level of 95% corresponds to prevailing literature opinion (Chatfield et al., 2018).

The model was expressed by the F-criterion whereby it was not accepted 78 times and 201 times accepted (cf. Annex XVI. on page lxx). Annex XVIII. (on page lxxii) outlines a simple examination of possible multicollinearity, potential overlapping influences of the X variables on the Y variables, expressed by the correlation of the X variables with each other.

A strong positive correlation is observed for the X variables [FT] and [CDA], a strong negative correlation for X variables [FT] and [NPL].

The strong positive correlation is attributable to the fact that both investigated the *universal banks* cooperated with *fintechs* towards the end of the investigation period and at the same time increased digital access to the population groups examined.

The negative correlation could be an expression of the effectiveness of digitally based selection algorithms concerning the credit allocation of the banks.

5.5 Regression diagnostics and results.

The aim of this subchapter is to analyse the impact of *fintechs* on *business models* of classic *universal banks*. The impact (level of disruption) was divided into the levels high, neutral, and low. The interpretation is first based on the calculated statistical relationships and then economically. This well knowing that no direct economic causality can be derived from statistical relationships.

Interpretation of statistical relationships.

The inference to the three hypotheses formulated in chapter 3 is made here purely statistically, based on the determined p-values.

Figure 39: Conclusion on the hypotheses.

Hypothesis	Disruption	Fintech experience time [FT]	Reinvest-ment Rate [BM]	Price to book ratio [SP]	Non-performing loans [NPL]	Customers' digital accessibility [CDA]
H_A	high	high	high	high	low	high
H_B	medium	neutral	neutral	neutral	neutral	neutral
H_C	low	low	low	low	high	low

Source: Own elaboration.

Table 44: Overall view of the p-values.

Hypothesis	Degree of disruption	p-values	[FT]	[BM]	[SP]	[NPL]	[CDA]	Count
		0.00 < 0.01	38	92	18	26	55	229
H_A	high	0.01 < 0.02	12	3	6	9	12	42
		0.02 < 0.05	11	21	17	20	24	93
H_B	medium	0.05 < 0.20	45	44	54	58	45	246
H_C	low	0.20 < 0.50	57	47	70	69	56	299
		0.50 ≤ 1.00	115	71	113	96	86	481
Test			278	278	278	278	278	1.390

Source: Own elaboration.

Table 44, based comprehensively on the entire model, outlines in relation to the quantitative hypothesis the counted p-values of the independent (X) variables resulting from the calculations.

Observable is that the significance of the X variables is either clearly between 0.00 and 0.01 or concentrated on the medium or low end.

This means, that the explanatory influence on the Y variables is eighter remarkably high or is in the significance of very clearly extremely low (cf. Annex XVII. on page lxxi).

As single variable stands out [BM], with 116 (278) p-values in the high significance range. The X variables seem to offer the least significance with 172 (278) p-values and [SP] with 183 (278) p-values.

Thus, either one expression (albeit lower) can be seen for H_A as well as for H_C. However, H_C is not consistently confirmed because of its high significance in terms of [NPL] but is rather neutral to low.

The explanatory employment of the two variables and [FT] and [CDA] is somewhat neutralized by their strong positive correlation (cf. Annex XVIII. on page lxxii).

5.6 Bigtech litmus test.

The term litmus test is used in chemistry to test the pH-value of a substance using the litmus dye (Moore, 2020).

In Anglo-Saxon journalism, the meaning of litmus test turned to a judgmental decision that shows how a situation can really be classified (Kasadha et al., 2020). An equivalent word would be "touchstone". The simple but proven test of a situation is symbolized.

Hence the choice of the heading in the context of this thesis in relation to the quick analyse of the effects of the *bigtechs* on the financial *ecosystem*. The named litmus test is in this case an event study based on capital market information. This is possible since all analysed objects are capital market oriented (§264d HGB) and thus equipped with homogenic data sets (e.g. time-series of share prices).

Assumption to be investigated:

The price-relevant events are not believed to cause any effects neither on stock prices nor on the long-term credit rating of the analysed companies. Thus, no confirmation of the overarching hypothesis H5 (revolutionary impact on the *business model* of classic *universal banks* (cf. Figure 4 on page 21)) is expected.

Design of the event study:

The aim of the study is to review the reaction of the *bigtechs'* stock prices and their potential counterparties, the *universal banks*. This at the time of the official approval of the respective banking licenses by local supervisory authorities (cf. Table 45 next page).

Thus, the influence of this access to the financial *ecosystem* by *bigtechs* is to be shown, illustrated by their market capitalization. The investigation of the reactions of the stock prices of the banks examined serve as a contrast.

The complete market efficiency (Fama, 1970) is assumed for this study. This has also been partially proven in scientific studies, as the example of the market efficiency of NASDAQ[41] shows (Younas et al., 2018).

In addition, the beta factors (going back to CAPM) are shown in order to represent a kind of plaque for the volatility of the individual securities (Cremers et al., 2000). The beta factor of a share expresses its volatility in relation to the volatility of the overall market (here

[41] National Association of Security Dealers Automated Quotations exchange.

expressed by the markets in which the companies are listed). A beta of 1 means that the stock changes its value parallel to the overall market. If the beta is less than 1, the willingness to change the value is less than that of the overall market. With a beta greater than 1, the volatility is greater than that of the overall market. The share is therefore classified as riskier about the risk of changes in market prices. However, the refinancing of a company does not only consist of equity. Debt also plays a role. According to Modigliani and Miller, the liability side of a company is relocated without having an impact on the company's value (Modigliani et al., 1958). This increases the return on equity. For this reason, the rating of companies from well-known rating agencies such as Moody's is used (cf. Annex X. on page lxiv).

Table 45: *Bigtechs* and bank licenses.

Metacode	Country	Bigtech name	Commercial Name	Type	Event No	Authorised	EEA National Competent Authority
GAFA	USA Mountanview, California	Alphabet Inc. (ex Google)	Google Payment Lithuania UAB	Electronic-money institution	8	20.12.2018	Lietuvos Bankas (Lithuania)
			Google Payment Limited	Electronic-money institution	6	26.04.2018	FCA (United Kingdom)
			Google Payment Ireland Limited	Payments institution	9	24.12.2018	Central Bank of Ireland (Ireland)
GAFA	USA Seattle, Washington	Amazon	Amazon Payments Europe S.C.A.	Electronic-money institution	1	24.09.2010	CSSF (Luxembourg)
			NewDay Ltd	Payments institution	5	19.02.2018	FCA (United Kingdom)
			Amazon Payments UK Limited	Payments institution	12	02.05.2019	FCA (United Kingdom)
GAFA	USA Menlo Park, California	Facebook Inc.	Facebook Payments International Limited	Electronic-money institution	7	09.07.2018	Central Bank of Ireland (Ireland)
			Facebook Payments International Limited	Service Provider Excluded from Scope of PSD2	13	27.11.2019	Sveriges Riksbank (Sweden)
			Facebook Payments International Limited	Service Provider Excluded from Scope of PSD2	10	13.02.2019	Central Bank of Ireland (Ireland)
GAFA	USA	Apple	Red Apple Finance Limited	Exempted Payments institution	11	07.03.2019	FCA (United Kingdom)
			Apple Distribution International Limited	Service Provider Excluded from Scope of PSD2	10	13.02.2019	Central Bank of Ireland (Ireland)
BAT	China Peking	Baidu	no results found in the EBA PSD II Register		4	17.11.2015	Start-up Baixin Bank
BAT	China Hangzhou	Alibaba			2	16.10.2014	Foundation of Ant Financial
BAT	China Shenzen	Tencent			3	01.12.2014	WeBank approved by Chinese Regulatory Authorities

Source: Own elaboration based on internet research and EUCLID of EBA.

Steps of the event study:

This study is conducted in a simple form, without any cleanup or flanking investigation of available information around the event date.

Step 1: Definition of the event => Authorization date of *bigtechs'* bank licences.

Step 2: Definition of the sample and sources of information => 7 Bigtechs + 2 EU_19 G-SIB *Universal Banks* based on Refinitiv data.

Step 3: Definition of the event window: ±7 days around the event date (to include market movements due to insiders or late movers).

Step 4: Graphical representation for each examination object, by combining the share prices, the respective index, and the rating.

The tables on the two following pages represent the (*bigtech* specific) key technical data of the investigation.

Table 46: *Bigtech* data part I.

Metacode	Country	Bigtech name	Business model	IPO-Date	ISIN	Beta aof	RIC	Market	Index	EEA Bank license	Financial Statement	CCY	Market capitalization aof 30/04/2020	Price-to-book ratio
GAFA	USA Mountanview, California	**Alphabet A (ex Google)**	Search advertising	19.08.2004	US02079K3059	1,048	GOOGL.O	NASDAQ Global Selected Market	NASDAQ Composite S&P500	✓	US-GAAP	USD	922.222.958.394	4,5080
		Alphabet C (ex Google)			US02079K1079		GOOG.O	NASDAQ Global Selected Market	NASDAQ Composite S&P500					
GAFA	USA Seattle, Washington	**Amazon**	Goods retailer	01.05.1997	US0231351067	1,346	AMZN.O	NASDAQ Globat Selected Market	NASDAQ Composite S&P500	✓	US-GAAP	USD	1.140.221.960.193	18,3700
GAFA	USA Menlo Park, California	**Facebook Inc.**	Advertising from social media	18.05.2012	US30303M1027	1,16	FB.O	The NASDAQ Stock Market LLC	S&P 500	✓	US-GAAP	USD	576.288.124.491	0,8700
GAFA	USA Cupertino, California	**Apple**	Electronic hardware	12.12.1980	US0378331005	1,167	AAPL.O	The NASDAQ Stock Market LLC	NASDAQ Composite S&P500	✓	US-GAAP	USD	1.252.926.218.450	14,3580
BAT	China Peking	**Baidu**	Search advertising	05.08.2005	US0567521085	1,421	BIDU.O	NASDAQ	NASDAQ Composite		US-GAAP	USD	34.906.467.910	1,5100
BAT	China Hangzhou Cayman Islands	**Alibaba**	Buyer/Seller matching fees	01.04.2007 NYSE 19.09.2014	US01609W1027	1,594	BABA.K	NYSE	HANG SENG COMPOSITE INDEX NYSE TMT		US-GAAP	USD	521.735.975.458	4,9000
BAT	China Shenzhen	**Tencent**	Gaming	16.06.2004	KYG875721634	1,185	0700.HK	SEHK (Stock Exchange of HongKong)	HANG SENG INDEX		IFRS	RMB	514.022.568.967	8,4100

Source: Own elaboration based on Refinitiv data aof 3rd May 2020.

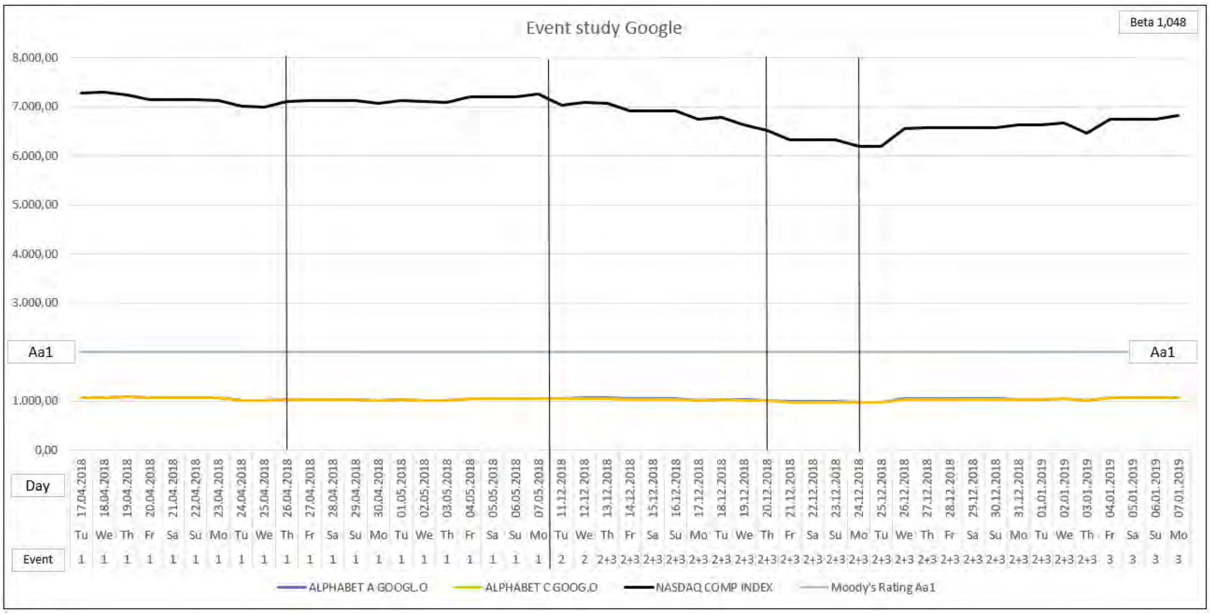
Table 47: *Bigtech* data part II.

Metacode	Country	GDP 2019 HQ Country	Bigtech name	EBITDA aof 31/12/2019	FCF aof 31/12/2019	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	ROE aof 31/12/2019	ROA aof 31/12/2019
GAFA	USA Mountanview, California	21.439.450.000.000	**Alphabet A (ex Google)** **Alphabet C (ex Google)**	47.579.000.000	22.446.000.000	Google 99,59%	Other Bets 0,41%	n/a	n/a	n/a	n/a	18,12%	13,50%
GAFA	USA Seattle, Washington		**Amazon**	30.256.000.000	21.653.000.000	Amazon Web Services 12,5%	Online Stores 51,5%	Physical Stores 6%	Subscription Services 6%	Third Party Seller Services 19%	Other 5%	18,58%	5,35%
GAFA	USA Menlo Park, California		**Facebook Inc.**	34.549.000.000	21.212.000.000	Single segmented reporting structure.						19,96%	14,47%
GAFA	USA Cupertino, California		**Apple**	77.305.000.000	58.896.000.000	Americas 45%	Europe 23%	Greater China 17%	Japan 8%	Rest of Asia Pacific 7%	n/a	62,09%	17,28%
BAT	China Peking	14.140.160.000.000	**Baidu**	25.468.000.000	9.377.000.000	BAIDU Core 74%	Inter-Segment (1%)	iQiyi 27%	n/a	n/a	n/a	1,21%	-0,76%
BAT	China Hangzhou Cayman Islands		**Alibaba**	150.309.000.000	115.493.000.000	Core Commerce 86%	Cloud Computing 6%	Digital Media and Entertainment 6%	Innovation Initiatives and Others 2%	n/a	n/a	28,19%	15,36%
BAT	China Shenzhen		**Tencent**	140.269.000.000	91.602.000.000	Online Advertising 18%	Others 2%	Value added services 53%	Fintech and Business Services 27%	n/a	n/a	24,68%	11,43%

Source: Own elaboration based on Refinitiv data aof 3rd May 2020.

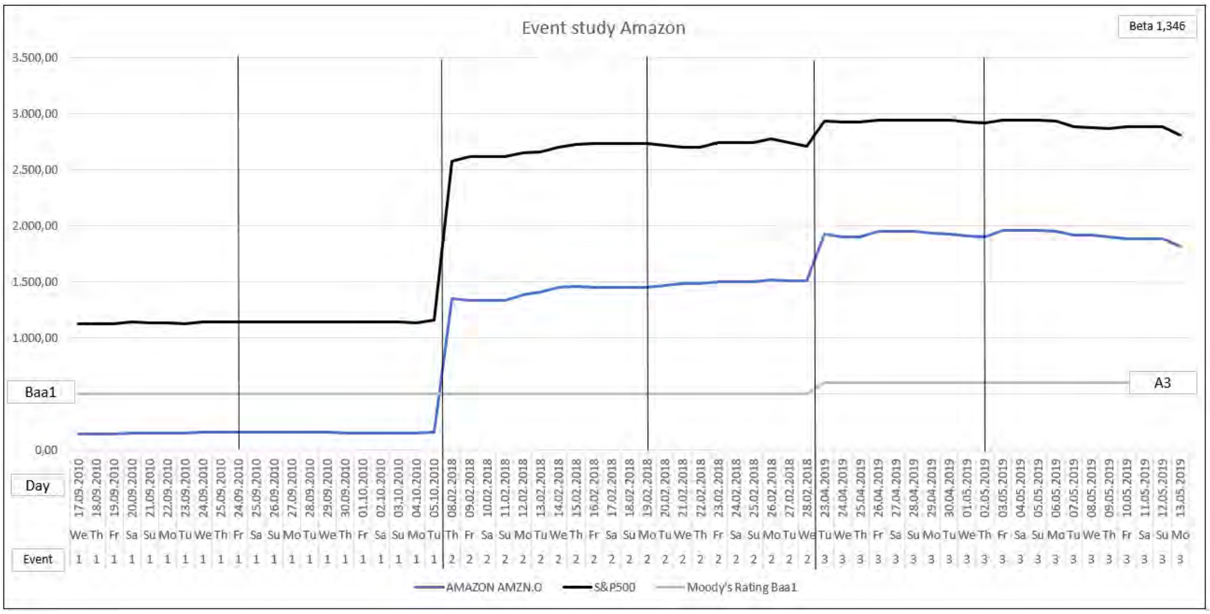
Event studies of bigtechs as potential disruptors.

Graph 1: Event study Alphabet A & Alphabet C.



Source: Own elaboration based on Refinitiv data.

Graph 2: Event study Amazon.

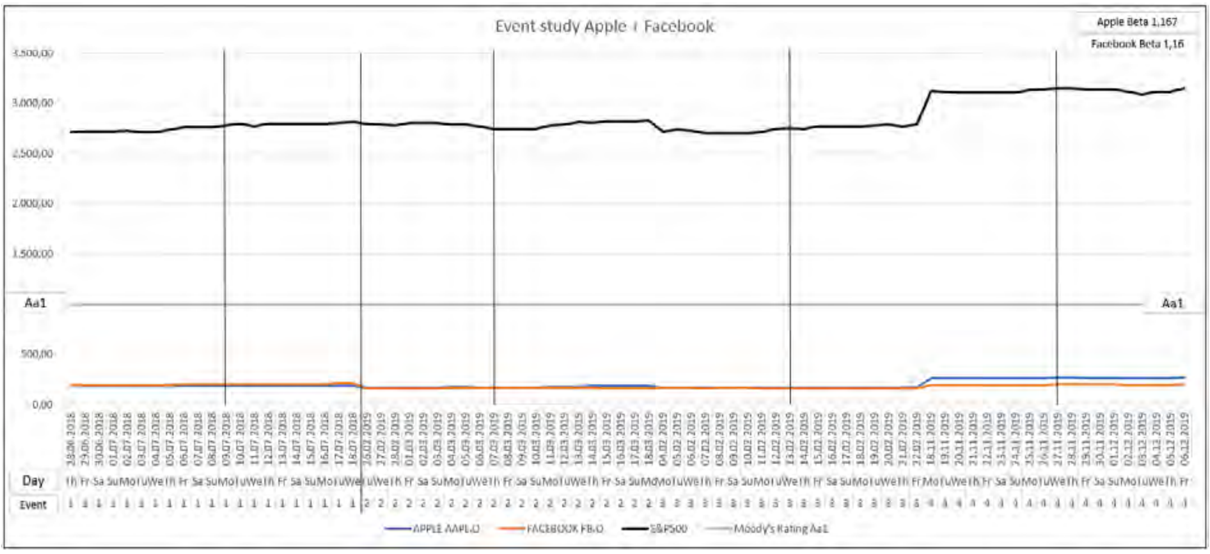


Source: Own elaboration based on Refinitiv data.

The respective company-specific cut-off dates for the examined events can be seen in Table 37. All graphs contain the time in days on the abscissa (±7 days around the event) as well as the number of the events (footer of the graph). They contain three pieces of information on the ordinate: 1. Market price (blue, orange) 2. Rating (grey) 3. Listed index (black).

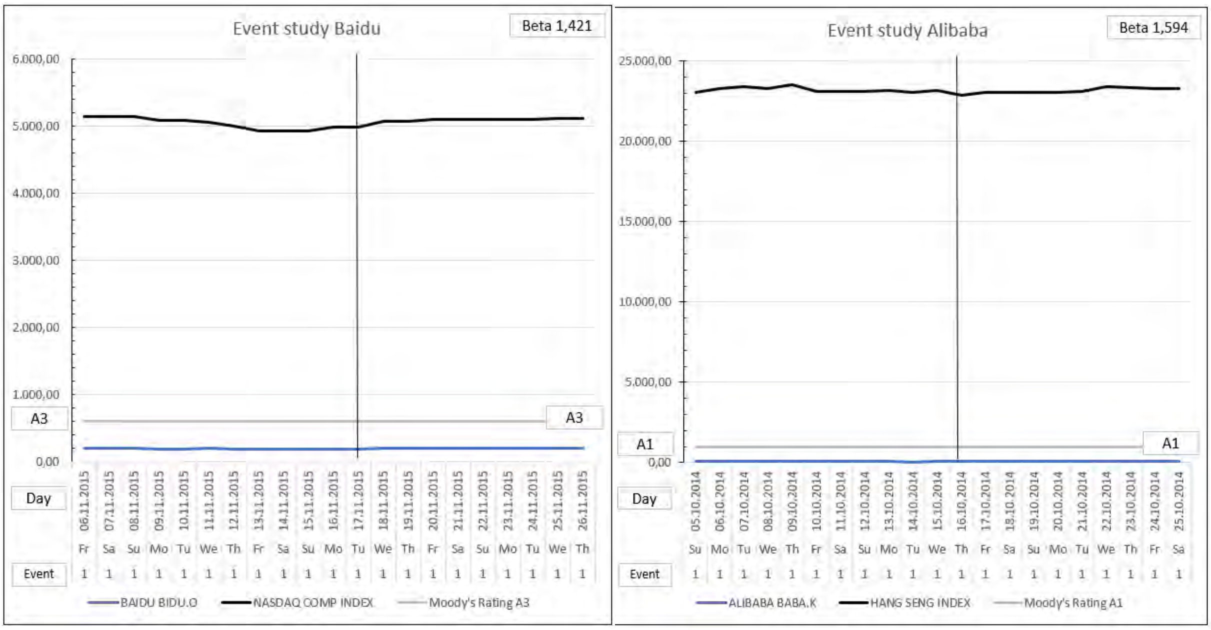
Therefore, the ordinate comprises three scales: 1. € for market prices (blue, orange) 2. rating scale according to Moody's long-term credit rating table (grey) 3. Index-point (black).

Graph 3: Event studies Apple & Facebook.



Source: Own elaboration based on Refinitiv data.

Graph 4: Event studies Baidu and Alibaba.

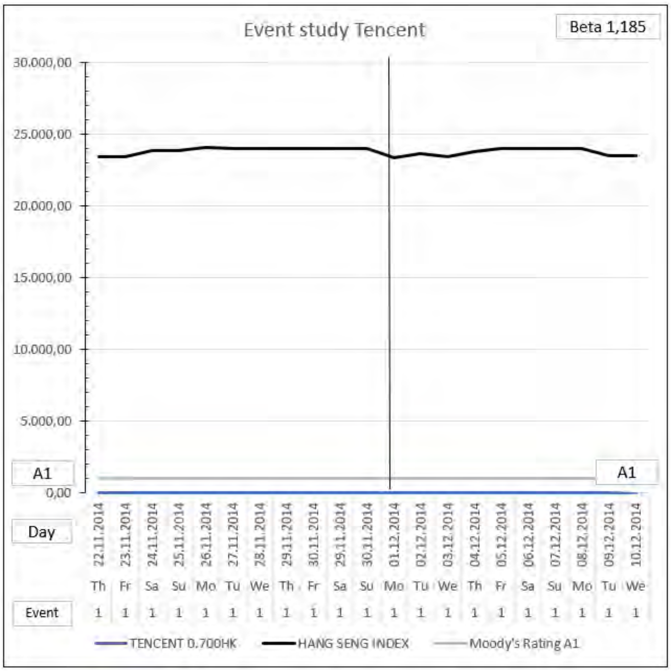


Source: Own elaboration based on Refinitiv data.

Anglo-Saxons tend to have multiple licenses in Europe from different NCAs. Chinese *bigtechs*, on the other hand, have an extensive license from the national banking regulator. Therefore, several event points were examined in the former, and only one in the latter.

Contrary to the original design of the study, the beta factor only plays a subordinate role. The current 5-month beta factor, determined over a period of 5 years, is given informatively in the graphics on the top right. They indicate a moderate volatility of all analysed stocks (Cremers et al., 2000).

Graph 5: Event study Tencent.

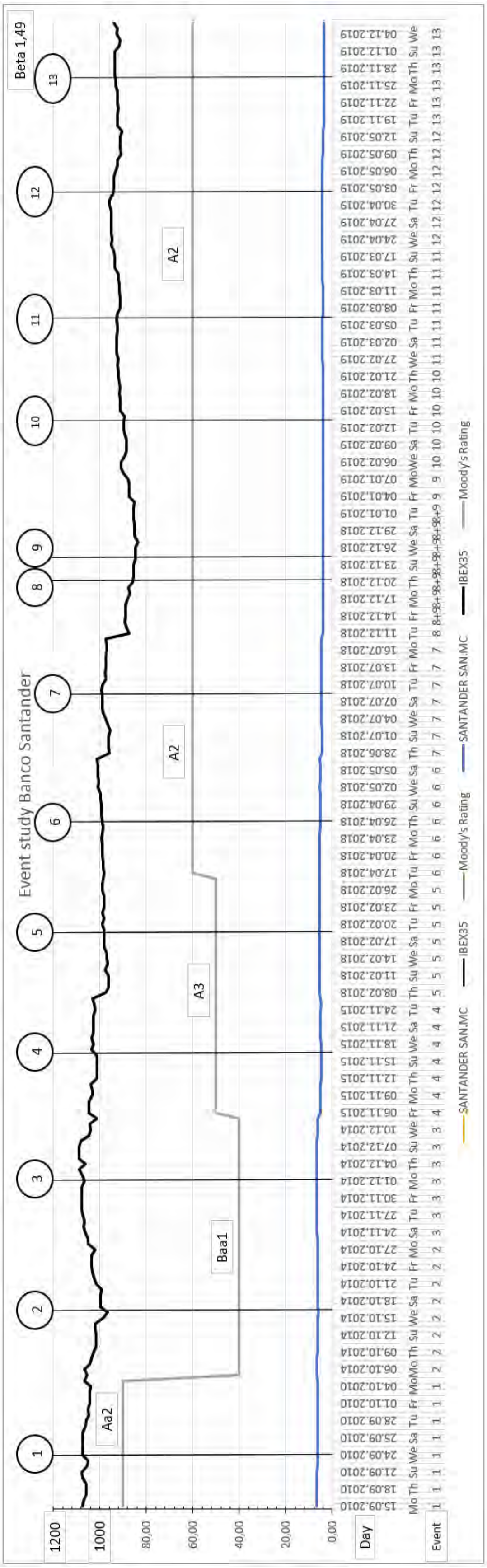


Source: Own elaboration based on Refinitiv data.

Event study of an EU_19 G-SIB as reference for potential defenders.

The following graphic shows Banco Santander contrastive to the already examined *bigtechs.* This is intended to increase the robustness of insights towards *bigtechs'* market behaviour. Banco Santander as G-SIB was selected on behalf of the other credit institutions.However, the share (blue line) shows neither anticipatory nor reactive sensitivity at the time of price-relevant events (presented in chronological order along the x axis, marked by the numbers 1.-13.). There is no further investigation of any overlapping price-relevant events. The movements of the IBEX35 (black line) show that additional information was priced in at that time. The market efficiency of the IBEX35 is assumed in this quick acid test. Studies show that the market efficiency hypothesis of the IBEX35 is at least not refutable (Dias et al., 2002). The beta factor of the share increases slightly over the course of the observation period. In 2016 it was 1.26, in 2020 it was 1.49 (finanzasmania, 2016). This shows that the share is quite sensitive compared to the other participants in the IBEX35. However, this did not come into effect at the time of price-relevant events. The presentation of the long-term credit rating (grey line) serves as a further contrast to support the insight gained. So far, only refinancing via equity has been considered. The refinancing via debt capital also shows no abnormalities around the price-relevant events. It can be assumed that the rating for short-term funding via the money market also shows no abnormalities regarding the issuance of the banking licenses to the *bigtechs*.

Graph 6: Contrastive event study Banco Santander.



Source: Own elaboration based on Refinitiv data.

Meaning of this subchapter to the overall hypotheses.

The litmus test, shown by upper graphs (Graph 1 - Graph 6), demonstrates that the granting of banking licenses (assumed to be price-relevant events) have no impact on the stock exchange prices, either from the perspective of potential attackers (*bigtechs*) or from the perspective of the defender (Banco Santander representative). The consistently positive price-to-book ratio of the *bigtechs* (cf. Table 46 - Table 47 on pp.206) proves that the stock market is currently convinced of the *business models* of the *bigtechs*.

However, the core business of these companies does not relate to the provision of banking services, as with incumbent banks. The analysis gives the impression that banking services are offered by *bigtechs* to support their actual core business.

A positive side effect is the realization that *bigtechs* tend to be willing to offer financial services in markets avoided by traditional international banks. However, this is only complementary to the incumbent banks as providers of banking services on the international financial market. This should rather be understood as an additional contribution to the liberalization of the international financial markets (Sahay et al., 2020; Vives, 2020a).

From the point of view of changes in the *business model* of traditional banks, this should not be understood as a confirmation of H3 (disruption) or of H5 (revolution).

Table 48: Chap 5.6 link to overarching hypothesis.

Chapter	Keyword	Insight	Enforced hypothesis	Comment
5.6	*bigtech* litmus test	No enforcement of H5 (Revolution).	H5 🡣	Rather a coexistence than a competition of *bigtechs* and the financial *ecosystem*
5.6	*bigtech* litmus test	Enforcement of H1 (Evolution) observable (e.g. cooperation in payment systems).	H1 🡡	Western *bigtechs* tend to cooperate with the classic financial *ecosystem*. Eastern *bigtechs* tend to form own digital banks to fill the existing regional service gap.
5.6	*bigtech* litmus test	Slight enforcement of H3 (Disruption) observable due to the necessity to adapt new ways of distribution (reduction of brick-and-mortar banks).	H3 ➔	The constraint to offer customers services in new digital ways (muti-channel vs. omni-channel) and to compensate *bigtechs'* knowledge advantage over their customers through big data is observable.

Source: Own elaboration.

H5 cannot be supported by the insights of this chapter. The assumption is confirmed that the decision of an NCA (National Competent Authority) to approve a banking license to a *bigtech* as parent entity or one of its subsidiaries has no externally measurable influence on the *business models* of the analysed incumbent *universal banks*.

5.7 A qualitative approach by questionnaire.

This subchapter is dedicated to the questionnaire which was created to qualitatively validate the knowledge gained through the quantitative approach (cf. Annex VIII. on pages liii). The questionnaire created and addressed to the incumbent *universal banks* during the research semester (winter semester 2018) is intended to complement the robustness of quantitative results.

Robustness in the biological sense (Kitano, 2004) as well as in the sense of information technology (Wieland et al., 2012) means the property of the system of the research results to have an adequate fault tolerance. This ensures the continued existence of the system.

Central focus of the questionnaire.

The focus of the questionnaire is to put light on the degree of digitalization on the *business models* of incumbent banks. The need for this qualitative analysis is based on the result of the previous quantitative analysis.

This did not provide the expected insight that there had already been major changes in the sense of economic improvements to the *business models*. The quantitative empirical analysis (cf. Chapter 5 on pp.185) shows an indifferent average change in *business models* (cf. Table 44 on page 202).

The analysis is based on sources of external reporting and externally accessible key figures only providing a retrospective view. Changes in the *business models* are recognizable, but in which field of action or segment specifically? The questionnaire ties in at precisely this point and aims to generate an answer by asking the actors (incumbent banks).

Experts operating only in a bank's strategic environment (group strategy department) can answer such questions with a view to the future. The challenge of a questionnaire is to reach these experts. Furthermore, to get them to answer company specific sensitive questions.

For this reason, the questionnaire is anonymized and designed with neutral questions that allow different perspectives.

Assumption to be investigated:

About the overarching hypotheses, it should be ascertained where the surveyed *universal banks* could be allocated, according to their own point of view, on the diagonal spanned from hypothesis H1 via hypothesis H3 to hypothesis H5 (cf. Figure 4 on page 21).

Design of the questionnaire:

For this, the questionnaire comprises 14 questions shown by the following table.

Table 49: Overview of the questionnaire's content.

No	Ref	Style	Content	Objective
1		L	Agreement to “Bermuda Triangle” situation.	Raise interest and awareness.
2		L	Intensity of each corner of the triangle.	Awareness of the current exogenous situation.
3		L	Focus on the *business model* of incumbents.	Awareness of the optimization potential.
4	2	L	*Fintechs* and challenges.	Awareness of *fintechs*.
5	3	W	Additive opinion to the questionnaire’s content.	Opinion in case of negation.
6	3	L	EBA cluster.	Awareness of which cluster in particular.
7	6	L	BCT cluster.	Awareness of BCT cluster in particular.
8		L+W	Supposed (+) investment	Decision, in which cluster the investment should be allocated to improve the *business model* plus the possibility to offer a further opinion beyond the provided content.
9		L+W	Supposed (-) investment	Decision, in which cluster the investment should be allocated to maintain the *business model* plus the possibility to offer a further opinion beyond the provided content.
10		L	BCT (Block chain technology)	Bank segment with the supposed highest profit of the new BCT in terms of CIR🡻.
11	6	W	BCT	Opinion if BCT is not interesting.
12		L	*bigtechs*	Contrastive: Are *bigtechs* more disruptive than *fintechs*?
13		W	*bigtechs*	Greatest disruptive potential in which field of activity?
14		L	Machine or humans	Contrastive: Preference.

Source: Own elaboration (L: Likert scale; W: written).

According to the knowledge of modern scientific theory (Popper, 1934), the questions are arranged for avoiding an induction error and measurement errors (e.g. bias, random errors and correlated errors) (Smith, 2020). A deductive acquisition of scientific knowledge should be made possible by presenting perspectives other than those apparently given by the questionnaire.

11 of the 14 questions (marked with L) enable a fast answer[42] on a Likert (Likert, 1932) scale with 11 values. The scale covers 10 attitude areas whereby 1 equals disapproval and 10 full approval. The even number of ten is provided to avoid a tie.

At least the central areas 5 and 6 should reflect at minimum tendencies of opinion even in the event of a tie situation. Indifference can be expressed through area 11 ("don't know").

[42] Pilot testing: An expert test candidate needed 20 mins to answer the questions.

5 of the 14 questions (marked with W) enable open answers, whereby the proband can bring in his possibly differing views on the questions. Good, unknown, and new ideas should also be expressible in this way by the market actors and not redeemed from the very beginning.

In the structure of the questionnaire (Brace, 2018), Popper's statement is followed that only refutable assumptions add scientific value. However, assumptions that cannot be refuted, that is, can easily be confirmed, offer less opportunities to open new perspectives. The aim was to circumvent the apparent inability to collect data via questionnaires to recognize rival hypotheses (Lebedev, 2015).

For this purpose, several contrasting questions have moved in, which on the one hand reflect the willingness of the probands to provide answers to the topic, and on the other hand confront them with completely new perspectives.

This includes, for example, the future-oriented question no 14. The idea is being questioned that one day the consumers of banking services will no longer be satisfied with an exclusively digital range of banking services. If a human service is offered, there may be a greater willingness to pay fees (wealth management).

Implementation of the survey:

The investor relations (IR) departments of the 31 banks analysed were surveyed by email (Smith, 2020).

The choice of the first contact was based on the following assumption. The task of the IR department is to counteract information asymmetries between principal and agent through transparency (Chahine et al., 2019). Such inquiries are usually forwarded to the responsible internal specialist departments if there is a legitimate interest.

The questionnaire was sent deliberately by the Microsoft account of the CEU San Pablo to avoid possible irritation due to an unknown, private email account (spam).

Furthermore, absolute anonymization of the results was pointed out. First, the two Austrian banks examined were addressed. Subsequently, the other banks, by country, were headed with a processing deadline. After the deadline was exceeded, all banks were contacted once again.

Results of the survey:

The response rate is sobering at 6.4%. Completed questionnaires were not received electronically. Two questionnaires were filled out in a personal conversation. The handwritten answers are transferred as red or blue crosses in the template of the questionnaire (cf. Annex

VIII. on pages liii). The only two negative responses received electronically can be seen in Annex IX (on page lxiii).

Analyse of the answers towards overarching hypotheses.

If the answers of the two probands recorded by personal contact are taken as a substitute for the missing others. The following picture emerges about the overarching hypothesis:

Table 50: Chap 5.7 link to overarching hypothesis.

Chapter	Keyword	Knowledge	Enforced hypothesis	Comment
5.7	Questionnaire	Low enforcement of H5 (Revolution).	H5 ↓	Rather a coexistence than a competition of *bigtechs* and the financial *ecosystem*. They are supposed to contain threat potential.
5.7	Questionnaire	Enforcement of H1 (Evolution) observable (e.g. cooperation in payment systems).	H1 ↑	Western *bigtechs* tend to cooperate with the classic financial *ecosystem*. Eastern *bigtechs* tend to form own digital banks to fill the existing regional service gap.
5.7	Questionnaire	Slight enforcement of H3 (Disruption) observable due to the necessity to adapt new ways of distribution (reduction of brick-and-mortar banks).	H3 →	The constraint to offer customers services in new digital ways (multi-channel vs. omni-channel) and to compensate *bigtechs'* knowledge advantage over their customers through big data is observable.

Source: Own elaboration.

Questions 1-3:

The level of agreement with the answers to questions 1 - 3 is largely identical (L 8-9). As a result, banks are in upheaval.

Question 4-5:

There is disagreement in question 4 regarding the determination of the impact on the *business model*. One answer supports H5 (revolutionary) and one H3 (disruptive).

Questions 6-11:

Questions 6-10 should identify the focus of the impact in the *business model* of incumbent banks. There is broad agreement on the technology to be used (BCT: Block Chain Technology) and the special areas of application.

(Question 8) There is no agreement on the focussed fields of activity of future investments. Analogous to the controversial answer regarding the effects on the *business model* in questions 4-5, the test subjects would either invest in old business fields (H1 or H3) or in completely new ones (H5).

Questions 12-13:

Bigtechs are brought up as a controversial threat. At least the potential for threats is attributed to them, based on classic banking services.

Question 14:

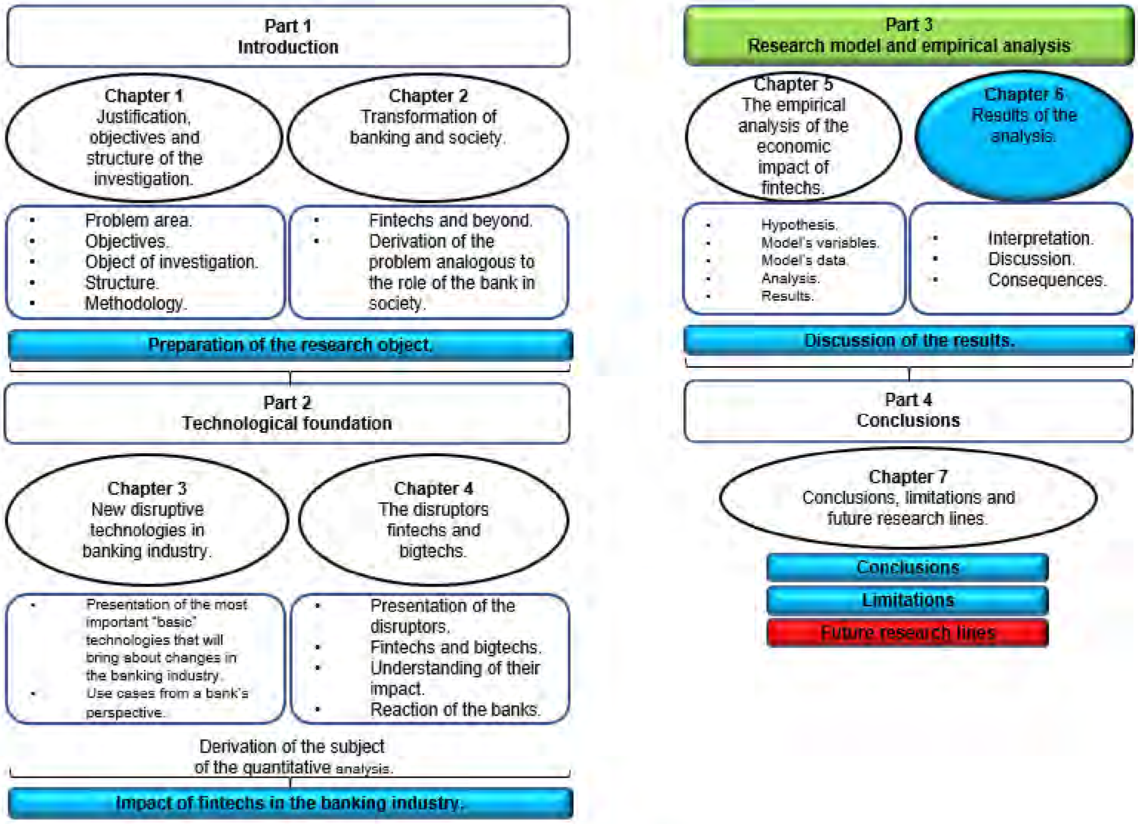
An indifferent answer is given here, with a tendency to little approval. Surprisingly, an apparently mechanical reaction based on algorithms is at least almost equated to a human representation of banking services.

Chapter 6. Results of the analysis.

6.1 Interpretation of the results.

6.2 Discussion of the analysis.

6.3 Consequences of the analysis.



The focus of this main chapter is on the interpretation of the quantitative and qualitative empirical analyses of the preceding fifth main chapter.

The interpretation of the statistical relationships takes place in subchapter 6.1.

First, the general quality of the model is outlined with the help of the Anova F-criterion.

Then, in contrast, a positively analysed bank (F-criterion <0.05%) and a so-called outlier are discussed in detail.

In support of this knowledge, sub-chapter 6.2 discusses the approach, both the quantitative approach and the qualitative approach, in the form of the questionnaire.

In subsection 6.3 the tentative attempt to draw economic conclusions from the statistically obtained knowledge takes place.

This, however, while avoiding the mistake of trying to derive economic causalities directly from statistical relationships (attention: induction errors).

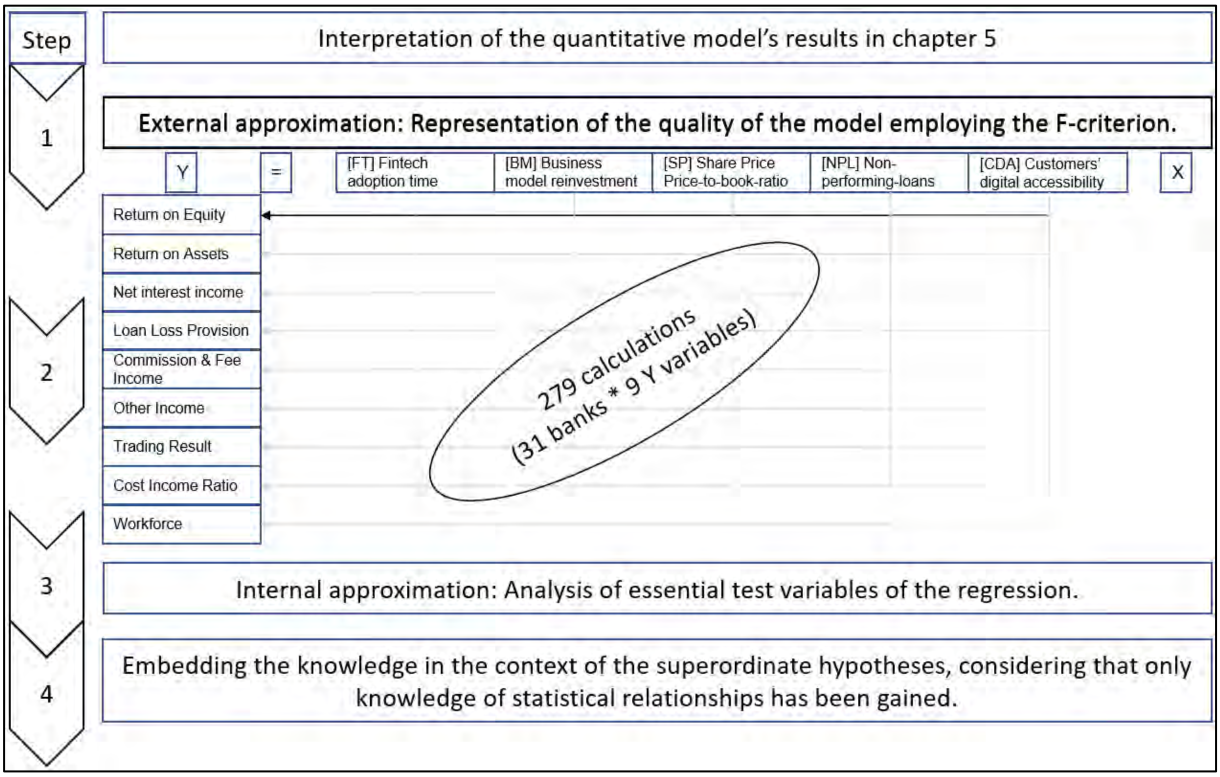
Therefore, an attempt is made to contribute to prevention. For this purpose, weak signals are discussed according to Igor Ansoff (Ansoff, 1957) with reference to the current environmental situation (heat map cf. Figure 13 on page 55) of the banks.

6.1 Interpretation of the results.

The task of this subchapter is the statistical interpretation of the knowledge of the quantitative model, calculated in the fifth chapter. This subsection does not attempt to derive economic relationships, except for carefully embedding the findings in the context of the overarching hypotheses.

The following figure shows the way of interpretation. First, the key data of the quantitative model are listed in tabular form. Then (step 1) the overall quality of the model is graphically represented by the condensed F-criteria of the Excel Anova calculations of the individual banks (cf. Figure 41 on page 224). Following this (step 2 and step 3), a hit (Erste Group Bank) and an outlier (Alpha Bank) are shown as examples. Finally (step 4), the findings are transferred to the overarching concept of hypotheses (see Figure 4 on p.21).

Figure 40: Structure of the interpretation of the results.



Source: Own elaboration.

The results of the quantitative analysis of the degree of disruption between *fintechs* and the *business models* of incumbent banks are interpreted from the outside in. First, the following table summarizes the main features of the multivariate regression model.

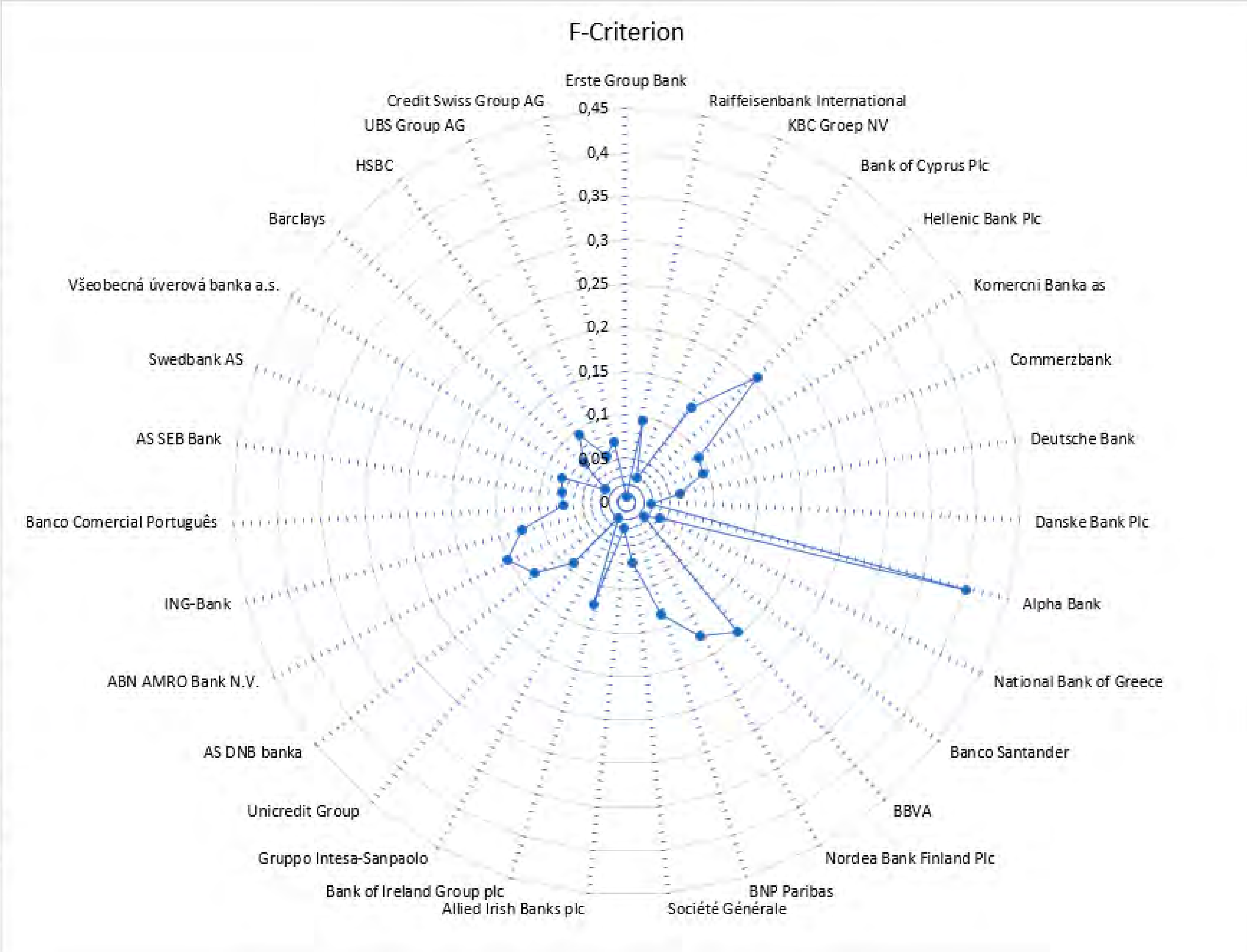
Table 51: Key data of the quantitative model.

Topic	**Comment**
Purpose of analysis	Attempt to determine the measurability of the degree of disruption of classic *universal banks business models* by *fintechs*.
Limitations	• *Universal banks* headquartered in EU or EEA • Concentration on G-SIBs and D-SIBs • Main data source public financial statements (strong retrospective character) • Assumed linear relationships of regressors and regressands • Only one model is employed not any additional contrastive model • No information about the effects of regulation, changed customer behaviour and digitization on the *business model* of incumbent banks • Use of Microsoft Excel Anova
Data-sources	• Refinitiv (former Thompson Reuters Eikon) • Bloomberg • IFRS group financial statements (a total of 248) • DESI (EU Commission) • ECB FX-rates
Targeted statistical explanation	The aim is to try to measure the degree of disruption of incumbent banks' *business models* by *fintechs*. At least the three stages of development, low, medium, and high, should be made statistically observable.
Type of model	Multivariate linear panel regression model
Statistical instrument	Microsoft Excel Anova

Source: Own elaboration.

The following graphic shows the results of the summarized F-criteria of the analyzed 31 banks. The compression was carried out by means of a simple averaging of the F-criteria of the individual 9 regressants (Y variables) (cf. Annex XVI. on page lxxiv).

Figure 41: F-Criterion of the model.



Financial institution	F-Criterion
Erste Group Bank	0,005808934
Raiffeisenbank International	0,09486432
KBC Groep NV	0,030396385
Bank of Cyprus Plc	0,131424631
Hellenic Bank Plc	0,208008654
Komercni Banka as	0,097049664
Commerzbank	0,093383883
Deutsche Bank	0,061591877
Danske Bank Plc	0,028362401
Alpha Bank	0,402154154
National Bank of Greece	0,042596775
Banco Santander	0,025980666
BBVA	0,195385751
Nordea Bank Finland Plc	0,175186915
BNP Paribas	0,134887189
Société Générale	0,069007442
Allied Irish Banks plc	0,030493238
Bank of Ireland Group plc	0,122627523
Gruppo Intesa-Sanpaolo	0,020114822
Unicredit Group	0,091811166
AS DNB banka	0,132063829
ABN AMRO Bank N.V.	0,150857011
ING-Bank	0,123929918
Banco Comercial Português	0,071991065
AS SEB Bank	0,07441863
Swedbank AS	0,078899567
Všeobecná úverová banka a.s.	0,027956296
Barclays	0,066427849
HSBC	0,094330063
UBS Group AG	0,05661183
Credit Swiss Group AG	0,069699749

Source: Own elaboration.

Results of the condensed F-test.

The test is used to examine whether the selected model or models fit the data to be analysed, using the least squares. The F distribution, also Fisher-Snedecor distribution (Salkind, 2010), is a continuous probability distribution. An F-distributed random variable results as the quotient of two chi-square-distributed random variables, each divided by the associated number of degrees of freedom. The F-distribution has two independent degrees of freedom as parameters and thus forms a two-parameter distribution family (Wooldridge, 2018).

The result of the compressed F-test shows that 10 banks are within the 5% significance level. In the further course, a bank (EBS Erste Bank Group (AT)) is analysed in more detail, with a significance level of 0,5% and a bank (AB Alpha Bank (EL)), with a significance level of 40% (outlier).

The detailed discussion of the extremes ((EBS (AT) and AB (EL)) shown above in the context of the ANOVA F-Criterion representation takes place in two stages. A further in-depth test of the application requirements of the linear regression is carried out on stage 1. The normal distribution is checked (BLUE[43] criteria) of the regressors using the Shapiro Wilk test. At level 2, the regression diagnosis of the two extremes by Excel ANOVA itself is presented.

Stage 1: Comparative Shapiro Wilk test to analyse the regressors' normal distribution.

The Shapiro Wilk Test (SHAPIRO et al., 1965) was chosen as a simple procedure to quickly deal with 33 observations of the individual regressors (5) based on Excel. In its unexpanded original version, this test procedure is certified to be limited to 3 to 50 values. In the specific case, there is an odd number of observations (n 33). Therefore, their median was not used for the calculation. The test takes place in 4 steps:

1. sorting of the regressors in sequential order ($x_1 \leq .... \leq x_n$).

2. enter the previously determined weights a1 - a33 of the sample size n 33.

3. Execution of the calculation of the W test and determination of the appropriate p-value

(if necessary, by linear interpolation).

4. Interpretation of the results (depending on the sample size):

If W> critical value of p = 0.05 the null hypothesis is not rejected (regressors are normally distributed).

[43] BLUE: best linear unbiased estimator.

If W <critical value of p = 0.05, reject the null hypothesis (regressors are not normally distributed).

The test gives the following result regarding the normal distribution of the 5 regressors:

Table 52: Shapiro Wilk test of the regressands' normal distribution.

Component	FT	BM	SP	NPL	CDA
EBS (AT)	reject	reject	not reject	reject	not reject
AB (EL)	reject	reject	reject	reject	reject

Source: Own elaboration (cf. Annex XIX on page lxxiii).

This result could indicate that, therefore, a regression line or regression hyperplane no longer represents the best estimate. Further measures (e.g. transformation of the variables) were refrained from against the background of the application of the central limit value theorem (Gehrke, 2019). The time-specific dummy variable FT was not checked, as this cannot be normally distributed per se.

Stage 2: Presentation of Excel ANOVA's own regression diagnostic indications.

First, the components of Excel ANOVA (ANalysis of VAriance) regression diagnostics are explained. Then the two *universal banks* with clearly positive and negative F-criteria are shown in two subsequent tables. The intention is to support the statistical interpretation of the results.

What is striking about the comparative investigation of the regression diagnostics of both banks is that the model quality (F-criterion) of the EBS (AT) is consistently remarkably high. The model quality of the Alpha Bank (EL), however, is only satisfactory for the dependent variables ROA (OUT PT ROA) and ROE (OUT PT ROE). The model should tend to be rejected regarding the remaining 7 dependent variables.

Only in the first model (EBS (AT)) R^2 indicates a strong explanatory character of the independent variables. With the Alpha Bank (EL), the relationships between x- and y-variables are only shown much weaker.

At the time the data was collected, Alpha Bank (EL) did not yet have a statement about the cooperation with a fintech in the annual financial statements. For this reason, the Fintech Adoption Time is zero. Furthermore, not all data on all independent variables were fully available (FT and BM).

Table 53: Explanation of Excel ANOVA regression diagnostic.

Components	Explanation	Indication
	Model summary: Regression-Statistics	
Multiple correlation coefficient	Correlation between the dependent and the independent variables. A value between -1 and 1 can be assumed. -1 means absolute negative correlation, 0 indifference and +1 absolute positive correlation. It is a measure for the strenght, direction and linear dependency between de	Relationship between regressors and regressands: - Values towards +1 strong linearity - Value of 0 no correlation - Value against -1 no linear relationship
Coefficient of determination	It is the correlation to the second power. Answers the question: How many x-values fall on the regression line in order to explain the corresponding y-value? A value between 0 and 1 can be assumed.	The higher the value, the more positive the statement (ideally +1).
Adjusted coefficient of determination	It is a corrected R-squared. Calculated because the more independent variables are used, the better the dependent variable are explainable with the model. This version of R^2 is considering this fact.	Must be high just like the unadjusted R^2. Will always be a little below, because of the consideration of all regressors.
Standard error	Standard deviation of the observations from the prognosis values. It is the average deviation of the observed values to the values determined by the regression line. Square root of the residue's mean square sum. It is a measure for the fit of the regressions line.	The smaller the better.
Observations	Number of observations.	The greater the number of observations, the more meaningful. n = 30 observations as a minimum are accepted as a rule of thumb in the literature (Mossig 2012).
	Significance of the regression model	
ANOVA F-criterion	The F-criterion is used to check the overall significance of the model. It answers the question whether the model has significant explanatory power.	Must be lower than the choosen significance level (e.g. < 5%).
	Coefficients	
Point of interception	Intersection with the y-axis: Starting point of the regression analysis (constant).	
Regressors	Returns the least squares estimate. The regression coefficient is the mean increase in the dependent variable while the other explanatory variables remain the same.	
	P-value	
Point of interception	Intersection with the y-axis: Starting point of the regression analysis (constant).	
Regressors	Returns the probability for the hypothesis test. Significance of the effect of the explanatory variable on the dependent variable.	If value < 0,05 reject H_0 (). If value > 0,05 not reject H_0 ().
H_0	The null hypothesis of the test states that the independent variable has a large part to explain the dependent variable.	
H_A	The alternative is that at least the independent variable has no explanative part in the dependent variable.	
Confidence intervals are generally a way to verify the accuracy of the estimate. A 95% confidence interval is the range that includes the actual value of the parameter on average in 95 out of 100 cases.		

Source: Own elaboration based on (Mossig, 2012; Gehrke, 2019).

The overview above explains the following tables' content.

Table 54: Erste Bank Group's (AT) ANOVA regression statistics.

EBS AV									
Dependend variables	OUT PT ROE	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				Regression-Statistcs					
Multiple correlation coefficient	0,981968921	0,9830471	0,925049591	0,936042574	0,620215988	0,602737586	0,64091994	0,950965774	0,961435037
Coefficient of determination	0,964262962	0,966381601	0,855716745	0,8761757	0,384667871	0,363292598	0,41077837	0,904335904	0,92435733
Adjusted coefficient of determination	0,957644992	0,960155971	0,828997624	0,853245274	0,270717477	0,245383819	0,301663253	0,886620331	0,910349428
Standard error	0,000433532	0,007410636	0,000245152	0,000456831	0,000246455	0,000342605	0,00134726	0,056942157	2,44379E-07
Observations	33	33	33	33	33	33	33	33	33
ANOVA F-criterion	1,18701E-18	5,2176E-19	1,53058E-10	2,00675E-11	0,01696461	0,025055837	0,010259963	6,4379E-13	2,78727E-14
Dependend variables	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				Coefficients					
Point of interception	0,039432556	0,001630445	0,011072843	0,004989301	0,00503508	0,001249245	-0,009904654	0,491069895	2,33436E-05
FT (Fintech adoption time)	-0,02660426	0,001668244	-0,00011918	-0,00123533	0,000516815	0,000450662	-0,008072044	0,131960926	1,17542E-06
BM (Business model)	1,034668446	0,0023817	-0,00062169	-0,01521633	-0,000308415	0,00613177	0,021052294	-4,71039627	-8,83536E-07
SP (Share price)	0,007365814	0,000504516	-0,00050932	-0,00047239	0,000207777	9,06271E-05	-0,001448892	-0,08417236	-1,06389E-07
NPL (Non performing loans)	-0,11460013	0,00675991	-0,00307913	0,00723545	-0,003585239	0,001363431	-0,007704957	-0,72296374	1,38865E-05
CDA (Customers' digital accessibility)	-0,00036826	2,23339E-05	-9,3684E-05	-7,2288E-05	-5,02559E-05	-2,86841E-05	0,000196935	0,007367528	-7,9107E-08
Dependend variables	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				P-value					
Point of interception	0,05785458	0,168538351	2,43534E-12	0,007260081	9,55498E-06	0,340876655	0,06103257	0,029855882	2,20504E-20
FT (Fintech adoption time)	0,848907082	0,359115186	0,90040143	0,48823788	0,59025933	0,735119587	0,131111393	0,552035592	0,222046006
BM (Business model)	1,26245E-19	2,17094E-20	0,64806006	1,79228E-06	0,82152669	0,003026367	0,008384628	1,17276E-14	0,516043365
SP (Share price)	0,126434716	0,400560525	0,085455589	0,382085896	0,475023919	0,821897796	0,363606228	0,214840117	0,711256171
NPL (Non performing loans)	0,203993447	0,330115953	0,427560375	0,318761054	0,359112006	0,800484666	0,716645933	0,422619673	0,001125083
CDA (Customers' digital accessibility)	0,054391775	0,343294297	5,58276E-08	0,004817269	0,000494176	0,115740192	0,008524864	0,018304816	1,00563E-06

Source: Own elaboration.

Table 55: Alphabank's (EL) ANOVA regression statistics.

ALPHA GA									
Dependend variables	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				Regression-Statistcs					
Multiple correlation coefficient	0,849721923	0,897027265	0,339195367	0,332302863	0,269942997	0,199979807	0,446440943	0,540836713	0,470924812
Coefficient of determination	0,722027346	0,804657915	0,115053497	0,110425193	0,072869222	0,039991923	0,199309516	0,29250435	0,221770179
Adjusted coefficient of determination	0,670550928	0,768483454	-0,04882549	-0,05431088	-0,098821663	-0,13778735	0,0510335	0,161486637	0,077653545
Standard error	0,008787753	0,179927446	0,00373889	0,004012799	0,000798998	0,000915588	0,00152123	3,795536664	1,26895E-05
Observations	33	33	33	33	33	33	33	33	33
ANOVA F-criterion	8,48046E-07	8,40255E-09	0,626737552	0,649324285	0,827553869	0,948496229	0,276135126	0,080014361	0,211125105
Dependend variables	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				Coefficients					
Point of interception	-0,00197845	-0,01772814	0,00966827	0,004535174	0,001995548	1,42721E-05	-0,001925537	3,528585937	0,000112764
FT (Fintech adoption time)	0	0	0	0	0	0	0	0	0
BM (Business model)	0,022293064	0,567621931	9,65947E-05	-0,00066856	0,000106681	0,000303135	0,000283013	-2,90495937	1,29018E-06
SP (Share price)	0,002444829	0,011152798	-0,00022741	-2,1898E-05	4,62202E-05	0,00015301	-0,001515598	-4,2624087	-7,34945E-06
NPL (Non performing loans)	-0,02088987	-0,48067736	-0,01206242	0,013131395	-0,001994989	-0,000640243	0,003106911	2,789155946	-3,30534E-05
CDA (Customers' digital accessibility)	0,000344265	0,008443846	0,000104991	-0,00018028	9,21862E-06	4,55571E-06	-4,88447E-05	-0,10053796	8,87819E-07
Dependend variables	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	PUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
				P-value					
Point of interception	0,651383784	0,84300454	1,56475E-05	0,029816099	2,53122E-05	0,974995119	0,016046495	0,069986944	1,37716E-16
FT (Fintech adoption time)	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!
BM (Business model)	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!	#ZAHL!
SP (Share price)	0,551212149	0,894035938	0,896010071	0,990642035	0,901069042	0,71978893	0,039712502	0,02172539	0,219743775
NPL (Non performing loans)	0,250669346	0,198146436	0,122747897	0,117711664	0,228182287	0,73252267	0,322116078	0,719504169	0,209241061
CDA (Customers' digital accessibility)	0,281020995	0,198651593	0,437266289	0,217912069	0,74844975	0,889919301	0,375234603	0,463422826	0,059827256

Source: Own elaboration.

This development of the Alphabank (EL) may be since the bank still has to cope with the consequences of the exogenous disruption of the global financial crisis (GFC) (Alpha Bank Business Review, 2018).

Meaning towards the overarching hypotheses H1 – H5.

At this point it should be explicitly highlighted that in this way only statistical relationships with their strengths and weaknesses can be identified. The mistake of deriving predictions of the economic future based on statistical backgrounds and based on historical time series must not be made!

Therefore, in Table 56 on next page, the attempt to transfer the results of the statistical sphere into the sphere of the superordinate hypotheses is only cautiously presented.

Meaning of the p-value in Table 44 on p.202.

In the sense of a correct understanding of the p-value[44] as one of the most important interpretive output values (besides the coefficients, R^2, residual diagrams) (Gehrke, 2019) of a regression model, a few explanatory words (Fisher, 1925; Cassidy et al., 2019).

In statistics, the p-value (defined as probability with values from 0 to 1) is considered an evidence measure for the credibility of a null hypothesis. It also gives observations that support the null hypothesis. In this context, the null hypothesis is assumed that there is no connection between the explanatory (X) and the variable to be explained (Y).

If the null hypothesis (no association between the (Y) and the explanatory (X) variables to be explained) is actually a condition, the p-value is the probability of obtaining the observed value of the test variable or a more extreme value. For this purpose, the calculated p-value is compared with the previously defined level of significance. The level of significance represents the risk that an existing association is inferred even though there is none.

According to the prevailing literature, a significance level of 5% has emerged (Hedderich et al., 2018). If the p-value is less than this level of significance, the null hypothesis can be rejected in favour of the alternative hypothesis. If the p-value is above the significance level, this rejection is no longer possible.

If the null hypothesis is rejected in favour of the alternative hypothesis, there is statistical significance. This means simply coincidental and is not to be equated with practical relevance or scientific significance. In other words, an economic interpretation of the results obtained in this way should only be carried out with the greatest caution and distance.

Against this backdrop, the three quantitative hypotheses H_A – H_C were assigned significance levels as an attempt to interpretively assign the p-values to the high, medium, and low levels of disruption.

[44] Sir Ronald Aylmer Fisher (* 17. February 1890 London, England; † 29. July 1962 Adelaide, Australia)

Table 56: Transfer of the quantitative analysis's insights to the overarching hypothesis.

Quantitative Hypotheses	Level of signify-cance	Level of dis-ruption	Count	Character-istic of H3	Overarching hypotheses
H_A	$p < 0.05$	high	364/1390 = 27%	H3 ↑ H5	H5
H_B	$0,05 < p < 0.2$	medium	246/1390 = 17%	H3 = H3	H3
H_C	$0.2 > p > 1$	low	780/1390 = 56%	H3 ↓ H1	H1

Source: Own elaboration.

Due to the distribution of the p-values, in total six reading points were assigned to the overarching hypothesis H1, H3 and H5. H1 received 3 points, H3 received one point and H5 two measuring points (cf. chapter 7 Table 61: Synthesis of the overarching hypotheses part I.

on page 252). This conclusion is based on the statistical insights, without accompanying microeconomic attempts at interpretation.

6.2 Discussion of the analysis.

The quantitative analysis includes the relation of *fintechs* to incumbent banks on the one hand and the relation of *bigtechs* to incumbent banks. In this subchapter, both analyses will be briefly discussed about their limits.

Then strengths and weaknesses of the questionnaire are also briefly discussed. The latter represents the qualitative approach to support the interpretation of quantitative results.

Fintech analyse's positive aspects.

A contrast is already made by extending the choice of objects to be examined by EU incumbent banks to those of the EEA.

The strength of the procedure lies in reaching an interpretable statistical result with available and accepted means. This allowed the focus to be on the acquisition of the data.

In this way, the path of quantitative empirical investigation is secured. A further step could be to carry out the examination once again with R up to a complete diagnosis of the linear panel regression (Chamberlain, 1982).

Robustness of the model.

To evaluate the normal distribution of the residuals, a Shapiro-Wilk test was carried out for the regressors of a hit (Erste Group Bank) and an outliner (Alpha Bank).

The multicollinearity of the regressors was tested to ensure the robustness of the model (cf. Annex. XVIII. on page lxxii). For this purpose, the correlation matrix of the independent variables was calculated as a first approach. However, dependencies can only be identified in pairs in this way. Values greater than 0.8 are considered critical in the literature (Dormann et al., 2013).

Against this backdrop, only the pairwise correlation of the regressors [FT] <=> [BM] with (0,1066) is to be regarded as critical.

Fintech analyse's aspects with room for improvement.

For the final assessment of the robustness of the statistical model, a complete regression discussion should ideally be established. However, the calculation of a comprehensive view is beyond the limits of Excel Anova. This would have required the use of R with the appropriate functions.

So far, the linearity of the relationships between the explanatory variables and the respective variables to be explained has been assumed.

In a more specific, further investigation, the following application requirements (AR) can be carried out to finally prove linearity of the regression analysis.

Application requirements (AR) for linear regression and robustness could be checked in advance. If the requirements listed in the table below are met properly, the least squares estimate is unbiased, best, and thus fulfils the BLUE (best linear unbiased estimator) properties.

If assumption AR6 is fulfilled, the t-tests for the regression coefficients are reliable. Regarding the AR7 assumption, which is sometimes not as strictly assessed, the central limit value theorem (Moivre-LaPlace) (Hazewinkel, 1995) set applies for larger sample sizes.

Table 57: BLUE properties of the regression analysis.

Property	Argument	Application requirements (AR) for linear regression analysis and robustness (R)	Stochastic tool
BLUE AR1	X => Y	No misspecification - linearity between dependent and independent variable is given.	Scatter plot
BLUE AR2	Residuals	The expected value of the residuals is zero.	Intercept in modelling
BLUE AR3	X and X => Y	The regressors are not endogenous. There is no correlation between the residuals and the independent variables.	RESET-Test
BLUE AR4	Residuals	Homoscedasticity is given. The variance of the residuals is constant and finite.	Testing the heteroskedasticity: Goldfeld-Quant-Test Breusch-Pagan-Test White-Test
BLUE AR5	Residuals	No correlation of the residuals with each other (autocorrelation).	Durbin-Watson-Test Breusch-Godfrey-Test
BLUE AR6	X	Multicollinearity is not recognizable or not very pronounced.	Comparison of the coefficient of determination and the p-values VIF Variance Inflation Factors
BLUE AR7	Residuals	The residuals are normally distributed.	Shapiro-Wilk-Test Jarque-Bera-Test
BLUE R1	Total equation	There are no outliers for the regressands and the regressors.	Leverage-values or Cook’s distance

Source: Own elaboration based on (Auer, 2016; Gehrke, 2019).

The above-mentioned table provides an overview of stochastic tools needed to examine the BLUE criteria. Achieving BLUE (best linear unbiased estimator) properties (Auer, 2016) follows the Gauss-Markow theorem (Judge et al., 1988).

The terms disturbance or error (ε) and residuals (y-ȳ) should not be confused. Disturbance terms are unobserved random variables that measure the vertical distance between the observation point and the regression line. Residuals, on the other hand, are calculated quantities that measure the vertical distance between the observation points and the estimated regression line.

The interpretability of the results of a linear regression is reinforced by the fulfilment of the above requirements. Subsequently, the individual BLUE properties and its corresponding tools are presented in the form of a short presentation.

BLUE AR1 Scatter plot.

First the linearity of the variables is checked. If the criterion is not met, the line does not provide the best estimator. For this purpose, the residuals are plotted against the linear estimated values of the model using a scatter diagram. If no linearity exists, the transformation of the variables would be a possible solution.

BLUE AR2 Intercept in modelling.

The expected value of the residuals must be zero. Only in this case are the effects of the disturbance variables random. This assumption can be violated if the independent variables are measured too high or too low by a constant term. The residual then contains a systematic effect that can lead to the model not correctly reproducing the focus of the observation points. This might be remedied by introducing a constant term β_0 (Gehrke, 2019).

BLUE AR3 RESET-Test.

Ramsey's RESET test (REgression Specification Error Test) (Ramsey, 1969) generally tests for incorrect specification of a regression model. The F-test is used to check whether non-linear combinations of the explanatory variables (X) have an influence on the variable to be explained (Y).

Incorrect specifications can be caused by disregarding relevant variables, structural breaks, or homoscedasticity. The advantage of the test is that no alternative model must be specified for the contrast. The disadvantage is that the test shows the wrong assessments, but not an optimal alternative (Gehrke, 2019).

BLUE AR4 Homoscedasticity versus heteroskedasticity.

Homoscedasticity means that a set of random variables has the same finite variance. The standard assumption of a linear regression is that the variance of the error term ε is the same across all observations. Furthermore, the variance of the error term does not depend on the independent variables (X). To check, it is assumed that a random variable is then homoscedastic if it is heteroskedastic in truth. (McCulloch, 1985). The residuals can be reviewed for homoscedasticity using a Breusch-Pagan test. This test creates an auxiliary regression of the squared residuals to the independent variables (Wooldridge, 2018).

This generalizes the Goldfeld-Quandt test, which is used to test group-wide heteroscedasticity. To overcome one of the main disadvantages of the Breusch-Pagan test, the White test does not see the mandatory condition of the normal distribution of the residuals of the original regression. This test works in a similar way and can also be used for non-normally distributed residuals (Gehrke, 2019).

BLUE AR5 Durbin-Watson-Test and Breusch-Godfrey-Test.

The two tests mentioned serve to check the residuals for autocorrelation. This is used to denote the correlation between two usually successive residual quantities ε_i and ε_j. A positive and negative autocorrelation can occur (Gehrke, 2019).

Autocorrelation can occur if, for example, a relevant regressor was not considered in the model (incorrect specification) or if a regressor is non-linear. It leads to the fact that the least squares estimators may be accurate and consistent but are no longer efficient (no BLUE properties). The t-test and F-test can then lead to delusive results (Gehrke, 2019).

The first-order autocorrelation can be checked analytically using the Durbin-Watson test. This compares the residuals of two neighbouring observations with each other. A connection can be made between the Durbin-Watson statistics and the correlation coefficients.

The Breusch-Godfrey test enables the investigation of higher-order autocorrelation by using an auxiliary regression (Wooldridge, 2018).

BLUE AR6 coefficient of determination and the p-values + VIF (Variance Inflation Factors).

A multicollinearity is a high correlation between the explanatory variables (regressors X). If the multicollinearity is perfect, a clear estimate of the regression coefficients is not possible. In case of its existence, an independent variable can be mapped linearly by one or more other independent variables (Gehrke, 2019).

The comparison of the coefficient of determination with the p-values can provide an initial indication of the multicollinearity as soon as the values are high.

The multicollinearity test can also be performed using the Variance Inflation Factors (VIF). These are factors by which the variances of the regression coefficients increase with increasing multicollinearity.

This test not only detects multicollinearity in pairs. Multicollinearity can also be detected, which is due to linear combinations of the independent variables (Gehrke, 2019).

BLUE AR7 Shapiro-Wilk-Test and Jarque-Bera-Test.

The normal distribution of the residuals is checked to ensure a low standard error and the power of the tests. The power of a test specifies the probability of a 2^{nd} type error in the sample model being avoided. This 2^{nd} type error means not to reject the null hypothesis (H_0: residuals are normal distributed), even though the assumption of H_0 is not correct.

The normal distribution assumption can be easily checked graphically using a histogram. Common tests such as the Shapiro-Wilk test or the Jarque-Bera test are available as analytical methods. The latter gains quality with increasing sample size.

The normal distribution assumption is often not checked because the central limit theorem applies. If the sample size is not too small, a normal distribution of the residuals is assumed. In the literature, a sample size of N> 30 is regarded as a limit (Gehrke, 2019).

BLUE R1 Leverage-values or Cook's distance.

Basically, the observations of the modelling should have no or only a few outliers. Individual observations that do not follow the trend of most observations are called outliers. They can be identified analytically by determining the leverage values (hat values) and the Cook's distance. They should also be shown graphically.

Hat values are a measure of the deviation of the values of the independent variables for observation i from the average values of the independent variables $x_1, ..., x_n$ (Gehrke, 2019).

The Cook's Distance can be calculated i for each individual observation. This is done based on carrying out a new regression, omitting the data from the observation i.

To simplify matters, the Cook's Distance can also be derived from the leverage values (Gehrke, 2019).

Final regression diagnosis.

To carry out a final diagnosis of a panel regression and thus underlining its robustness, the following aspects should be analysed in particular:

- Heteroscedasticity (presence of a constant and finite variance of the residuals (homoscedasticity). Their absence is called heteroscedasticity.
- Autocorrelation (no serial correlation between successive residuals).
- Cross-sectional correlation (no correlation between the general error term and the explanatory variables).
- Multicollinearity (several regressors explain almost the same).

Bigtech analyse's positive aspects.

In the sense of a litmus test, it is a quick and efficient approach to get an answer to the question. The challenge is to collect data and accurately graph the results. In this way, optical results were quickly achieved, for possible contrasting of the first analyse.

The *bigtechs* event study focuses not only on investors (stock market), but also on creditors (bond market) for possible contrast.

Bigtech analyse's aspects with room for improvement.

Expected returns around the event deadlines could have been determined using the CAPM model (Barahona, 2018). The deviations from the values that occurred posteriori could then have been determined.

The influence of new information on the market price in the form of emerging excess or sub-yield could have been stochastically precisely determined and tested (Gehrke, 2019).

Questionnaire's positive aspects.

The questionnaire was set up to enable the deductive approach in the sense of Karl Popper (Popper, 1934). The sequence of questions should be used to determine the degree of disruption of the classic *business model* of *universal banks* surveyed triggered by *fintechs*. The impact of *bigtech's* should also be questioned. Ultimately, a new, possibly future-oriented aspect, beyond digitalization, should be sounded.

To achieve a high rate of utilization, a uniform layout design including mapping to increase the attention of the target persons was created.

The strength of the questionnaire is essentially to research where the incumbent banks themselves see the challenges that the digital basic technology creates. Another strength is to avoid induction errors through predetermined suggestive impulses on the proband. In addition to the level of knowledge at the time the questionnaire was created, new insights from the probands can be added.

Questionnaire's aspects with room for improvement.

A response rate of 6.4% (2 responses in 31 attempted surveys) indicates an extremely low level of representativity (Rubin, 2009). Nevertheless, since the two answers came from different cities in Europe and thus different major banks (Madrid and Frankfurt), at least some trends are recognizable.

The low response rate indicates systematic failures (refusal, ignorance). This could be because the questionnaires were emailed to the Investor Relations Department for further distribution. The actual target person was therefore not reached. The length and complexity of the questionnaire containing sensitive points for the incumbent banks' strategic orientation as well as the lack of incentives could have been decisive.

The weaknesses of the questionnaire lie in the complexity of the content, the technical data collection channel (e-mail) and the lack of inventory to generate answers. The content of the questionnaire also addresses overly sensitive issues relating to the strategic orientation of the analysed companies. Answers were only achieved with personal interviews.

A solution based on the experience gained consists in direct personal contact with the actors from the perspective of a management consultancy. From an external point of view, the addressed investor relations departments are usually the first points of contact, with a clear (often physical) proximity to the strategy departments. However, these will not give sensitive considerations externally to unknowns.

6.3 Consequences of the analysis.

This subchapter's task is a try to draw economic conclusions from the knowledge gained through the quantitative and qualitative analysis.

On the one hand, the view has so far been strengthened that the effects of digitization on banks' *business models* are noticeable but tend to be evolutionary rather than revolutionary.

On the other hand, the introduction of new key technologies, which also bring about social changes, accelerated by COVID-19 (branch extinction, changed customer behaviour, cf. Interview with Professor Ricardo Palomo Zurdo CEU San Pablo (Müller, 2020)), reveals possible revolutionary changes. They could make the classic *business model* of *universal banks* appear obsolete.

Based on the knowledge of statistically firmed relationships, no attempt should be made to economically interpret the effects on the individual incumbent banks. Nevertheless, the statistical relationships show occurrences in the form of reinforcement of the overarching hypotheses H1, H3 and H5.

In contrast, the opportunity to strategically realign should be seized here. It should also be pointed out the difficulty in presenting the true cause of the effects on the key performance indicators between the changing customer behaviour, growing regulation and digitization.

At this point, no attempt has been made to analyse the objects to be examined in more detail based on the quantitative results. Under certain circumstances, this attempt could lead to conclusions that are no longer statistically justifiable. Nevertheless, the results should at least indefinitely offer management the approach to strategic realignments (Schreyögg et al., 2020). Such a strategic change is necessary solely to remain economically independent in the future and not have to strive for a merger.

If these adjustments are delayed too long, a development with negative effects on a *business model* can start opening a vicious circle. The development may have started quietly, almost unnoticed, and may have expanded into a strategic crisis, which in the end can lead to bankruptcy (Niering et al., 2020).

An alternative maybe sustainable banks' business is sketched in more detail in Chapter 7. In this subchapter, at least an attempt has been made to show the degree of concern about the sustainability of the current *business model*.

Which circumstances can lead to creating a risk awareness among those responsible in the first step, as a basis for further steps to cope with the reaction times in crisis situations? What circumstances can lead to a necessary and wholesome process of collective rethinking even at this level of the hierarchy? This also includes giving up something that has become dear to management in charge over the years (Maisch et al.).

To derive the idea, the allegory of a Formula 1 racing car and its driver was sought. For several centuries now, the banks had time to expand and refine an existing *business model* through a plethora of larger and smaller evolutionary steps. In Formula 1, both the vehicles and the safety precautions for the drivers were continuously optimized since its beginning in 1948 (Motor Sport Magazine, 1947).

Nevertheless, accidents with fatal consequences continue to occur (María de Villota Comba † 11th October 2013; Jules Bianchi † 17th July 2015). On the positive side, the number of fatalities is much lower than at the beginning of the Formula 1 race (Walthert, 2013).

The banks move figuratively with their robust and extremely powerful vehicle (*business model*) on a racetrack that, unlike those in Formula 1, does not run in circles. It rather leads at high speed, winding roads from familiar into unfamiliar terrain. The financial racetracks are sometimes without guard rails.

What could induce the driver, despite the high tech, not to rely on systems that seem to work, but to be constantly alert and ready to brake a priori and / or to choose a set of tires that enables traction even in unfamiliar terrain.

One approach taken by the driver could be to distinguish known from unknown risks and to allow the thought that known risks can also be controlled at the limit with the latest technology. Unknown risks, on the contrary, can lead to fatal errors despite trained short reaction times.

To link these considerations with the topic of the work, the banks' heat map (see Figure 13 on page 55) reflecting exogenous threats is used in combination with the considerations of Igor Ansoff's weak signals (Ansoff, 1975).

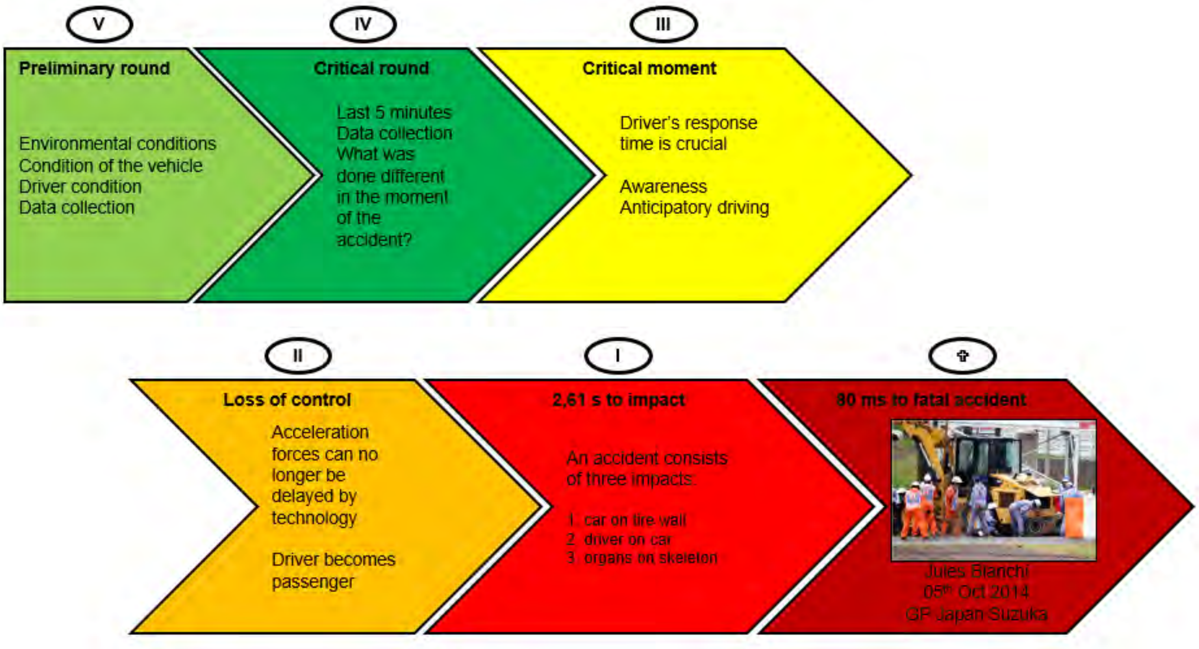
The management is symbolized by the driver, the racetrack is represented by the above-mentioned banks' heat map and the *business model* is represented by the vehicle. The attention and responsiveness of the risk takers (management = driver) are represented by the 5 levels of risk ignorance according to Ansoff.

Endogenous disturbances, possibly represented by the mental condition of the driver, are not considered.

The Ansoff level of weak signals (risk ignorance) (5 (trivial) to 1 (critical)) was assigned to the 25 heat map's individual matrix fields intuitively and discretionarily. The aim of the exercise is to issue a symbolic warning of the phase of an accident (bankruptcy) in which the risk takers are already.

According to current accident research by the FIA (starting in 1994 caused by Ayrton Senna's death in Imola) (Schmidt, 2015a), the following phases were identified:

Figure 42: Crash phases in F1 accident research.



Source: Own elaboration based on (Schmidt, 2015b).

The driver can still intervene in the action up to phase III (critical moment). Then he is handed over to be the passenger in his own car, to an extend defenceless against the acceleration forces.

In a figurative sense, the SRB (Single Resolution Board) in Brussels has the right to dismiss the management of a bank if control is lost and the bank is under resolution (Directive 2014/59/EU – BRRD, 2014; Regulation (EU) 806/2014 – SRMR, 2014). From this point on (critical moment when a bank is considered to fail or being likely to fail FLTOF), the management becomes a passenger, a spectator of what is happening, equal to the formula 1 car driver.

The business administration has developed concepts of corporate planning, strategy development of controlling for well-structured problems over decades. This is what Igor Ansoff criticized in his article (Ansoff, 1975), which is widely regarded today (Holopainen et al., 2012).

He stated that modern planning techniques have not enabled industry to identify and cope with crisis situations that threaten the existence of the company in good time.

Such crisis situations are understood to be sudden changes in environmental conditions that were previously assumed to be relatively stable. In his article, Ansoff cites the oil crisis of 1973 as examples of strategic surprises (which even led to the decline of the Herstatt bank in 1974 (fraud as a catalyst), as well as to Basel I) (Mourlon-Druol, 2015).

Ansoff also mentions the surprise of the American automotive industry with the compact car (changed customer behaviour, success VW Beetle). Ansoff's statement that companies are surprised by events (COVID-19) that at least lead to sensitive adaptation measures (branch closure) or beyond is still partially valid today (Lufthansa 2020 or Cirque du Soleil 2020).

In the case of threatening events (COVID first wave simultaneous supply and demand crisis (Wyman, 2020)), an existence-crisis can be generated. The inertia of the sometimes extremely complex planning and budgeting cycles (e.g. Commerzbanks' 5 year MYP multiyear planning process) (Commerzbank, 2018) are identified as a cause of not being able to reflect on and respond to threatening events in good time and, above all, promptly.

According to Ansoff, discontinuities can in principle be anticipated. His approach to a solution includes two bundles of measures (reduction of the probability of occurrence and readiness for defence).

He encourages management to reduce the gap in environmentally relevant information. To this end, he differentiates between five levels of information in sense of risk ignorance.

I. critical: The management has a vague feeling that some threat (opportunity) is developing (= vague state of information).

II. high: The source of the threat (opportunity) is known.

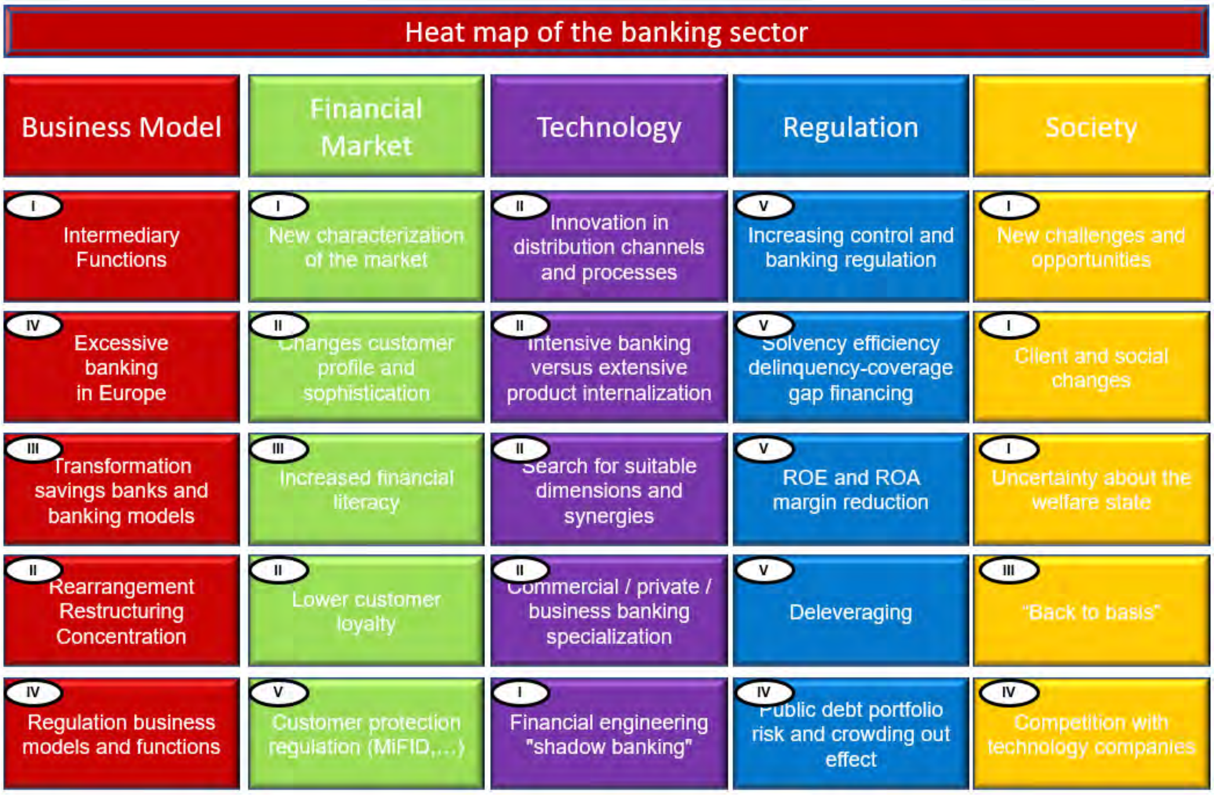
III. medium: The threat (opportunity) is known in its concrete form.

IV. low: The response options to this threat (opportunity) are known.

V. trivial: The consequences of the threat (opportunity) are manageable.

Level I is to be understood as the highest level of risk ignorance by risk takers and level V as its lowest level. These levels transferred to the banking sector's heat map, the image of exogenous disturbances, result in the following representation.

Figure 43: Banking sector's heat map with Ansoff's levels of weak signals.

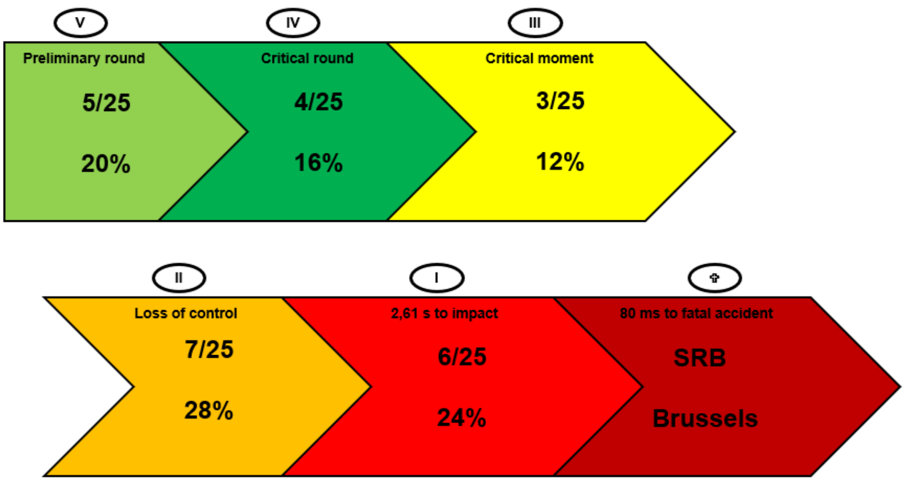


Source: Own elaboration based on ideas of Prof. Dr. Ricardo J. Palomo Catedrático de Economía Financiera / Full Professor of Finance Universidad CEU San Pablo..

The following observation frequencies arise, which are then transferred to the phases of F1 accident research.

Figure 44: Transfer of the observations to accident's research phases.

Degree of ignorance		
I	critical	6
II	high	7
III	medium	3
IV	low	4
V	trivial	5



Source: Own elaboration.

The observations, consciously obtained on an intuitive and discretionary basis, show at least that the way to Brussels (SRB Single Resolution Board) seems to appear more likely than not based on the findings of accident research in formula 1. In relation to the superordinate hypotheses, this knowledge is interpreted as a reinforcement of the hypothesis H5 (revolutionary change).

This is an attempt to counter the apparent convenience of the picture of key figures of the empirical quantitative and qualitative analysis.

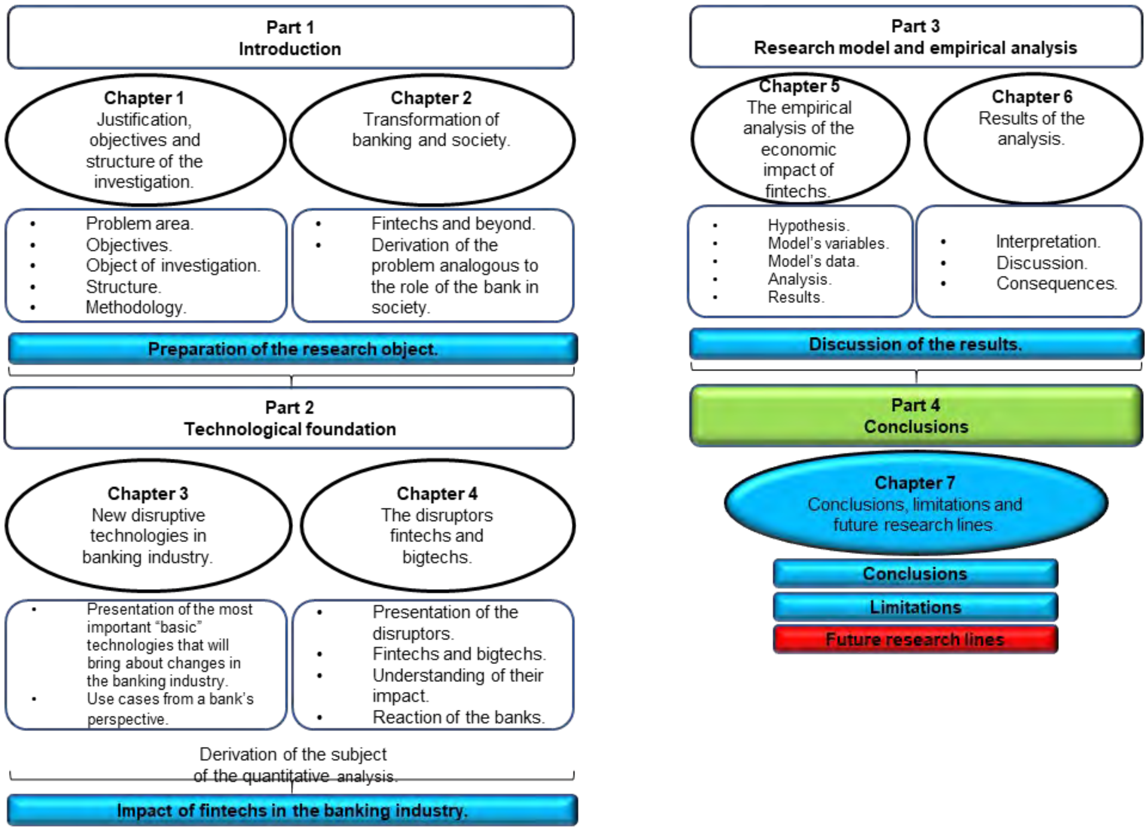
Part IV. Conclusions.

Chapter 7. Conclusions, limitations, and future research lines.

7.1 Conclusions

7.2 Limitations of the investigation

7.3 Future lines of investigation



7.1 Conclusions.

The task of this chapter is the comprehensive reflection and presentation of the conclusions based on the analysis carried out in the previous chapters.

The aim of this work is to gain scientifically sound new knowledge about the impact of digitalization on the *business model* of *universal banks*. For this purpose, the basic elements of scientific work are first discussed, and this work is classified against this background.

Then the measuring points interwoven with the superordinate hypotheses H1-H5 and obtained in the analysis are shown schematically with the aim of creating a synthesis.

To classify the degree of "scientific nature" of this work, the following table shows argumentation techniques, such as their classification in non-scientific and scientific action. It also shows which types of argumentation were used in this work. This is intended to highlight the mix of techniques for gaining knowledge.

Table 58: Positioning used argumentation techniques in a non-scientific context.

Type of argument	Explanation	Reason of application	Dominant usage
Non-scientific approach			
Arguments of authority	Based on the statements of persons in authority, so-called experts.	Was applied in a figurative sense, by supporting legal texts and knowledge in this area of recognized organizations (e.g. BIS, EBA).	Chapters 2.2 and 2.3.
Religious arguments	Based on religious dogmas and scriptures.	In this work no distinction was made between banking based on the Western model and Islamic banking.	Is not used.
Tradition	Based on traditional knowledge from previous generations.	A generic approach was used in Chapter 2, but it is based on historically secured knowledge and not on tradition-based arguments.	Is not used.
Common sense	Shared conviction of a group.	Certain perspectives (e.g. on the function of a bank) were assumed in this work.	Is used indirectly.
Intuition	Based on the own gut feeling, instinct	The determination of the direction of the research is based on intuition, based on approximately 30 years of professional experience of the author in the financial industry.	Overarching hypothesis based on corresponding literature. The positioning of the measuring points.
Anecdotal evidence	Based on personal life experience, the social environment, or the media	Used for the FIA accident research with I. Ansoff and non-scientific end of the thesis.	Chapters 6.3, 7.2 and 7.3.
Logic	(Popper, 1934) Logik der Forschung	Arrangement of the questions in the questionnaire to enable a deductive approach and avoid induction errors.	Use of logic-based arguments was pursued in this work in the context of the questionnaire.

Source: Own elaboration based on (Döring et al., 2016).

Table 59: Positioning used argumentation techniques in a scientific context.

Type of argument	Explanation	Reason of application	Dominant usage
Scientific approach			
Scientific research means, in this specific case, using recognized scientific methods to research economics as an empirically analytical research area for secured new insights.			
Descriptive approach	The introduction to the actual analysis and its enrichment are sometimes descriptive.		Used in all chapters
literature-oriented-investigative	Evaluation of up-to-date, quotable, and quote-worthy literature.	This approach was used to generate the overarching hypotheses, to identify the technological basis and to establish the quantitative model. This approach was also used to secure knowledge about *fintechs* and *bigtechs*.	chapters 3, 4 and 5.
Quantitative empirical analytical	Acquisition of scientific knowledge gain based on quantitatively evaluated empirical data.	The impact of *fintechs* as a representative of digital change on the *business model* of *universal banks* was examined, as well as the impact of *bigtechs* on them in the form of a simple event analysis.	chapter 5
Qualitative empirical analytical	Acquisition of scientific knowledge gain based on qualitatively evaluated empirical data.	To support the findings from chapter 5.1 to 5.5, the perspective of the responsible specialist department of the analysed banks should be determined as an expert using a questionnaire.	chapter 5.7
Mixed approach	The empirical-analytical approach consists of a quantitative-qualitative mix.		chapter 5
Own research project	The research semester was devoted to creating and launching the questionnaire. There was no comprehensive evaluation due to a lack of responses.		chapter 5.7

Source: Own elaboration based on (Döring et al., 2016).

In this work, both non-scientific and scientific arguments are used to gain knowledge. The former for preparing the foundation, the latter for the actual empirical analysis.

In this way, the “red thread” was followed from the general to the specific, based on the overarching hypotheses as a guide.

7.1.1 Synthesis of the hypothesis.

The focus of this sub-chapter is on the synthesis (Kolbe, 1845) of the previously obtained analytical knowledge. The term was first introduced in the natural sciences (chemistry) and represents the counterpart to analysis.

In the economic context of this work, a synthesis is understood to mean the composition of the individual analytical knowledge to form new insights (Schmidt et al., 1987).

Before the knowledge gained is presented in detail, the research objectives of this work should be recalled (cf. chapter 1.3 on page 18).

Table 60: Objectives of this dissertation.

Overarching question
The banking function is from a macroeconomic perspective necessary even in the future.
General objectives
• Holistic approach: Draw a picture comprising all influencing factors of digitization on *universal banks' business models* by this research. • Status quo: Statement of the degree of transformation of the incumbent banks' *business models*. • Solution: Which transformation must the *business model* undergo to remain sustainable in the future.
Special objectives
• Changes in demand: Social transformation as driver. • Changes in demand and supply: Technological foundation (basis innovations) as driver. • Impact of *fintechs* on incumbent banks' *business models*. • Impact of *bigtechs* on incumbent banks' *business models*.

Source: Own elaboration.

To bundle this multitude of questions, 5 superordinate hypotheses were installed as a framework concept for the work. However, these are called overarching hypotheses, to avoid confusion with commercial law framework concepts (Framework IFRS or §252 HGB).

The individual analyses are aligned chapter wise in the form of measuring points to the superordinate hypotheses.

For this purpose, approximately 50 reading points were distributed in this work, each of which was related to the overarching hypotheses (cf. Figure 4 on page 21). The distribution of the assignment to the higher-level H1 to H5 is unweighted and directly reflects the analytically obtained knowledge. The following table shows the compilation of the individual findings, arranged according to chapters.

Table 61: Synthesis of the overarching hypotheses part I.

Chapter	Keyword	Knowledge	Enforced hypothesis
1.3	Introduction	Overarching hypothesis	H1 - H5
2.1	Change in society	Changes in demand => supply opportunities of private sector (*fintechs*)	H2
2.1	Change in society	Changes in demand => adapted supply of banking services	H3
2.1	Change in society	Changes in demand => supply opportunities supporting core business (*big techs*)	H5
2.1	Revenue pillars	Evolutionary adaption over the centuries	H1
2.1	Revenue pillars	Disruptive adaption caused by technological improvements	H3
2.2	PESTEL and Financial *ecosystem*	Opportunistic innovation to fill gaps in supply	H2
2.2	PESTEL and Financial *ecosystem*	Cooperation with fintechs as response	H3
2.2	Legal environment	Saveguarding evolutionary development	H1
2.2	Research objects	Representing classic *business models* with low innovative pace	H1
2.3	Segment reporting	Saveguarding evolutionary development as external reporting tool	H1
3.2	DLT Blockchain technology	Dispruptive adaptation enforced	H3
3.2	DLT Blockchain technology	The classic intermediary function may be threatened.	H5
3.3	AI Artificial Intelligence	Contributing cost cutting potential (e.g. cheaper and efficient onboarding)	H1
3.3	AI Artificial Intelligence	Disruptive potential by enabling third parties to provide classic bank services.	H3
3.3	AI Artificial Intelligence	Bigtechs will be enabled to use their customer data towards banking business.	H5
3.4	Big Data	Positive impulse on customer focussing and risk modelling.	H1
3.4	Big Data	Disruptive potential together with AI, ML and CC.	H3
3.5	Cloud computing	cost reduction is possible	H1
3.5	Cloud computing	disruptive potential given by accessibility	H3
3.6	Quantum computing	disruptive potential for incumbent banks by rising cyber risks	H3
3.6	Quantum computing	competitors will be able to overcome incumbent banks … and even the cryptography of a blockchain	H5
3.7	IoT	physical items can cause digital reactions	H3
3.7	Biometrics	additive security instrument	H1
3.7	Open API	door opener to external *ecosystem*s	H5
3.7	Robotics	cost cutting potential	H1
3.7	ML	optimisation of old *business model*	H1
3.7	Wearables	subordinated additive role	H1
3.7	XR Extended Reality	subordinated additive role	H1

Source: Own elaboration.

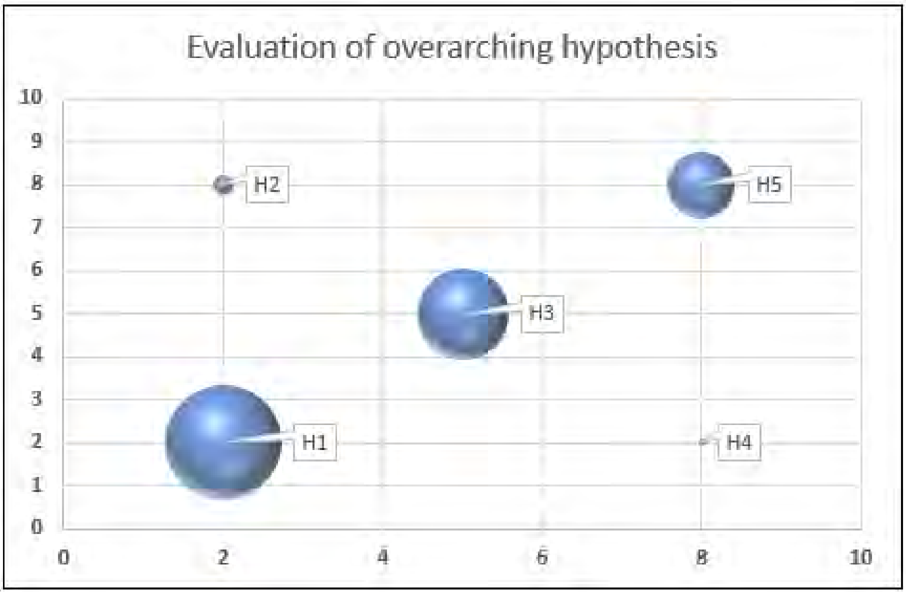
Table 62: Synthesis of the overarching hypothesis part II.

Chapter	Keyword	Knowledge	Enforced hypothesis
4.1	Fintechs still having room for stand-alone developments	The next decade will bring together still individual solutins. Open API will be the basis for the startup developments.	H2
4.1	Fintechs and universities' unaligned innovation	education offer and research	H4
4.1	Fintechs' cooperations with incumbent banks	often the way is paved via incubators	H3
4.2	Bigtechs in the western world	trend to cooperations with incumbent banks	H3
4.2	Bigtechs in the eastern world	bigtechs founded their own banks (but without crowding-out of incumbent banks)	H5
4.3	Incumbent banks tend to save their *business model*	Evolutionary adaption observable	H1
4.3	Incumbent banks form a financial *ecosystem*	Disruptive adaption observable	H3
4.3	Non-financial *ecosystems* are forming	Reaction to the formation of financial *ecosystems*	H5
5.6	Bigtech litmus test	No enforcement of H5 (Revolution)	n.a.
5.6	Bigtech litmus test	Enforcement of H1 (Evolution) observable (e.g. cooperation in payment systems)	H1
5.6	Bigtech litmus test	Slight enforcement of H3 (Disruption) observable due to the necessity to adapt new ways of distribution (reduction of brick-and-mortar banks).	H3
5.7	Questionnaire	Strong enforcement of H1 (investment in new technologies of incumbent bankservices)	H1
5.7	Questionnaire	Moderate enforcement of H3	H3
5.7	Questionnaire	Slight enforsement of H5 (due to the answers of the 2nd proband).	H5
6.1	Evaluation Table 54: Transfer of the results of the fintech-specific quantitative empirical analysis to the overarching hypotheses. H1 received 3 points. H3 received 1 point. H5 received 2 points.		H1
6.1			H1
6.1			H1
6.1			H3
6.1			H5
6.3	FIA crash research and I.Ansoff's weak signals.	The level of ignorance of the management only indicates evolutionary changes.	H1
7	Conclusion	Invitation to a paradigm shift.	H5

Source: Own elaboration.

The table above containing 49 reading points results in the following graphic representation, based on the portfolio selection according to Markowitz (neoclassical capital market theory). The expected risk is plotted on the x-axis of the graph and the expected return on the y-axis. Both in the figurative sense of portfolio selection theory (Markowitz, 1952).

Figure 45: Evaluation of overarching hypothesis.



Source: Own elaboration.

In percentage terms, with the 49 reading points, the following figures emerge.

Table 63: Evaluation of the reading points for H1 - H5.

Hypothesis	Type of digital impact on the business models	Percentage
H1	Evolutionary innovation	38,78%
H2	Opportunistic innovation	6,12%
H3	Disruptive innovation	30,61%
H4	Unaligned innovation	2,04%
H5	Revolutionary innovation	22,45%

Source: Own elaboration.

None of the overarching hypotheses should be rejected. All 5 hypotheses were evaluated by the analyses. The hypotheses H2 (*Fintech* as a start-up, opportunistic innovation) and H4 (universities with unaligned research) experience the least reinforcement. The reason for this can be the low level of public visibility if the projects are in their development stage.

The diagonal spanned by H1 (evolutionary), over H3 (disruptive) to H5 (revolutionary) is clearly confirmed. H1 was confirmed most clearly as an indication for evolutionary changes, followed by H3 and H5. As a synthesis it can be deduced from this that endogenously driven changes take place carefully in an evolutionary way.

Dramatic exogenous disturbances (e.g. a pandemic) or the emergence of new, previously unrecognized *ecosystems* can force revolutionary changes (e.g. market adjustment through the onset of mergers).

Newly emerging basic technologies sometimes force disruptive changes, which established banks try to counter through cooperation and create their own *ecosystem* (Gomber et al., 2018).

This evaluation also confirms entrepreneurial human behaviour step by step without the expected high risk and with the acceptance of a low return, only gradually penetrating new territory (to meet changed demand) through investments.

As the sum of all insights gained, digitization has brought about a change in the *business models* of classic European *universal banks* in this decade. The changes were mainly driven endogenously evolutionary as far as possible with little entrepreneurial risks.

Exogenous disruptive changes in *business models*, triggered by *fintechs*, are recognizable. *Fintechs* are no longer viewed by incumbents as an enemy, however (Bömer et al., 2018; Galvin et al., 2018). They are integrated into the existing *business models* through collaborations often initiated by their incubators.

Even exogenous, potentially revolutionary changes triggered by *bigtechs* are starting to smooth out the financial community through cooperation (Arons et al., 2020).

The following subsection 7.1.2 presents the perspective of contemporary literature on the future of the *business model* of a *universal bank*.

In summary, the main scientific contributions of this work are presented on the following page analogous to the questions. In isolated cases, these findings are already available, but not as an overall picture.

Banks will continue to exist in a different form, customer oriented as a service platform, using the skills they have acquired over the centuries (creditworthiness assessment and lending).

Table 64: New knowledge from this work.

Overarching question
The banking function is from a macroeconomic perspective necessary even in the future.
Yes, the function will also be needed in the future from a macroeconomic point of view. Inverse to the value-added goods and production flows, this function is responsible for the inverse necessary needs-based allocation of liquid funds.
Banking is necessary, banks are not! (Haley, 1994)
The statement made by Bill Gates in an interview with Playboy in 1994 is incorrect! As long as this system exists, central banks will always fall back on the wreath of credit and financial services institutions with banking licenses as intermediaries. To put it simply, this is how central banks avoid the KYC (know-your-customer) compliance problem. *Fintechs* and *bigtechs* are already the focus of regulators to maintain financial market stability.
General objectives
Holistic approach: Draw a picture comprising all influencing factors of digitization on *universal banks' business models* by this research.
Work must be done on the solution to merge overly complex demand behaviour with digital, unique customer-oriented offers. This considers the regulatory framework and the current low interest rate phase. Strategic realignments of the companies are necessary, which, however, often go hand in hand with uncertainty and possibly a lack of methodological competence.
Status quo: Statement of the degree of transformation of the incumbent banks' *business models*.
• There have been changes in *business models*. The analysis of the segment reporting showed this. • The degree of complexity of the *business models* has been reduced (and thus, also the inherent risk). • Endogenously driven digitization more pronounced than exogenously initiated digitization.
Solution: Which transformation must the *business model* undergo to remain sustainable in the future.
• Customer orientation, trust as a new currency (privacy), stronger IT orientation, CIR reduction, focus on core competencies. • see chapters 7.2 and 7.3.
Special objectives
Changes in demand: Social transformation as driver.
• Banks followed the socially induced changes in demand but did not try to anticipate.
Changes in demand and supply: Technological foundation (basis innovations) as driver.
• Digital accessibility of the bank by customers calls into question the branch network (accelerated by COVID-19).
Impact of *fintechs* on incumbent banks' *business models*.
• *Fintechs* usually do not reach the critical size to be perceived as competition. • All incumbent banks analysed cooperate with fintechs. • Initially disruptive changes were smoothed out into evolutionary ones.
Impact of *bigtechs* on incumbent banks' *business models*.
• *Bigtechs* have other economic interests than replacing banks. • Own financial instruments are used to accelerate the core business. • Revolutionary potential is smoothed out through cooperation.

Source: Own elaboration.

7.1.2 Conclusions about the technological foundation.

In this subchapter, the findings of the third chapter on the technological foundation are brought together with the aim of drawing conclusions about the banks’ future *business model*.

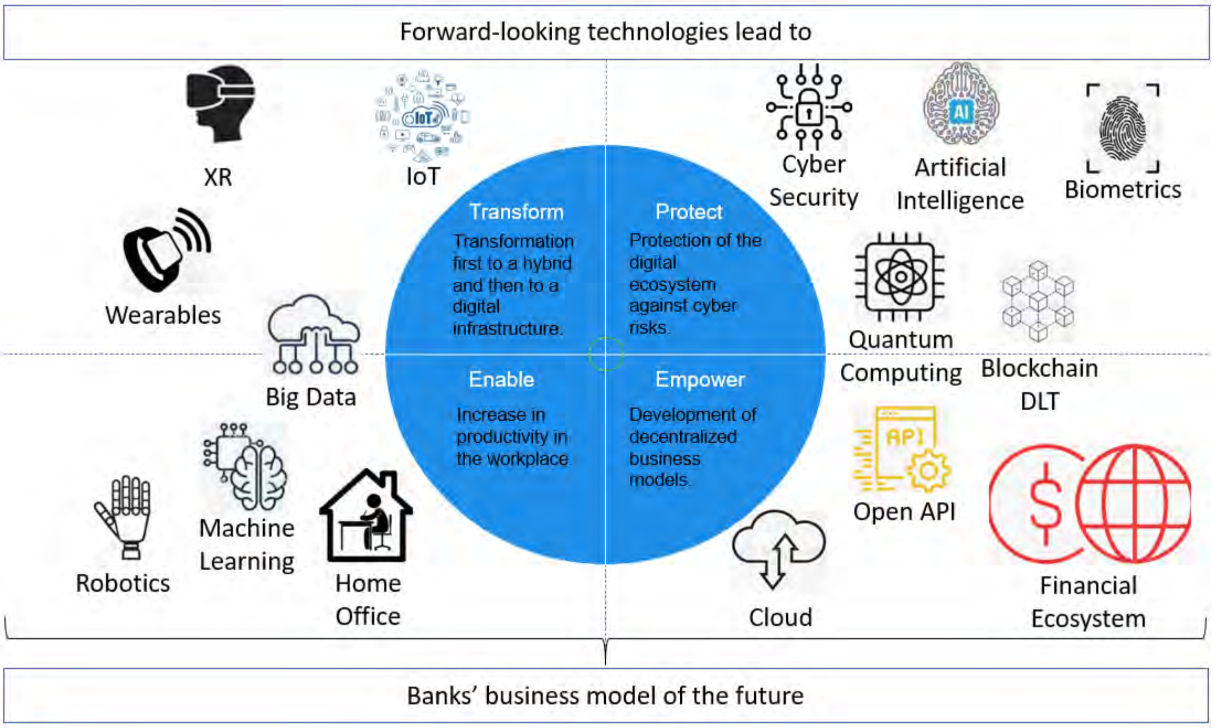
The focus of the consideration is the question of an optimal mix of existing technologies to lower the CIR and to increase customer satisfaction (ECB COVID-19, 2020; ECM SSM Consolidation Guide, 2020). The current pandemic (COVID-19) will accelerate this process (Seetharaman, 2020).

However, a purely technical solution will "only" again consist of optimizing an already existing *business model*.

Nevertheless, new IT infrastructure and cooperation models must be analyzed in detail in order not to lose market shares in the constant change. It is becoming more and more clear that comprehensive technological competence and customer focus will form the basis of existence in the future.

The following graphic overview summarizes the findings of the third chapter combined with insights of the fourth chapter.

Figure 46: Banks' *business model* of the future.



Source: Own elaboration based on (Handelsblatt-Journal, 2016).

Transform.

The transformation to an initially hybrid infrastructure relies on a digital unification of both the supply side (incumbent *universal bank*) and the demand side (customers). The first step is to have a hybrid infrastructure that also enables classic access to a bank, as not all customers are digital natives.

Protect.

The new *business models* will have to be flanked by protection concepts that are constantly being revised to minimize cyber risks. Furthermore, a largely automated compliance (aaS as a service) is at the centre of the considerations.

Empower.

New operating models for IT are necessary. The services must be fundamentally realigned to enable flexible new *business models* across platforms (keyword aaS ... as a Service). The aim should be to integrate the company in question into a financial *ecosystem* that might initially be regionally limited.

Enable.

Efficient cooperation of all stakeholders seven days a week and around the clock should be made possible by exploiting all digital potential.

Pro new development.

Banks of the future will have to be much more IT-oriented than they already are. The aim will be to become part of a financial *ecosystem* in which the central banks are more and more integrated (Brühl et al., 2019).

Banks can use different platforms to regroup to meet individual customer requirements and, in this way even iteratively test new *business models*. In the event of success, these will be continued; in the event of failure, they will be dismantled without high costs. Thus, banks can get rid of the main drivers of the CIR, the high number of employees and the real estate. New jobs will be created, but with a higher requirement profile.

Contra new development.

At any cost, the digital protection of the financial *ecosystem* (comprehensive compliance) will be the focus of efforts. The above-mentioned major cost drivers in traditional banking could be replaced by a new cost driver, cyber risk. Furthermore, customer trust in the infrastructure must be protected by unconditional compliance with privacy.

Existing new creation of a business model.

Figure 47: Main Incubator's *business model*.

Source: Elaboration based on (main-incubator.com, 2018).

As a 100% subsidiary of Commerzbank, the research and development unit (incubator) is an entity that initially finances new business ideas from *fintech* startups through venture capital. The medium-term goal is to integrate robust and powerful ideas into the mother's IT infrastructure.

Prototyping means the development of new business ideas (e.g. tokenization for autonomous driving trucks (Zmudzinski, 2019)) that can be incorporated into the classic corporate customer business as an asset.

Close networking and presence in the financial community is essential for the successful implementation of these goals. Networking takes place on the usual available channels (social media, regular fintech event series (Frankfurt "Between the Towers") and even awards).

7.2 Limitations of the investigation.

The contribution of this subchapter is the discussion of the limitations of this research approach. For this purpose, a distinction is made between endogenous (inherent to work) and exogenous (environmental influences) limitations.

Endogenous limitations.

The results obtained must be framed within the limitations presented by this work. The main of them has been the selection of objects, the wide time period over nearly ten years and the modelling.

Selection of research objects.

The selection of the research objects was geographically limited to the area of the EEA. Thus, there is no contrasting comparison with the sometimes-successful American banks (pre-pandemic) or Japanese banks that have been exposed to low interest rates for decades (IMF Blog, 2020).

Data collection.

Data collection over a period of almost 10 years poses particular challenges. In 2017, a research object (AS PNB Banka) was classified as likely to fail (FOLTF) by the ECB and wound up by the SRB (Single Resolution Board, 2019).

Modelling.

The quantitative analysis is designed in such a way that it cannot provide any specific quantitative information about the influences of exogenous factors such as the current phase of low interest rates and growing regulatory requirements (CGFS, 2018).

A model based on descriptive analytical statistics (based on the past) can primarily only show statistical relationships.

Approach to research.

Sometimes discretionary, intuitive, experience-based assignments and conclusions were drawn. This was necessary to deal with the complexity of the task (Selart, 2010).

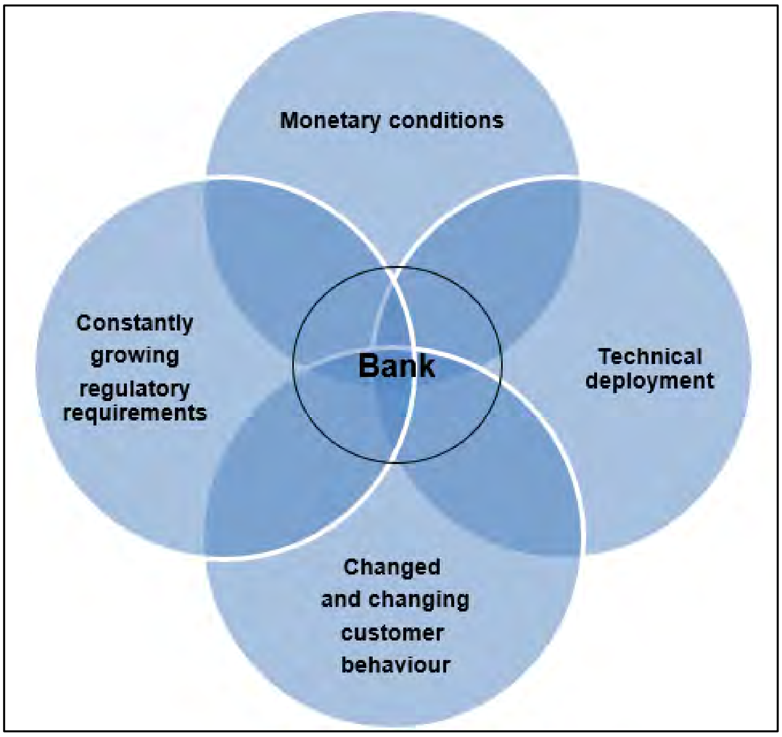
Influencing factors not considered.

A digital transformation can only be successfully implemented with motivated employees. Digitization itself, like leadership in the digital age, require new skills from those involved (Cortellazzo et al., 2019).

The content of the knowledge gained is therefore not transferable to other industries or savings banks or cooperative banks with their respective top institutions. A transferability of the methodology might also be conceivable across industries (e.g. to the automotive industry that is subject to similarly profound transformations (PWC, 2018)).

Exogenous limitations.

Figure 48: Limits of the analysis.



Source: Own elaboration.

Monetary conditions.

The current interest rate development, as a follow-up to the global financial crisis, calls the traditional *business models* of *universal banks* into question (Boucinha et al., 2020).

Technical deployment.

The challenging question is in which technology to invest is the dominant one that either enables the future to be secured (blockchain) or, if ignored, provokes exit from the market (quantum computing). In general, the advantage is seen in a combination of the existing new technologies.

Changed and changing customer behaviour.

From a bank's point of view, changes in demand behaviour are often difficult to anticipate (Chambers et al., 1971). At the moment, it is also extremely difficult to make iterative modifications to the *business model* with little risk (Solod, 2020).

Constantly growing regulatory requirements.

Growing regulatory requirements have on the one hand a negative impact on a bank's CIR (Ben Naceur et al., 2009).

Sooner or later, all considerations about changing the *business model* of existing banks will be subject to regulatory supervision (BCBS, 2018a).

Nevertheless, like a pandemic, the regulation represents a uniform level playing field for all those involved (Bitar et al., 2020).

Limitations beyond this research's approach.

A dialogue about humanistic perspectives and their post humanistic replacement by so-called dataism could be opened here (Tranberg, 2017), far beyond the scope of this work (Harari, 2017; Hao, 2019). Therefore, it should be noted as a warning that the unconditional privacy of an individual must necessarily be the focus of efforts (ENISA, 2014).

This even has to be incentivized or penalized so that the visions of Eric Arthur Blair alias George Orwell (1984), written in post war 1949, never become reality (Orwell, 1949).

Digital developments in Chinese society do not seem particularly worth emulating (ECFR.EU, 2020).

Every individual participating in a digital *ecosystem* of whatever kind is carelessly operating external electronic reporting that is legible and thus reproducible over a long period of time (sometimes beyond decease).

7.3 Future lines of investigation.

The subject of this concluding subchapter is the attempt to outline a way to develop a sustainable *business model* for *universal banks*. Based on the knowledge gained in this dissertation, a possible technological realignment was already presented as a basis for this in subsection 7.1.2.

In addition, the economic reorientation will now be discussed in several facets. The scientifically unsound attempt to discover a way out of the “Bermuda Triangle” is undertaken through product innovation and a strict customer orientation.

It is intended to think beyond pure impact analysis and point the way to the future. The subject of these considerations is the development of a new *business model* using the Blue Ocean strategy. At the centre are not the challenges of implementing such a strategy in a company whose tradition goes back several hundred years.

The added value of this subchapter should be to look beyond the box and to present ideas for new developments. Furthermore, this subchapter is an invitation to further researchers to advance studies on the future of banking on a scientific basis essential for survival of numerous jobs in Europe. According to a study by the ECB, the number of bank branches in the EU is decreasing annually by 7.5%. The number of employees in EU banks declines by an average of 2.3% per year. In the EU (EEA with currently all 28 member states), this number fell from 2.74 million to almost 2.67 million (end of 2018) (Ruhkamp, 2019).

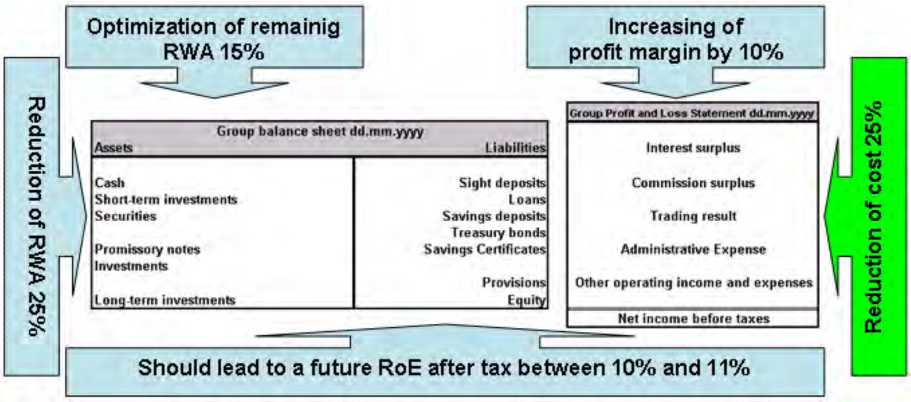
Decision-makers in banks are at a crossroads given the changing environment and disruptive technological developments. They can concentrate on:

- conserving the classic *business models* through modification.
- trying transitionally a mix of old and new *business models*.
- completely new ways to tread.

Conserving the classic business model => Evolutionary approach.

If this course should be taken, the focus must be on strengthening the classic core competences (cf. Figure 11 on page 49) of a *universal bank*. This considering the environmental changes already listed in Table 1: Changes in the banks’ operating environment. on page 5.

Figure 49: Typical solutions recommended by consulting companies.



Source: own elaboration.

This approach aims at increasing the RoE (Return on Equity) after tax from currently 3.95% to an average of 10% to 11% to be accepted by the capital markets[45].

To achieve this objective the structure of the assets is to be changed. High risk weighted assets (RWA) are recommended to be reduced and the remaining assets should be optimized in terms of earnings stability.

This in combination with an optimized *business model* should lead to a higher profit margin. The measures should be achieved by a cost reduction of 25%. That very often leads to outsourcing, optimization of the IT-infrastructure and staff redundancies. The latter is very often played.

Digitization is not mentioned in the first place rather viewed as an optimizing aid.

Discussion of the pro and contra aspects.

Higher profitability should be reached with less risky and optimized assets and an optimized cost structure as reaction to the increasing regulatory demands and the persistent phase of low interest rates.

At first glance, this approach appears to be attractive, as it appears to harbour the least internal resistance. However, it is bought by the management with on the one hand a regulatory applauded risk reduction but on the other hand still low income.

Allfinanz (Allianz Dresdner 1999) was also a way that did not work. This ended prematurely after less than 10 years in 2008 in the merger of Dresdner Commerzbank (old).

[45] Even in the subprime crisis, RoE targets of 25% were proclaimed (Reuters (2009)).

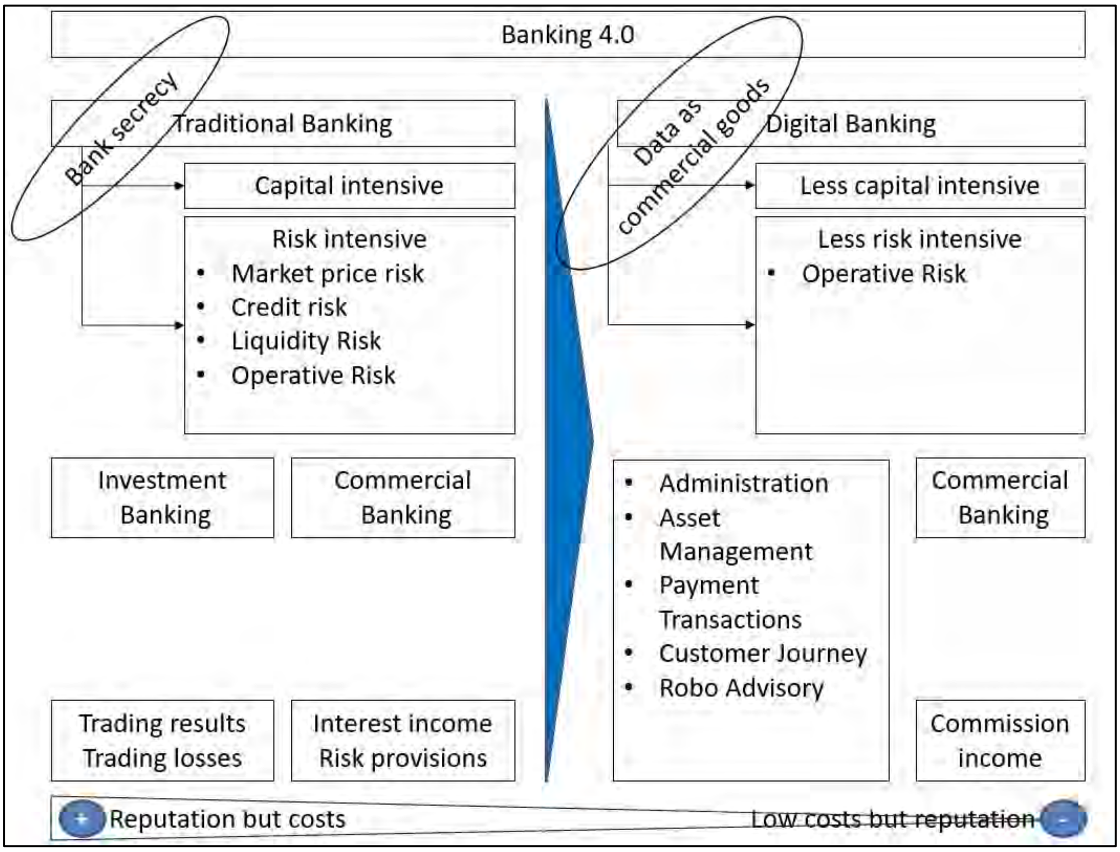
Overall, the approach seems like squaring the circle. To put this ostensibly impossible approach in a nutshell. The current pandemic as exogenous shock puts this exercise to the test again.

To delay or to stop the continuous downward spiral of an entire industry more aspects must be examined. If the traditional *business model* of a globally operating *universal bank* is to survive it must be modified.

Trying transitionally a mix of old and new business models => disruptive approach.

The following graphic shows the transition to a hybrid bank 4.0 on a meta level. This graphic is based on bank internal considerations from 2014.

Figure 50: Banking 4.0.



Source: Own elaboration.

What is striking is the coexistence between the classic banking *business model* on the one hand and the new, digital banking *business model* on the other.

The strengths of the first are banking secrecy (the part still possible under current international tax law (FATCA)) and the banks' robust reputation. The second is the database that apparently only needs to be cultivated (e.g. AI and big data => cf. chapter 3).

Discussion of the pro and contra aspects.

This approach is seemingly charming because, based on a hybrid exercise, it enables a slow and targeted transition to the digital bank.

What is disruptive about this is the new view that banks' databases can be made usable in many ways. Here customer benefit and data protection should have or top priority.

In this way, a transition to a less risky *business model* with lower capital intensity seems possible, considering all age groups of customers (their digital affinity).

The price is the increasing reputation risk, for example through exogenous governmental and non-governmental cyber-attacks or endogenous tempting but wrong decisions, e.g. to sell databases as asset packages or not to use them in the interests of customers.

Following table is a compilation of contemporary literature also dealing with this idea. In 2020 there is still no clear, consistent, uniform picture of the banking of the future in the international community.

Clear statements are:

- COVID-19 will accelerate the transformation process.

- Banks will have to focus more clearly on customers and will be omnipresent.

- The customer-bank relationship will be reversed:

  The customer no longer searches for the bank via branding.

  The bank must look for customers with individual products.

- Banks are increasingly becoming technology platforms.

Against the background of these findings, strategic thinking must go far beyond what has been done so far, also with the courage to question well-known and convenient approaches and, if necessary, to part with them.

Table 65: Literature review of the future of banking.

Key words		Future of banking		
Google search period: 01st January 2020 – 20th September 2020				
Originator	**Study**	**Publication**	**Content**	**Conclusion**
World Bank	09th July 2020	Future of Banking in the Post COVID-19 World	COVID-19 came on top of the already existing "Bermuda Triangle". Consequences: - increasing non-performing loans. - restructuring in the sector will accelerate. - surviving incumbents must face powerful *big techs.*	COVID-19 will accelerate the struggle for scarce resources.
McKinsey & Company	5th May 2020	The future of banking talent	- 43% of working hours can be automated with current technology. - Identification of critical roles and talent management necessary. - Use of data for personnel selection - Adopt an agile business model!	Human capital will be the top challenge.
Forrester	29th July 2020	The Future of banking has arrived	- Invisible: not brand driven but insight driven to the products in time and need. - Connected: Unconditional presence in the ecosystems. - Insights-driven: Customer-thrust is the finite asset. - Purposeful: Customers will prefer banks that align with their environmental and social values	Future Banking will be invisible, connected, insights-driven, and purposeful. Banks Will Have A Stark Choice: Own Customers, Or Power Finance; Few Can Manage Both
Do better by ESADE	8th January 2020	The future of banking is in the hands of transaction data	Collaboration with fintech companies will allow the banking sector to innovate, create new income sources and improve its business proposal.	New customers want to feel that their bank anticipates their needs. Transaction data has become one of the most valuable assets for banks.
IESE insights	3rd May 2020	A new perspective: The big picture.	Evolving consumer expectations, tech innovations, regulatory changes and new business models are fast reshaping the global banking industry. Fintech and platform-based competitors are eating into the market that used to be dominated by a few major international banks. As the rules of the game change, who will emerge as the winners?	- Incumbent players still have advantages. - Fintechs and bigtechs will gain more ground. - PacMan idea incumbent banks could be eaten by fintechs and bigtechs. - PSP2 on level playing field for all?
Deloitte	26th March 2020	Deloitte: 2030 and the future of banking.	Banking trends: - Cyberrisk and financial crime - Digital technology - Digital Transformation - Data and analytics - Agility - Monetising data and customer experience - Financial services ecosystem	To be successful over the next decade, banks must embrace emerging. technologies and digital transformation, according to Deloitte

Source: Own elaboration based on (World Bank, 2020);(Vives, 2019a; McKinsey & Company, 2020; Torrens, 2020; Vives, 2020b).

Completely new ways to tread => Revolutionary approach.

The traditional *business model* of a *universal bank* as the sum of all knowledge from this work is not sustainable. Banks are currently using the option of making this traditional model more robust through investment and aligning it with external requirements.

These include, as a reminder, essentially the low-interest phase, the changed customer behaviour, and the growing regulatory requirements in an already distributed market. So that the statement by Bill Gates cited at the beginning of this thesis does not become true one day, banks should develop completely new strategies that go far beyond the previously known *business model*.

Although this is material for further research, this work should conclude with an attempt to outline a way to develop new strategies based on agile *business models* which, thanks to their extensive technological support, also forgive wrong decisions.

To sketch a completely new strategy, the Blue Ocean Strategy according to (Kim et al. 2015) is to be used as a first approach. The purpose of this tool is the creation of new markets (blue oceans) to avoid cost-intensive competition on existing markets (red oceans).

This approach is aimed at penetrating from existing markets (red oceans) into new markets (blue oceans) that are not yet exposed to competitive pressure.

Through innovations and the revision of traditional behaviour, the focus is on customer orientation while reducing costs. Below is a graphic representation of how such a strategy sketch could be provided (Papazov et al., 2016).

Table 66: Core components Red Ocean vs. Blue Ocean Strategy.

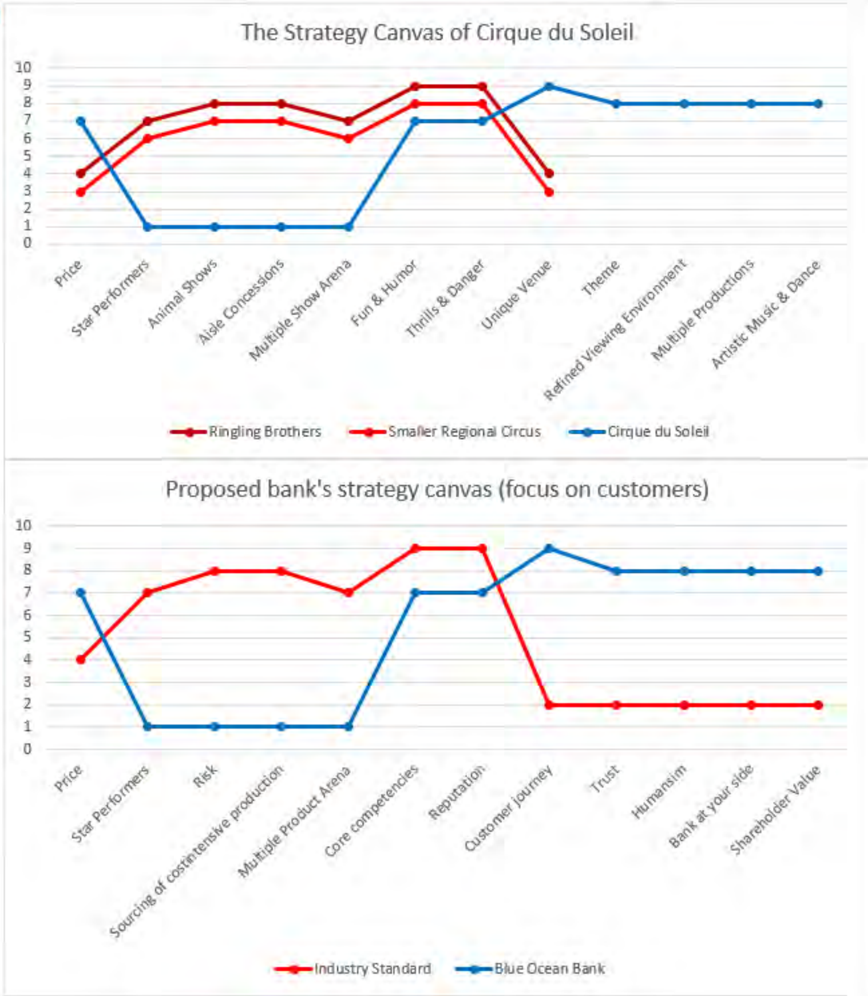
Core component	Red Ocean Strategy	Blue Ocean Strategy
field of activity	Compete in existing market space.	Create uncontested market space.
competition	Beat the competition.	Make the competition irrelevant.
demand	Exploit existing demand.	Create and capture new demand.
key	Make the value-cost trade-off.	Break the value-cost trade-off.
challenge	Align the whole system of a firm's activities activities with its strategic choice of differentiation or low cost.	Align the whole system of a firm's activities in pursuit of differentiation and low cost.

Source: Elaboration based on (Kim et al., 2015).

Figure 51: Red Ocean vs. Blue Ocean strategy canvas.

	Competing Factors	Ringling Brothers	Smaller Regional Circus	Cirque du Soleil
	Price	4	3	7
Eliminate	Star Performers	7	6	1
Eliminate	Animal Shows	8	7	1
Eliminate	Aisle Concessions	8	7	1
Eliminate	Multiple Show Arena	7	6	1
Reduce	Fun & Humor	9	8	7
Reduce	Thrills & Danger	9	8	7
Raise	Unique Venue	4	3	9
Create	Theme			8
Create	Refined Viewing Environment			8
Create	Multiple Productions			8
Create	Artistic Music & Dance			8

	Competing Factors	Industry Standard	Blue Ocean Bank
	Price	4	7
Eliminate	Star Performers	7	1
Eliminate	Risk	8	1
Eliminate	Sourcing of costintensive produ	8	1
Eliminate	Multiple Product Arena	7	1
Reduce	Core competencies	9	7
Reduce	Reputation	9	7
Raise	Customer journey	2	9
Create	Trust	2	8
Create	Humansim	2	8
Create	Bank at your side	2	8
Create	Shareholder Value	2	8



Source: Own elaboration.

The previous page compares the strategic considerations of the operator of Cirque du Soleil (Stuart, 2019) and possible strategic considerations for the future design of the *business model* of a customer-focused retail bank.

Cirque du Soleil has eliminated costly components of entertainment (considered as an industry standard). This includes keeping animals, circus tents and the involvement of star artists. These were replaced by a unique range of topics that put the focus on the customer experience again, in an inner-city environment and ambience that should even encourage theatre or opera visitors to buy tickets.

Unfortunately, the presence-based *business model* in 2020 proved to be insufficiently resistant to the exogenous effects of the pandemic. In June 2020, due to the worldwide cancelled shows, the bankruptcy was filed (Efe, 2020).

For a bank, the basic considerations could be the same. With a return to SRB MREL (critical functions and critical business lines of a bank), a bank could outsource all cost components that have hitherto been the industry standard.

This could include the reduction of physical representative buildings (high-rise buildings in the best inner-city location), compliance sourcing, IT infrastructure sourcing, and possibly also the sourcing of assets to reduce risk-weighted assets.

By concentrating on the core competencies learned over centuries (cf. chapter 2) (lot-size and maturity transformation), the customer benefit could be put in the focus. This includes trust, presence, data protection, possibly also specifically from the offer of human consultants, in a time after the digital hype.

In addition, banks contribute use their well-known role as intermediaries in new business areas:

- Funding of intangible assets (García-Posada et al., 2020).
- Funding of astronautics (EIB, 2020).
- Funding of and investing in sustainable assets (Loyarte-López et al., 2020; Valls Martínez et al., 2020) (Leichsenring, 2019; Esposito et al., 2020).

Closing words based on the scientifical analyses.

In the following, possible future research strands are listed, which were not deepened in this work.

Strategic Management.

- Search for the optimal (risk-return optimization analogous to risk appetite) future-proof strategy formulation (Ai et al., 2012).

Quantitative empirical research.

- Quantitative solution of the Bermuda Triangle consisting of low interest rates, digitization, and regulatory requirements (Mersch, 2019).
- Cyber Risk Management (Mazzoccoli et al., 2020).
- Research on regulatory costs (Dautović, 2020).

Macroeconomic research.

- Overcoming or dealing with the low-interest-rate (model Japan) (Bohn et al., 2020).

Customer based research.

- Age-related customer group acceptance of digitalisation (Lecoeuvre et al., 2021).
- Digital customer loyalty (Mainardes et al., 2020).

HR based research.

- Leadership in a digital decentralized environment (Guzmán et al., 2020).
- Qualification and talent development in a digital environment (Elia et al., 2020).

Up-to-date scientific articles or speeches could be found on the individual proposed research topics. However, no article fully covers the proposals.

This work began by tabulating the various divergent factors that reflect the current process of change in the financial industry (cf. Table 1 on page 5). This table is finally called up again at this point, supplemented by findings from this work.

Table 67: Analysed changes in the banks' operating environment.

Factor	Origin	Impact	Knowledge gained
• macro financial environment	external	margin ↑	will probably continue for a long time (Wiebe, 2019).
• regulation and supervision	external	*business model* →	Of course, new forms will be subject to regulatory supervision, solely to avoid the threat to financial market stability (cf. chapter 2).
• stakeholder scrutiny	external	funding ↑	will decrease again with the stabilization and profit orientation of the *business model*.
• development of the non-bank sector	external	competition ↓	Impact of *fintechs* and *bigtechs* not as revolutionary as originally assumed. Evolutionary pace sometimes recognizable (cf. chapters 4 and 5).
• technological change	internal	efficiency ↑	Comprehensive investments are necessary here (cf. chapters 3 and 7.2).

Source: Own elaboration (Buch, 2018).

In the short term, the main focus is on overcoming the phase of low interest rates as well as coordinated strategic decisions and investments in the IT infrastructure.

In this way the foundation stone can be laid for a medium-term gradual change in the *business model*. This will bring back the trust of the stakeholders.

Unscientific closing words.

To end this dissertation, it is more likely than not that *bigtechs* will not substitute in a revolutionary way incumbent *universal banks* in the next years in providing financial services.

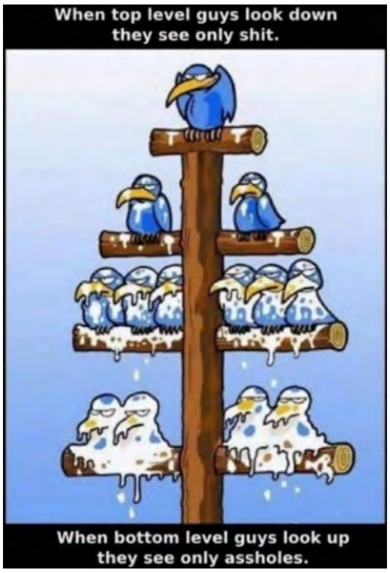
It is probable that these companies will foster a disruptive digital transformation of the incumbents allied with *fintechs*. Ten years ago, *fintechs* were discussed as the future fourth pillar of the German banking system, which has not happened (WD des DtBT, 2009).

On the contrary, the rise of new *ecosystems* sometimes complementing sometimes concurring is more likely than not. Regulations, cyber risks, and pandemics ensure a common level playing field.

Thus, the analysed *universal banks* do not have to fear revolutionary threats neither of *fintechs* nor of *bigtechs*. It is rather an evolutionary than disruptive enrichment of the banks' *business models*.

Incumbent *universal banks* must fear an idiosyncratic risk which is not in the focus of the companies themselves nor the regulator. It is an unsystematic risk that is made up of human characteristics, such as fear, incompetence, stupidity, ignorance, greed, and lack of appreciation. It is a social problem that is reflected in the hierarchy of a company. It leads to hardly quantifiable friction losses due to inefficiency and wrong allocation of resources.

Figure 52: Hierarchy.



Source: Unknown.

How else has the sale of compact discs full of sensitive bank customer data been driven to the financial authorities of the German state of North Rhine-Westphalia (2 BvR 2101/09, 2010)? It was certainly not just monetary incentives to expose oneself to the hazard.

This dissertation began with reference to a well-known citation of Bill Gates. So, it ends with two challenging excerpts getting the insights to its point:

- “Trust is the new currency when it comes to digital technology.” (Satya Nadella CEO, Microsoft since 2014).
- “Uber yourself before you get kodak’ed.” (Singularity University think tank at an event in San Francisco 2016)

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Glossary of definitions.

Glossary of definitions.

Definitions

The following terms are used in this dissertation with the meanings specified:

Business model

A *business model* is defined as an abstract representation of some aspect of a firm's strategy (Porter, 1996; Zott et al., 2011). For definition purposes in this thesis, it is not to deepen the technical term corporate strategy, going back to Andrews 1971 but the contemporary understanding of the term *business model* as:

- a new unit of analysis,
- a system-level, holistic approach to explain how companies "do business",
- under consideration of the firm's activities,
- the model's intention is to explain how value is created (Zott et al., 2017).

This term is evidenced in this thesis as follows: „A *business model* describes the rationale of how an organization creates, delivers, and captures value." (Pigneur et al., 2013)

Bigtech

The term *bigtech* is a composition of the words "Big" and "Technology". On an abstract level, this term is defined as the financial services offerings of technology companies with established presence in the market for digital services (Frost et al., 2019a).

Specifically, this term refers to the largest technology companies worldwide. These technology companies include older ones, such as Paypal, Samsung or Microsoft. Regarding the western hemisphere, the branding GAFA (Google, Amazon, Facebook and Apple) emerged and, about the eastern hemisphere, the branding BAT (Baidu, Alibaba and Tencent) was formed (Rodríguez, 2018).

Fintechs and *bigtechs* resemble to each other in their absolute technology focus. They differ in their capitalization, their efficiency, and their market penetration. With a biological analogy, *fintechs* are similar in their effect to ants, but *bigtechs* are comparable to elephants.

Due to their digital omnipresence, *bigtechs* can reach completely different customer numbers worldwide than, for example, *universal banks*.

Bigtechs are well able to compete on an equal footing with the world's largest established *universal banks*. Their big advantage lies in the continual acquisition of the new commodity of the 21st century, information (Rodríguez, 2018).

These firms often penetrate the market for financial products with payments. Thereafter, some expand into the provision of credit, insurance, and savings and investment products, either directly or in cooperation with financial institution partners (Frost et al., 2019a).

This behaviour as well as the fact that *bigtechs* can refinance due to their *business model* and not through the classic deposit business, already creates regulatory interest. Banking supervision is beginning to see *bigtechs* as a potential risk to financial market stability greater than the risk posed by banks before the GFC. However, there is currently no regulatory access to these companies as a whole (Buch, 2019).

In this thesis the term *bigtech* is used both in abstract and in the special sense.

Cyber risk

Cyber risk is not only of microeconomic importance but also of macroeconomic importance. Nevertheless, there is currently no uniform, scientifically backed definition of the term in the literature (Vakulyk et al., 2020).

For the purposes of this study the following definition as scientific extract of current literature is used: “*The approach and actions associated with security risk management processes followed by organizations and states to protect confidentiality, integrity and availability of data and assets used in cyber space. The concept includes guidelines, policies and collections of safeguards, technologies, tools and training to provide the best protection for the state of the cyber environment and its users.*” (Schatz et al., 2017)

Disruption

Disruption is understood as a process in which an existing *business model* or an entire market is replaced or destroyed by rapidly growing innovation46.

A disruptive process is understood to be necessary for the functioning development of a market (Clayton M. Christensen, 1997).

The value chains of traditional *universal banks* are already undergoing a disruptive transformation process or they are in the process of becoming involved (Urs Gasser et al., 2017). With the help of innovative digital technology, market participants are for the first time able to digitally transfer values without intermediaries (e.g. by blockchain technology) (Christian Catalini, 2017).

One of the positive characteristics of capitalist production is the ability to innovate and technical and economic progress. This is brought about by the creative power of destruction (disruption or revolution) (Schumpeter, 2015)(1943).

Ecosystem

The term *ecosystem* is referred to as an association of companies in the economic sense. These are aligned by an orchestrator on shared value creation (Moore, 1993). The total power of the *ecosystem* exceeds the sum of the individual services contributed.

From the point of view of companies, an *ecosystem* serves to increase the innovation performance through cross-industry networking. This in order to escape increasing competition in stagnant markets. Digitalisation is considered a driver.

The term occurs with the following three characteristics:

Knowledge *ecosystems*: loose business groups focused on knowledge sharing (Adner, 2006)

Platform *ecosystems*: Exploiting network effects through a variety of partners. (Ceccagnoli and Huang, 2012)

Business *ecosystems*: economic context (Moore, 1993)

[46] (US company Kodak for example: Once a pioneer of photography, developed the first digital camera in 1975 but concentrated too long on classic photo business ended up in bankruptcy in 2012).

This term is used in this thesis in the sense of a business *ecosystem*. The last chapter also highlights the importance of the platform *ecosystem*.

European Passport

Before banks, financial services providers, asset management companies, insurers or pension funds can commence operations, they need written authorisation from BaFin.

An exception applies to companies from another signatory state to the Agreement on the European Economic Area, which simply must notify BaFin of their intention to provide cross-border services or establish a branch in Germany. This is known as “notification procedure” or “European Passport”.

Financial stability

Financial stability can be defined as a state in which the financial system - i.e. financial intermediaries, financial markets, and market infrastructures - is resilient to shocks and unexpected developments in financial imbalances.

Financial stability reduces the likelihood of a disruption to the financial intermediation process, which is so severe that real economic activity is affected.

According to the ECB, financial stability can be defined as a condition in which the financial system – which comprises financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances.

This mitigates the prospect of disruptions in the financial intermediation process that are severe enough to adversely impact real economic activity.

Fintech

The technical and not yet legally protected term fintech refers to the two nouns finance and technology. Innovative financial solutions are delivered by the application of existing technology. There is no 100% consensus on a common definition of the term (Schueffel, 2016).

In this context, the first commercial use of the telegraph in 1833 and the first transfer of a transatlantic submarine cable in 1866 could be described as fintech (Douglas W. Arner et al., 2015).

In the sense of a contemporary understanding, the roots of the term are traceable to an American consortium “Financial Services Technology Consortium” founded in 1993 by Citicorp, the predecessor of today’s Citigroup (Hochstein, 2015). The company thereby tried to overcome its own closeness regarding technical cooperation with external partners.

Fintechs tend to be start-ups, but that is not always the case (Bundesbank, 2016). Established businesses might also be engaged in activities that count as fintech business.

According to current understanding, the term fintech covers technology-based innovations on the financial sector giving rise to new financial instruments, services or intermediaries (Cai, 2018). In the narrower sense of the term, fintech is often used to describe the businesses providing such technology-enabled financial innovations. These young companies carve out, automate and rearrange parts of the value chain of traditional financial intermediaries (Bundesbank, 2016).

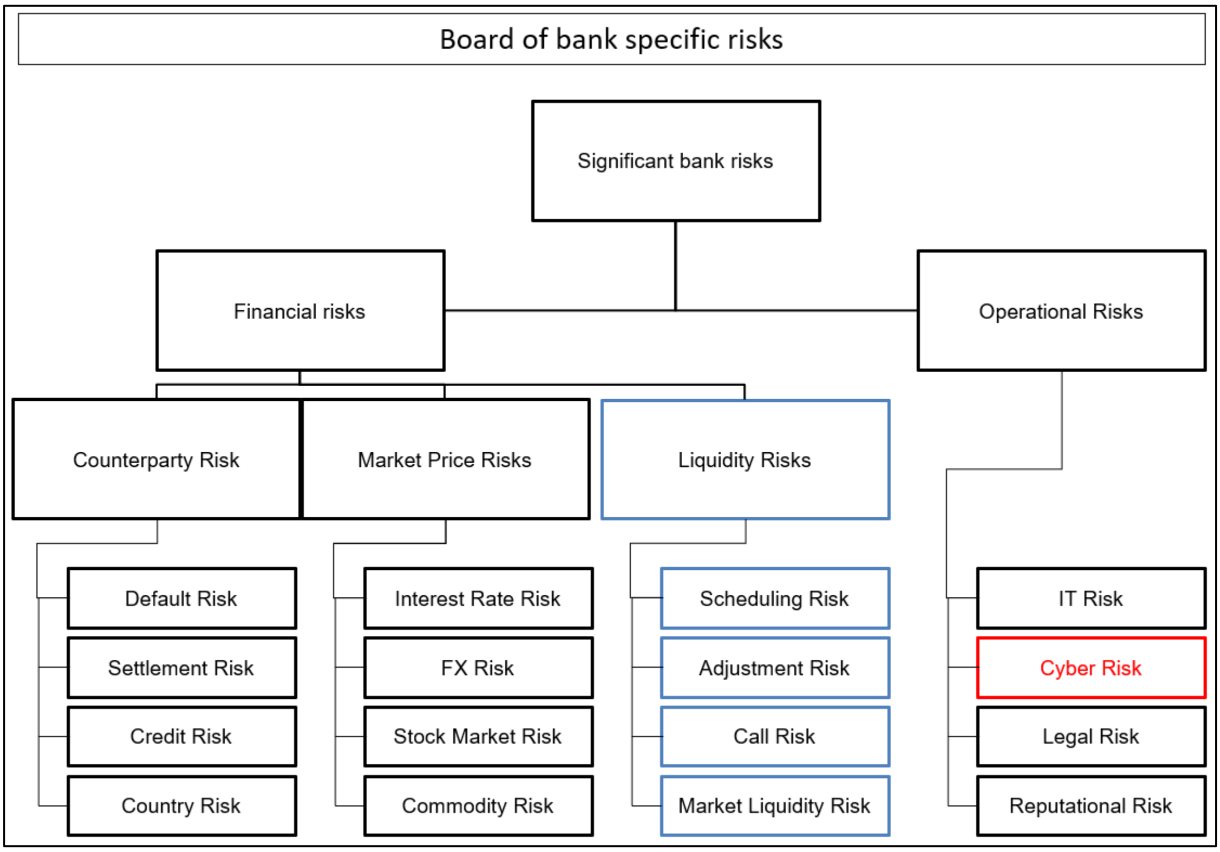
The term fintech is used in this work in the sense of the last financial definition.

Risk

Risk is intuitively understood in the context of the financial industry as a risk of loss or destruction. In the sense of statistics, this is actually the potential positive and negative deviation from an expected value. Opportunities and risks are thus closely related.

The challenge is to carefully determine an expected value in commercial terms and to use stochastic techniques (also recognized by the CRR (Capital Requirement Regulation)) to quantify the deviation from the expected value. In this work, the concept of risk is associated with the risk of loss. The following diagram shows the entrepreneurial risks to which banks are exposed daily, in the same way as the MaRisk (Minimum Requirements for Risk Managent) and CRR regulations.

Figure 53: Bank risks assessed by the regulator.



Source: Own elaboration based on Heinz Cremers HfB 1998 and MaRisk.

The two different main issues of the risk chart represent the categories of financial risks and operational risks. The insolvency of a company can already be a result. Operational risks can lead to financial risks, as if they were a catalyst.

Already the financial risks have three different branches and thus characteristics.

The *counter-party risk* differs from the market price risk by the asymmetric distribution of the probability density function around the expected value.

They are usually characterized by a so-called Fat Tail. Says that the likelihood of recovery of a credit at risk of default is quite high. Catastrophic total failure tends to occur less frequently. However, a bank cannot normally earn more with a loan than is provided for at the time of conclusion in accordance with the interest and repayment plan.

Market price risks, on the other hand, are characterized by a normal distribution (bell shaped) of the probability density function. Opportunities and risks of potentially occurring events deviating from the expected value are equally possible. The best example of this is changes in stock prices.

Liquidity risk differs from other risks in that it is a secondary risk. Another risk must be preceded to generate an additional liquidity bottleneck, which may lead to insolvency. For example, an interest rate risk has already led to a decline in interest rate margins for a long time.

This in turn has weakened the profitability of a company over several years, so that all reserves have already been used up. A liquidity outflow (bank run) is now due to a negative message. The bank can hardly stand in the way of this on its own.

Liquidity risks also have the character of being able to occur overnight. Therefore, precautions must be taken here differently from the other risks. They cannot be held up by additional equity.

That would be in her doubt too sticky in the balance sheet. The liquidity risk indicator LCR therefore also assumes the holding of so-called HQLA (High Quality Liquid Assets) on the assets side of the balance sheet. Operational risks, on the other hand, are sometimes not always apparent at first sight. The human factor, its degree of satisfaction, plays a large role here.

For example, due to the long-standing lack of appreciation of computer scientist, it may happen that the latter can sell CDs with sensitive customer data to the responsible financial authorities.

The new term cyber risk (marked in red) is presented in the 3rd chapter where a separate subsection is dedicated. They all have a brake on the profitable development of a *business model*. They must be contained by a non-profit share that cannot be underestimated.

Strategy

Igor Ansoff mentions the term "strategy" as a set of decision rules necessary to support growth and thus the continued existence of a company. Competition plays a role in his considerations of meeting supply and demand (Ansoff, 1957).

Systemic Risk

Systemic risks can arise both from endogenous (inherent in the financial system) and exogenous events (also “shocks”) and are considered difficult to predict.

Exogenous shocks include e.g. Pandemics, natural and man-made disasters, severe recessions (as far as they result from the real economy), wars and other accidents.

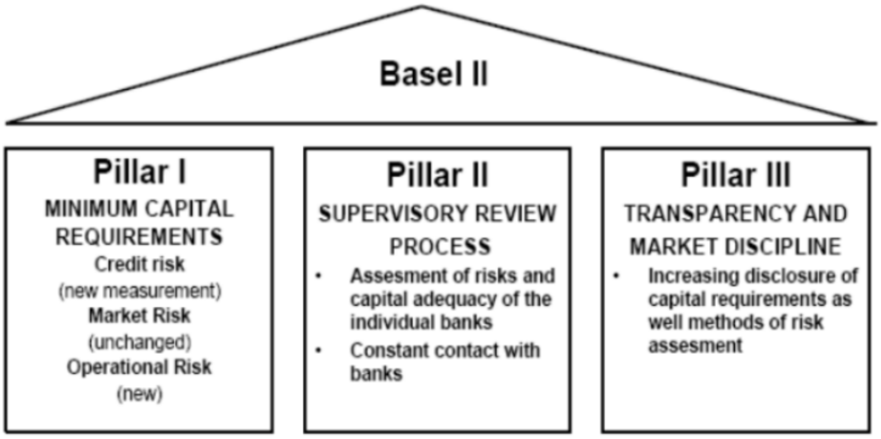
Endogenous triggers are to be found in the elements of the financial system and concern any scenario according to which the probability of ruin of at least one company increases drastically or the operation of important markets or infrastructures is in question.

Based on their causes and propagation mechanisms, systemic events can also occur after such i.e. and such in a broader sense be distinguished. A systemic event i.e. is idiosyncratic, i.e. bad news (up to the point of collapse) of a financial institution or market severely affects other financial companies or markets through domino effects or chain reactions.

With a systemic shock in a broader sense (also "systematically") a large number of financial institutions or markets are simultaneously severely affected; the effects are usually increased by feedback. each other and cause further negative reactions. A systematic shock can result from a systemic event i.e. arise (source)

Three pillar approach of European banking supervision of Basle II

Figure 54: Three pillar model of Basle II



Source: Elaborated based on BCBS128 from Basle II and (Do et al., 2019)

This model, created in 2004 ("International Convergence of Capital Measurement and Capital Standards") by BCBS128 of BIS, is currently practiced and is often mentioned in this dissertation. Pillars II and III are frequently endeavoured.

Evolution, Disruption and Revolution

These three terms are used together in this dissertation. Evolution and revolution are to be understood as the lower and upper limits of organizational changes. The disruption is midway between the two. What is meant by this is an organizational change stronger than a slow, preserving evolution, but not as radical as a revolution.

“The term evolution is used to describe prolonged periods of growth where no major upheaval occurs in organization practices.” (Greiner, 1989)

Disruption in the sense of organizational change in this work refers to significant technological breakthroughs. The effects of this force the complete revision and strategic realignment of the existing *business model*. Incumbent companies, however, have the chance to continue to exist through sage business policy setting (Valenduc et al., 2017).

“The term revolution is used to describe those periods of substantial turmoil in organization life.” (Greiner, 1989)

Universal banks versus special banks

Universal banks represent a significant subset of a complete financial system. An entire financial system in the narrower sense comprises financial markets, financial intermediaries, payment, and securities settlement systems.

In a broader sense, the structure of financial market supervision and the legal framework, including accounting rules, are also comprised. According to CRR Art.4(27) includes the term *financial intermediaries* domestic and foreign banks, insurance companies and other financial institutions. Depending on the special perspective, there are different approaches to categorizing the credit institutions of a country (NCAs (DACH Countries)) versus ECB).

A *universal bank* is an institution that operates all or almost all typical banking operations. CRR Art.4(1) defines the two terms "*credit institution*" and "*investment firm*". The former are companies that take deposits or other repayable funds on the liabilities side and grant them on the assets side in the form of loans.

The latter are delimited in the form of a negative definition. Despite the existence of legal approaches to the design of separation banking systems (AbschirmSanG Gesetz zur Abschirmung von Risiken und zur Planung der Sanierung und Abwicklung von Kreditinstituten und Finanzgruppen v 7.8.2013, BGBl I 2013, 3090, short form Trennbankengesetz), the trend toward the universal banking system dominates worldwide. (Universalbankensystem in Europa OECB 1992 banks under stress)

The term *special bank* describes banks with special fields of activity and serves to distinguish them from the *universal banks*. *Special banks* include real-estate banks, building societies, banks with special tasks and other *special banks*. Real-estate credit institutions such as mortgage banks provide long-term loans for the construction of real estate or for the financing of public projects. In addition, there are credit institutions with special tasks (e.g. KfW Kreditanstalt für Wiederaufbau).

Use case

Use cases are tools to capture the requirements of systems, that is, to determine what systems should do. Key concepts that are specified in this section are actors, use cases and subjects.

Each subject of a use case represents a system to which the use case can be applied. Users and other systems that can interact with a subject are represented by actors.

A use case is the specification of behaviour. An instance of a use case refers to the occurrence of the associated event. Such instances are often described through interactions (Kowarschick et al., 1997).

Value chain of a bank

Value Chain (internal view, practical implementation of a *business model*) is the term used to describe all stages of a work process, ultimately providing the customer with a product or service from conception through production (Pietrobelli and Staritz, 2018). At the end of this process, there should be added value (surplus) both from the perspective of the buyer and the supplier (Gereffi et al., 2005).

Glossary of acronyms and abbreviations.

Glossary of acronyms and abbreviations.

Abbreviation	Meaning
A	
ABS	Asset Backed Securities.
AD	Anno Domini.
AE	Advanced economies.
AI	Artificial Intelligence.
AMA	Advanced Measurement Approach (Regulatory Operational Risk).
ANOVA	Analysis of Variance (Fisher).
API	Application Programming Interfaces.
AR	Augmented reality.
AR	Application Requirement (Chap. 6.2).
AT1	Additional Tier1 (regulatory own capital position).
ATM	Automated Teller Machine.
B	
BaFin	German Federal Financial Supervisory Authority.
BAT	Baidu, Alibaba and Tencent (Asian bigtechs).
BC	Before Christ.
BCBS	Basel Committee on Banking Supervision.
BCT	Block chain technology.
BDE	Banco de España.
BilMoG	Bilanzrechtsmodernisierungsgesetz.
BilRuG	Bilanzrechtsumsetzungsgesetz.
BIP	Bruttoinlandsprodukt (=>GDP).
BIS	Bank for International Settlement.
BLUE	Best Linear Unbiased Estimator.
bn	billion.
BRRD	Bank recovery and resolution directive.
BSI	Bundesamt für Sicherheit in der Informationstechnik.
BSI	Federal Office for Information Security.
BuBa	Dt. Bundesbank.
C	
CAT Bond	Catastrophe Bond.
CAPM	Capital Asset Pricing Model.
CB	Crunchbase (Database Provider).
CBRC	China Banking Regulatory Commission.
CCP	Central Counterparty (Clearing).
CDO	Collateralized Debt Obligation.
CET1	Core Equity Tier 1.
CFGS	BIS Committee on the Global Financial System.
CGU	Cash Generating Unit.

CIO	Chief Information Officer.
CIR	Cost Income Ratio.
CITIC	China International Trust and Investment Corporation.
CODM	Chief Operative Decision Maker.
COVID-19	Coronavirus disease 2019.
CZ	Czech Republic.

D

DACH	DACH Countries are Germany, Austria, Swiss.
DESI	Digital Economy and Society Index (EU Commission).
DFS	New York State Department of Financial Services.
DK	Danmark.
DLT	Distributed Ledger Technology (Blockchain).
DOJ	US Department of Justice.
DPR	Data Protection Regulation (EU Commission).
D-SIB	Domestic Systemically Important Bank.

E

EBA	European Banking Authority.
EBITDA	Earnings before interest taxes depreciation and amortisation (pro forma revenue figure).
EBSCO	Elton B. Stephens Company.
ECB	European Central Bank.
ECFR	European Council on Foreign Relations.
EIB	European Investment Bank.
eIDAS	electronic Identification, Authentication, and trust Services.
EEA	European Economic Area.
EMAE	Europe most attractive employer.
EMDE	Emerging markets and developing economies.
ENISA	European Network and Information Security Agency.
ESMA	European Securities and Markets Authority.
EU	European Union (28 member states).
EUCLID	European Centralised Infrastructure for Supervisory Data.
EUR	Euro.
EY	Ernst & Young.

F

FATCA	US Foreign Account Tax Compliance Act (2010).
FI	Finland.
FIA	Fédération Internationale de l'Automobile.
FOMC	US Federal Open Market Committee.
FSB FIN	Financial Stability Board.

G

G20	G20 is hosted by the precidential member contries of the corresponding year (e.g. 2020 Riad); prepared by sherpa's of the gouvernment.

GAAP	Generally Accepted Accounting Principles.
GAFA	Google, Apple, Facebook, Amazon (American bigtechs).
GbR	Gesellschaft bürgerlichen Rechts.
GDP	Gross domestic product (=>BIP).
GFC	Global Financial Crisis.
GP	Grand Prix.
G-SIB	Global Systemically Important Bank.
G-SIFI	Global Systemically Important Financial Institutions.
G-SII	Global Systemically Important Institutions.

H

HGB	Dt. Handelsgesetzbuch (German Commercial Law).

I

IaaS	Infrastructure as a Service (Cloud Computing).
IAS	International Accounting Standards.
IASB	International Accounting Standards Board.
IASC	International Accounting Standards Committee.
IBM	International Business Machines Corporation (Armonk, New York).
ICO	Initial Coin Offering.
ICS	Internal Control System.
IFI	International Financial Institution.
IFRS	International Financial Reporting Standards.
IMF	International Monetary Fund.
IOSCO	International Organization of Securities Commissions.
IoT	Internet of things.
IPO	Initial Public Offering.
IR	Investor Relations.
InstitutsVergV	Institutsvergütungsverordnung.

J

JRC-IPTS	Joint Research Centre-Institute for Prospective Technological Studies.
JSTOR	Journal STORage.

K

KonTraG	Gesetz zur Kontrolle und Transparenz im Unternehmensbereich.
KPMG	Peat Marwick International (PMI) +Klynveld Main Goerdeler (KMG) (1987)
KWG	Kreditwesengesetz.
KYC	Know Your Customer.

L

LAN	Local Area Network.
LCR	Liquidity coverage ratio.
LSI	Less Significant Institutions.
LV	Latvia.

M	
MaRisk	Minimum Requirements for Risk Management.
MFI	Monetary Financial Institution.
MiFID II	Markets in Financial Instruments Directive II (Directive 2014/65/EU).
ML	Machine Learning.
MR	Mixed Reality.
ms	Milliseconds.
N	
NASA	National Aeronautics and Space Administration.
NASDAQ	National Association of Securities Dealers Automated Quotations exchange.
NCA	National Competent Authority (see NCB).
NCB	National Central Bank.
NIST	National Institute of Standards and Technology (U.S. Department of Commerce).
NL	The Netherlands.
O	
OECD	Organisation for Economic Corporation and Development.
OHG	Offene Handelsgesellschaft.
O-SII	Other Systemically Important Institutions.
P	
P1R	Pillar 1 Requirements.
P2G	Pillar 2 Guidance.
P2P	Peer-to-peer.
P2R	Pillar 2 Requirements.
PaaS	Platform as a Service (Cloud Computing).
PEST	Political, Economic, Social-cultural and Technological factors.
PESTEL	Political, Economic, Social-cultural, Technological, Environmental and Legal factors.
POS	Point of sale.
PoS	Proof of Stake.
PoW	Proof of Work.
PSD II	Payment Services Directive II (EU Directive 2015/2366 of 25th November 2015).
PWC	Price Waterhouse Coopers
R	
RechKredV	Kreditinstituts-Rechnungslegungsverordnung.
RESET-Test	REgression Specification Error Test.
RIC	Reuters Instrument Code.
RMB	Renminbi.
RPA	Robotic Process Automation.
RSA	Rivest–Shamir–Adleman algorithm for asymmetric encryption and decryption. asymmetric cryptographic algorithm.
RWA	Risk Weighted Assets.

S	
SaaS	Software as a Service (Cloud Computing).
SC	surface-code (cycles).
SE	Sweden.
SEHK	Stock Exchange of Hong Kong.
SI	Significant Institutions.
SK	Slovakia.
SOX	Sarbarnes-Oxley-Act (US 2002 as reaction to Enron balance scandal).
SRB	Single Resolution Board (Brussels).
SREP	Supervisory Review and Evaluation Process.
SRMR	Single resolution mechanism regulation.
SSM	Single Supervisory Mechanism.
SSRN	Social Science Research Network.
SWIFT	Society for Worldwide Interbank Financial Telecommunication.
SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis.
T	
TLAC	Total Loss-Absorbing Capacity.
TLoD	Three-lines-of-defence model (compliance).
TLTRO	targeted longer-term refinancing operations.
TSCR	Total SREP capital requirements.
U	
UG	Unternehmergesellschaft (haftungsbeschränkt).
USD	United States Dollar.
US-GAAP	US Generally Accepted Accounting Principles.
V	
VaR	Value at Risk.
VIF	Variance Infaltion Factors.
VR	Virtual reality (part of XR).
W	
WoS	Web of Science.
X	
XR	Extended Reality.

Appendices.

Table of contents of the appendix

Table 68: Overview of appendices.

Source: Own elaboration.

Annex I. List of G-SIBs as of 11/2019.

(used in chapter 2.2)

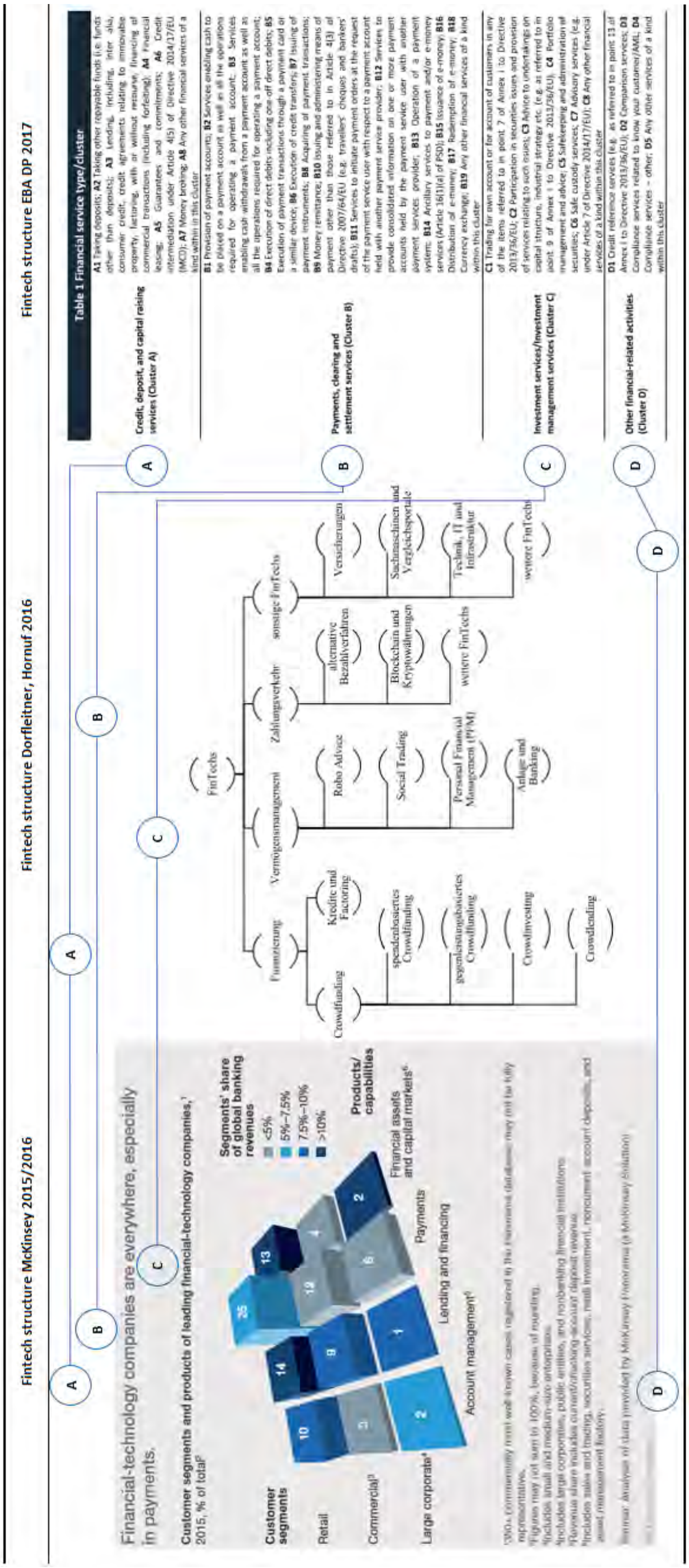
Bucket	-SIBs in alphabetical order within each buck	GAAP of external reportin	Reporting CC	Headquarter	Supervisor	Auditor
5 **(3.5%)**	(Empty)					
4 **(2.5%)**	JP Morgan Chase	US-GAAP	USD	New York	FRB OCC CFPB	PwC
3 **(2.0%)**	Citigroup	US-GAAP	USD	New York	FRB OCC CFPB	KPMG
	HSBC	IFRS	USD	London	OCC PRA FCA	PwC
2 **(1.5%)**	Bank of America	US-GAAP	USD	New York	FRB OCC FDIC	PwC
	Bank of China	IFRS CAS	Renminbi	Beijing	NCB	E&Y
	Barclays	IFRS	GBP	London	PRA FCA	PwC
	BNP Paribas	IFRS	EUR	Paris	ECB	PwC Deloitte Mazars
	Deutsche Bank	IFRS	EUR	Frankfurt a.M.	ECB	E&Y
	Goldman Sachs	US-GAAP	USD	New York	FRB	PwC
	Industrial and Commercial Bank of China	IFRS PRC GAAP	Renminbi	Beijing	NCB	KPMG
	Mitsubishi UFJ FG	JGAAP US-GAAP	Yen	Tokyo	NCB FSA	Deloitte
	Wells Fargo	US-GAAP	USD	San Francisco	FRB OCC	KPMG
1 **(1.0%)**	Agricultural Bank of China	CAS IFRS	Renminbi	Beijing	NCB	PwC
	Bank of New York Mellon	US-GAAP 1 Non-GAAP financial measures	USD	New York	FDIC OCC SEC CFTC	KPMG
	China Construction Bank	IFRS PRC GAAP	Renminbi	Beijing	State Council of the PRC	PwC
	Credit Suisse	US-GAAP	CHF	Zürich	FINMA	KPMG
	Groupe BPCE	IFRS	EUR	Paris	ECB ACPR	PwC Deloitte Mazars
	Groupe Crédit Agricole	IFRS	EUR	Paris	ECB ACPR	PwC E&Y
	ING Bank	IFRS	EUR	Amsterdam	ECB	KPMG
	Mizuho FG	JGAAP US-GAAP	Yen	Tokyo	NCB	E&Y
	Morgan Stanley	US-GAAP	USD	New York	FRB	Deloitte
	Royal Bank of Canada	IFRS	CAD	Toronto	FDIC	PwC
	Santander	IFRS	EUR	Madrid	ECB	PwC
	Société Générale	IFRS	EUR	Paris	ECB	E&Y Deloitte
	Standard Chartered	IFRS	USD	London	PRA	KPMG
	State Street	US-GAAP	USD	Boston	FRB FDIC	E&Y
	Sumitomo Mitsui FG	JGAAP IFRS	Yen	Tokyo	FIEA DIC	KPMG
	Toronto Dominion	GAAP IFRS	CAD	Toronto	OCC FRB CFPB	E&Y
	UBS	IFRS	CHF	Zürich	FINMA	E&Y
	UniCredit	IFRS	EUR	Frankfurt a.M.	ECB	Deloitte & Touche SpA

ACPR	Autorité de Contrôle Prudentiel et de Résolution
CFPB	Consumer Financial Protection Bureau
DIC	Deposit Insurance Corporation of Japan
FCA	Financial Conduct Authority
FDID	Federal Deposit Insurance Corporation
FI	Swedish Financial Supervisory Authority
FIEA	Financial Instruments and Exchange Act of Japan
FINMA	Swiss Financial Market Supervisory Authority
FRB	Federal Reserve Board
FSA	Financial Services Agency
OCC	Office of the Comptroller of the Currency (US)
PRA	Prudential Regulation Authority

Source: Own elaboration based on (FSB 2019).

Annex II. Fintech structure.

(used in chapter 4.1)



Source: Own elaboration based on (McKinsey&Company, 2016; Dorfleitner et al., 2016; EBA, 2017).

Annex III. Bank license of Commerzbank (used in chapters 2.1, 4.1)

List of Banking Services of Commerzbank AG approved by BaFin.

Company

COMMERZBANK Aktiengesellschaft

Type:
CRR-Kreditinstitut

Kaiserstraße 16 (Kaiserplatz)

60311 Frankfurt am Main
Deutschland

ID:
100005

Dispute resolution entity:
Ombudsmann der privaten Banken beim Bundesverband deutscher Banken
www.bankenombudsmann.de

Authorisations/activities	Date issued	End effective as of	Reason for end
Abschlußvermittlung (§ 1 Abs. 1a Satz 2 Nr. 2 KWG)	01.01.1998		
Anlageberatung (§ 1 Abs. 1a Satz 2 Nr. 1a KWG)	01.11.2007		
Anlagevermittlung (§ 1 Abs. 1a Satz 2 Nr. 1 KWG)	01.01.1998		
Anlageverwaltung (§ 1 Abs. 1a Satz 2 Nr. 11 KWG)	26.03.2009		
Depotgeschäft (§ 1 Abs. 1 Satz 2 Nr. 5 KWG)	10.07.1961		
Diskontgeschäft (§ 1 Abs. 1 Satz 2 Nr. 3 KWG)	10.07.1961		
Drittstaateneinlagenvermittlung (§ 1 Abs. 1a Satz 2 Nr. 5 KWG)	01.01.1998		
E-Geld-Geschäft (§ 1 Abs. 1 Satz 2 Nr. 11 KWG)	01.07.2002	30.04.2011	Inkrafttr. d. Gesetzes z. Umsetzung d. 2. E-GeldRL
Eigengeschäft (§ 1 Abs. 1a Satz 3 KWG)	01.11.2007	31.12.2010	Ende nach Art 1 des CRD II-Umsetzungsgesetzes
Eigengeschäft (§32 Abs. 1a KWG)	31.12.2010		
Eigenhandel (§ 1 Abs. 1a Satz 2 Nr. 4 KWG)	01.01.1998		
Einlagengeschäft (§ 1 Abs. 1 Satz 2 Nr. 1 KWG)	10.07.1961		
Emissionsgeschäft (§ 1 Abs. 1 Satz 2 Nr. 10 KWG)	01.01.1998		

Authorisations/activities	Date issued	End effective as of	Reason for end
Entgegennahme von Einlagen (Nr. 1)	01.09.2000		
Factoring (§ 1 Abs. 1a Satz 2 Nr. 9 KWG)	25.12.2008		
Finanzierungsleasing (§ 1 Abs. 1a Satz 2 Nr. 10 KWG)	25.12.2008		
Finanzkommissionsgeschäft (§ 1 Abs. 1 Satz 2 Nr. 4 KWG)	10.07.1961		
Finanzportfolioverwaltung (§ 1 Abs. 1a Satz 2 Nr. 3 KWG)	01.01.1998		
Finanztransfergeschäft (§ 1 Abs. 1a Satz 2 Nr. 6 KWG)	01.01.1998	31.10.2009	Ende nach Art 2 Zahlungsdiensteumsetzungsgesetz
Garantiegeschäft (§ 1 Abs. 1 Satz 2 Nr. 8 KWG)	10.07.1961		
Geldkartengeschäft (§ 1 Abs. 1 Satz 2 Nr. 11 KWG a.F.)	01.01.1998	30.06.2002	Ende nach § 64f KWG (4. FMFG)
Girogeschäft (§ 1 Abs. 1 Satz 2 Nr. 9 KWG)	10.07.1961	30.10.2009	Ende nach Art 2 Zahlungsdiensteumsetzungsgesetz
Kreditgeschäft (§ 1 Abs. 1 Satz 2 Nr. 2 KWG)	10.07.1961		
Kreditkartengeschäft (§ 1 Abs. 1a Satz 2 Nr. 8 KWG)	01.07.2002	31.10.2009	Ende nach Art 2 Zahlungsdiensteumsetzungsgesetz
Netzgeldgeschäft (§ 1 Abs. 1 Satz 2 Nr. 12 KWG a.F.)	01.01.1998	30.06.2002	Ende nach § 64f KWG (4. FMFG)
Organisiertes Handelssystem (OTF) (§ 1 Abs. 1a Satz 2 Nr. 1d KWG)	03.01.2018	30.07.2018	Rückgabe / Aufgabe
Pfandbriefgeschäft (§ 1 Abs. 1 Satz 2 Nr.1a KWG) Hypothekenpfandbriefe	08.10.2013		
Pfandbriefgeschäft (§ 1 Abs. 1 Satz 2 Nr.1a KWG) Öffentliche Pfandbriefe	21.05.2012		
Pfandbriefgeschäft (§ 1 Abs. 1 Satz 2 Nr.1a KWG) Schiffspfandbriefe	21.05.2012	31.05.2017	Rückgabe / Aufgabe
Platzierungsgeschäft (§ 1 Abs. 1a Satz 2 Nr. 1c KWG)	01.11.2007		
Revolvinggeschäft, sog. (§ 1 Abs. 1 Satz 2 Nr. 7 KWG)	10.07.1961		
Scheck- u. Wechseleinzugs- u. Reisescheckgeschäft (§ 1 Abs. 1 Satz 2 Nr. 9 KWG)	31.10.2009		
Sortengeschäft (§ 1 Abs. 1a Satz 2 Nr. 7 KWG)	01.01.1998		

Source:https://portal.mvp.bafin.de/database/InstInfo/institutDetails.do?cmd=loadInstitutAction&institutId=100005

Annex IV. Bank license of *fintech* N26. (used in chapter 4.1)

List of Banking Services of N26 GmbH approved by BaFin.

Company

N26 Bank GmbH

Type: CRR-Kreditinstitut

Klosterstraße 62
10179 Berlin
Deutschland

ID: 145827

Dispute resolution entity:

Authorisations/activities	Date issued	End effective as of	Reason for end
Abschlußvermittlung (§ 1 Abs. 1a Satz 2 Nr. 2 KWG)	18/07/2016		
Anlagevermittlung (§ 1 Abs. 1a Satz 2 Nr. 1 KWG)	18/07/2016		
Eigengeschäft (§32 Abs. 1a KWG)	18/07/2016		
Einlagengeschäft (§ 1 Abs. 1 Satz 2 Nr. 1 KWG)	18/07/2016		
Kreditgeschäft (§ 1 Abs. 1 Satz 2 Nr. 2 KWG)	18/07/2016		
Organisiertes Handelssystem (OTF) (§ 1 Abs. 1a Satz 2 Nr. 1d KWG)	03/01/2018	10/10/2018	Rückgabe / Aufgabe

Source:https://portal.mvp.bafin.de/database/InstInfo/institutDetails.do?cmd=loadInstitutAction&institutId=145827

Annex V. Banks' *fintech* partnerships. (used in chapter 4.1, 4.3 and 5)

Cooperations of European Universalbanks with fintechs						
Universal Banks	**Sources**	**Document page**	**Cooperation with fintechs**	**Cooperation partner**	**Kind of cooperation**	**Webpages of cooperation partner**
Belfius Banque SA	https://www.belfius.be/about-us/dam/corporate/investors/ratios-en-rapporten/belfius-reports/en/bel_RA2019_eng.pdf	21, 80, 84	✓	Jane insurtech	Investment&Incubator	https://www.jane.be/en/about-us
KBC Groep NV	https://www.kbc.com/content/dam/kbccom/doc/investor-relations/Results/JVS-2019/JVS_2019_GRP_en.pdf	20, 47	✓	Start it @KBC	Incubator	https://startit.be/
Deutsche Bank	https://www.deutsche-bank.de/pfb/content/unternehmerwissen_was-dieses-innovation-lab-startups-zu-bieten-hat.html		✓	Deutsche Bank Innovation Labs, Finanzguru, TrustBills, Hausgold	Investment&Incubator	https://labs.db.com/de/wer-wir-sind.html https://finanzguru.de/ https://www.trustbills.com/
Commerzbank	https://www.gruenderszene.de/galerie/bankenbeteiligungen?pid=16593		✓	Main Incubator, Commerz Ventures & OptioPay,	Investment&Incubator	https://main-incubator.com/ https://www.commerzventures.com/ https://www.optiopay.com/
Swedbank AS	https://internetbank.swedbank.se/ConditionsEarchive/download?bankid=1111&id=WEBDOC-PRODE53581973	4, 5, 42	✓	Minna Technologies, Kaching Retail fintech	Investment	https://minnatechnologies.com/ https://www.kachingretail.com/
AS SEB Bank	https://sebgroup.com/siteassets/investor_relations1/annual_reports/annual_report_2019.pdf	18, 68	✓	Tink	Investment	https://tink.com/
Bank of Ireland	https://www.bankofireland.com/about-bank-of-ireland/press-releases/2017/bank-ireland-partners-worldfirst-launch-international-payments-		✓	WorldFirst, Bank of Ireland Innovation Lab	Investment&Incubator	https://www.worldfirst.com/us/
Allied Irish Banks plc	https://aib.ie/content/dam/aib/investorrelations/docs/resultscentre/annualreport/aib-group-plc-annual-financial-report-2019.pdf	12	✓	PayZone	Investment	https://www.payzone.co.uk/consumers/
National Bank of Greece	https://www.bankofgreece.gr/en/main-tasks/supervision/fintech-innovation-		✓	FinTech Innovation Hub	Incubator	https://www.bankofgreece.gr/en/useful-links/fintech-form
Alpha Bank	https://www.finquest.gr/competition/		✓	Alpha Bank FinQuest	Event	https://www.finquest.gr/
Banco Santander	https://www.santander.com/content/dam/santander-com/en/documentos/informe-anual/2019/ia-2019-annual-report-en.pdf	63, 338	✓	Santander InnoVentures, Klar, Trulioo, Securitize	VentureCapitalFund	https://santanderinnoventures.com/ https://www.klar.mx/ https://www.trulioo.com/ https://www.securitize.io/
BBVA	https://www.bbva.com/en/bbva-and-anthemis-partner-to-build-the-next-generation-of-financial-services-startups/		✓	startup studio in London with Anthemis, - BBVA Open Talent competition	Incubator	https://openinnovation.bbva.com/en/open-talent
BNP Paribas	https://group.bnpparibas/en/news/fintech-bank-collaboration-bnp-paribas-active-europe		✓	BNP Paribas Capital Partner, WeAre Innovation: major BNP Paribas innovation hub	Incubator	https://capitalpartners.bnpparibas.com/
Société Générale	https://www.societegenerale.com/en/digital-and-innovation/innovative-services/bank-fintech-partnerships		✓	Societe Generale Ventures, Treezor	VentureCapitalFund	https://openinnovation.societegenerale.com/
Unicredit Group	https://www.unicreditgroup.eu/en/unicredit-at-a-glance/innovation/unicreditevo.html		✓	UniCredit EVO	Incubator	https://www.unicreditgroup.eu/en/unicredit-at-a-glance/innovation/unicreditevo.html
Gruppo Intesa-Sanpaolo	https://group.intesasanpaolo.com/content/dam/portalgroup/repository-document/investor-relations/bilanci-relazioni-en/2019/20200402_Bilanci_2019_uk.pdf	44	✓	Yolo, BackToWork24, Diamanti, MatiPay	Investment	https://yolo-insurance.com/ https://www.backtowork24.com/ https://www.matipay.com/en/
Bank of Cyprus Plc	/https://www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/cyprus		Ø	Universities, Regulator, Banks as well as Hackaton	Event	
Hellenic Bank Plc	/https://www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/cyprus		Ø	Universities, Regulator, Banks as well as Hackaton	Event	

Cooperations of European Universalbanks with fintechs

Universal Banks	Sources	Document page	Cooperation with fintechs	Cooperation partner	Kind of cooperation	Webpages of cooperation partner
AS DNB banka	https://vp267.alertir.com/afw/files/press/dnb_asa/202003043677-1.pdf	34, 61	✓	DNB AXT Accelerator	Event	
Citadele banka	https://www.fintechnews.org/citadele-bank-starts-cooperation-with-fintech-startup-sme-finance-in-lithuania/		✓	SME Finance fintech	Investment	https://www.smefinance.eu/
AB SEB bankas			Ø		Investment	
AB DNB bankas			Ø		Investment	
Deutsche Bank Luxembourg S.A.			Ø		Investment	
Société Générale Bank & Trust S.A.			Ø		Investment	
Bank of Valletta Group (BOV)	https://www.bovfundservices.com/News/bank-of-valletta-discusses-distributed-ledger-technologies-in-		Ø	DLT Investment	Investment	
HSBC Bank Malta plc (HSBC)			Ø		Investment	
ING-DIBA	https://www.ing.com/About-us/ING-Ventures.htm		✓	ING Ventures ,Fincompare	VentureCapitalFund	https://fincompare.de/ https://www.ing.com/About-us/ING-Ventures.htm
ABN AMRO Bank N.V.	https://www.abnamro.com/en/newsroom/blogs/hugo-bongers/2018/fintech-from-threat-to-ally.html		✓	Digital Impact Fund, Tink,	VentureCapitalFund	https://www.abnamro.com/en/about-abnamro/in-society/innovation/abnamro-ventures/index.html https://tink.com/
Erste Group Bank	https://www.handelsblatt.com/finanzen/banken-versicherungen/fintech-erste-group-bank-will-mit-online-plattform-george-neue-wege-gehen/v_detail_tab_print/22594586.html		✓	Onlineplatform George	Investment&Incubator	
Raiffeisenbank International	https://elevator-lab.com/	55	✓	Elevator Lab fintech partnership program, Elevator Ventures, kompany	Incubator	https://www.elevator-ventures.com/ https://elevator-lab.com/
Caixa Geral de Depósitos	https://www.caixabank.com/comunicacion/noticia/caixabank-and-the-international-platform-plug-and-play-create-a-programme-to-start-up-collaboration-programme-to-boost-innovation-in-fintech-		✓	collaboration program with plug and play	Incubator	
Banco Comercial Português	https://ind.millenniumbcp.pt/en/Institucional/sustentabilidade/Pages/2018/bank-millennium-abre-centro-de-coworking.aspx		✓	coworking centre for startups	Incubator	
NLB (Nova Ljubljanska banka)			Ø		Investment	
SID			Ø		Investment	
Všeobecná úverová banka			Ø		Investment	
Československá obchodná banka	https://www.csob.cz/portal/documents/10710/550083/ar-csob-2019.pdf	31	✓	Start it @ ČSOB acceleration program	Incubator	https://startit.csob.cz/
Nordea Bank Finland Plc	https://www.nordea.com/en/press-and-news/news-and-press-releases/news-en/2018/nordea-invests-in-fintech-crediwire.html	4	✓	CrediWire, Nordea StartUp accelerator	Investment&Incubator	https://crediwire.com/de/company.html https://nestholma.com/collaboration-programs/nordea-startup-accelerator/
Danske Bank Plc	https://danskebank.com/news-and-insights/news-archive/news/2019/15032019		✓	Danske Bank Growth, Lighthouse fintech	Investment&Incubator	https://danskebank.com/growth https://mclighthouse.com/
HSBC	https://fintech-alliance.com/news-insights/article/2580/hsbc-partners-with-fintech-for-digital-lending/banking		✓	Bud, Amount	Investment	https://thisisbud.com/ https://www.amount.com/
Barclays	https://home.barclays/who-we-are/innovation/barclays-accelerator/		✓	Barclays accelerator, Barclays Eagle Labs UK	Incubator	https://home.barclays/who-we-are/innovation/barclays-accelerator/

Source: Own elaboration based on annual IFRS group financial statements as of 31st December 2019 or press releases.

Annex VI. Banks' fintech investments.

(used in chapter 4.1)

	Rank	Blockchain	Data Analytics	Personal Finance	Wealth Management	Capital Markets Software	Lending	Payments & Settlement	Regulatory Technology
Santander	1	Digital Asset, elliptic, ripple, R3	visible alpha	Curve	ROOSTIFY, SIGFIG	personetics, TRADESHIFT	AutoFi, [illegible], Kabbage	payever, PAYJOY, PayKey, iZettle, MyCheck	SOCURE
Credit Suisse	2	R3	Dataminr		canopy	SYMPHONY, iCapital	WeLab, PROSPER		ACADIASOFT, Digital Reasoning
UBS	3	Digital Asset, R3	visible alpha		SIGFIG	SYMPHONY, iCapital	[illegible]		ACADIASOFT
BARCLAYS	4	R3				SYMPHONY, OpenExchange, CURVEGLOBAL		FORM3	Digital Reasoning, Cloud9
BBVA	5	R3		[illegible], Atom, saveup, DESTACAME.cl				sumup	
BNP PARIBAS	5	R3				SYMPHONY, CURVEGLOBAL		[illegible]	Digital Reasoning, ACADIASOFT
HSBC	5	R3	visible alpha, quantexa			TRADESHIFT			ACADIASOFT, kyriba
Deutsche Bank	8	R3				TrustBills, SYMPHONY		[illegible]	ACADIASOFT
SOCIETE GENERALE	8	R3				ERIS, SYMPHONY		TagPay	ACADIASOFT
ABN·AMRO	8	Digital Asset		[illegible], tink			CLOUD LENDING SOLUTIONS		[illegible]
ING	8	R3					[illegible], WeLab, Kabbage	twisto	
CRÉDIT AGRICOLE	12	SETL		Linxo					
RBS	13	R3							
UniCredit	13	R3							

Source: Elaboration based on (CBInsights, 2018).

Annex VII. *Bigtechs' business models.* (used in chapter 4.3)

GAFA

BUSINESS SUMMARY

Alphabet Inc. is a holding company. The Company's businesses include Google Inc. (Google) and its Internet products, such as Access, Calico, CapitalG, GV, Nest, Verily, Waymo and X. The Company's segments include Google and Other Bets. The Google segment includes its Internet products, such as Search, Ads, Commerce, Maps, YouTube, Google Cloud, Android, Chrome and Google Play, as well as its hardware initiatives. The Google segment is engaged in advertising, sales of digital content, applications and cloud offerings, and sales of hardware products. The Other Bets segment is engaged in the sales of Internet and television services through Google Fiber, sales of Nest products and services, and licensing and research and development (R&D) services through Verily. It offers Google Assistant, which allows users to type or talk with Google; Google Maps, which helps users navigate to a store, and Google Photos, which helps users store and organize all of their photos.

BUSINESS SUMMARY

Amazon.com, Inc. offers a range of products and services through its Websites. The Company's products include merchandise and content that it purchases for resale from vendors and those offered by third-party sellers. It also manufactures and sells electronic devices. It operates through three segments: North America, International and Amazon Web Services (AWS). Its AWS products include analytics, Amazon Athena, Amazon CloudSearch, Amazon EMR, Amazon Elasticsearch Service, Amazon Kinesis, Amazon Managed Streaming for Apache Kafka, Amazon Redshift, Amazon QuickSight, AWS Data Pipeline, AWS Glue and AWS Lake Formation. AWS solutions include machine learning, analytics and data lakes, Internet of Things, serverless computing, containers, enterprise applications, and storage. In addition, the Company provides services, such as advertising. It also offers Amazon Prime, a membership program that includes free shipping, access to streaming of various movies and television (TV) episodes.

BUSINESS SUMMARY

Facebook, Inc. is focused on building products that enable people to connect and share through mobile devices, personal computers and other surfaces. The Company's products include Facebook, Instagram, Messenger, WhatsApp and Oculus. Facebook enables people to connect, share, discover and communicate with each other on mobile devices and personal computers. Instagram enables people to take photos or videos, customize them with filter effects, and share them with friends and followers in a photo feed or send them directly to friends. Messenger allows communicating with people and businesses alike across a range of platforms and devices. WhatsApp Messenger is a messaging application that is used by people around the world and is available on a range of mobile platforms. Its Oculus virtual reality technology and content platform offers products that allow people to enter an interactive environment to play games, consume content and connect with others.

BUSINESS SUMMARY

Apple Inc. designs, manufactures and markets mobile communication and media devices, personal computers and portable digital music players. The Company sells a range of related software, services, accessories, networking solutions, and third-party digital content and applications. The Company's segments include the Americas, Europe, Greater China, Japan and Rest of Asia Pacific. The Americas segment includes both North and South America. The Europe segment includes European countries, India, the Middle East and Africa. The Greater China segment includes China, Hong Kong and Taiwan. The Rest of Asia Pacific segment includes Australia and the Asian countries not included in the Company's other operating segments. Its products and services include iPhone, iPad, Mac, iPod, Apple Watch, Apple TV, a portfolio of consumer and professional software applications, iPhone OS (iOS), OS X and watchOS operating systems, iCloud, Apple Pay and a range of accessory, service and support offerings.

Source: Elaboration based on Refinitiv (aof 5th May 2020).

BAT

BUSINESS SUMMARY

Baidu, Inc. is a Chinese language Internet search provider. The Company offers a Chinese language search platform on its Baidu.com Website that enables users to find information online, including Webpages, news, images, documents and multimedia files, through links provided on its Website. In addition to serving individual Internet search users, the Company provides a platform for businesses to reach customers. Its business consists of three segments: search services, transaction services and iQiyi. Search services are keyword-based marketing services targeted at and triggered by Internet users' search queries, which mainly include its pay-for-performance (P4P) services and other online marketing services. Its transaction services include Baidu Nuomi, Baidu Takeout Delivery, Baidu Maps, Baidu Connect, Baidu Wallet and others. iQiyi is an online video platform with a content library that includes licensed movies, television series, cartoons, variety shows and other programs.

BUSINESS SUMMARY

ALIBABA GROUP HOLDING LIMITED is a holding company that provides the technology infrastructure and marketing reach to help merchants, brands and other businesses to leverage the power of new technology to engage with users and customers to operate. The Company operates four business segments. The Core Commerce segment provides China retail, China wholesale, International retail, International wholesale, Cainiao logistics services and local consumer services through Taobao Marketplace and Tmall. The Cloud Computing segment provides complete suite of cloud services, including database, storage, network virtualization services, big data analytics and others. The Digital Media and Entertainment segment provides consumer services beyond the core business operations. The Innovation Initiatives and Others segment is to innovate and deliver new services and products.

BUSINESS SUMMARY

Tencent Holdings Limited is an investment holding company principally involved in the provision of value-added services (VAS) and online advertising services. The Company operates through three main segments. The VAS segment is mainly involved in provision of online/mobile games, community value-added services and applications across various Internet and mobile platforms. The Online Advertising segment is mainly engaged in display based and performance based advertisements. The Others segment is mainly involved in provision of payment related services, cloud services and other services.

Source: Elaboration based on Refinitiv (aof 5th May 2020).

Annex VIII. Questionnaire.

(used in chapter 5.7)

X answers Mainincubator (07.02.2019)

X answers Banco Santander (05.02.2019)

Blockchain Questionnaire Q1 2019 (used in chapter 5.6)

Since the time this questionnaire was drafted, at the beginning of 2019, the profitability of *universal banks* has been sometimes compared to the Bermuda Triangle, where profits have been steadily eroding. The three cornerstones of the triangle represent

- the low-interest-rate phase,
- changed customer behaviour and
- stricter post subprime crisis bank regulation.

This picture is underlined by the comparison of two key performance indicators RoE (return on equity) and CIR (cost income ratio) of European *universal banks* over the past 8 years (2010 to 2018), compared by country.

(cf. graph *Figure 1: CIR and RoE of the post subprime European universal banks.Figure 1: CIR and RoE of the post subprime European universal banks.*on page 7)

Data provided by Bloomberg

Against this backdrop, fintechs pose new challenges facing classic *universal banks*. The emergence of modern fintechs (end of the last decade) was encouraged by the above-mentioned developments.

Targeted investment in the new digital technologies could have a positive effect on the development of the CIR. From the multitude of fintech solution offerings, it is therefore necessary to filter out the technology that could point the way to a future with lower costs and higher yields.

The hypothesis to be refuted by this questionnaire is the intuitive assumption (environmental observations of the author) that blockchain technology (BT or DLT distributed ledger technology), with all its use cases, could offer this possibility to optimize the CIR.

For this reason, please answer the following questions as completely as possible. Your answers will be anonymized. You will not need more than 20 minutes of your valuable time to answer the 14 questions. To enable a statistical evaluation of the questions the provided answers are represented on a scale of 1 – 10 whereby 1 equals disapproval and 10 full approval. There are no wrong answers!

Question No.1

Do you agree that international *universal banks* are currently in the “Bermuda Triangle” due to persistently low interest rates, changing customer behaviour and increasing regulatory reporting requirements? (Please make only one tick).

Scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don’t know**
your choice								X	X		
scale value	disapproval				rather negative	rather positive				full approval	

Question No.2

Please rate the intensity of each corner of the triangle!

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don’t know**
low interest corner									X X		
customers‘ behaviour corner						X	X				
bank regulatory corner					X			X			
scale value	disapproval				rather negative	rather positive				full approval	

Question No.3

Do you agree that traditional *business models* need to be revised for revenue optimization?

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
your choice								X	X		
scale value	disapproval				rather negative	rather positive				full approval	

Question No.4

Do you agree that fintechs in the form of digital applications provide answers to the challenges asked for in question two?

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
your choice		X								X	
scale value	disapproval				rather negative	rather positive				full approval	

Question No.5

If your rating of question three is lower or equal 5, please describe very briefly your opinion as to what needs to be changed!

alternatives to reduce the CIR	**don't know**
The *business model* should not only be optimized but replaced. There is currently a lot of special business in the bank, which could be more standardized in this way and thus fully automated (payments on chain).	

Question No.6

If your rating of question three is higher than 5, please indicate in which cluster would you invest most, less, least and possibly not at all.

(structure according to EBA ((European Banking Authority) and FSB (Financial Stability Board))

cluster	**name**	**example**
A	funding	loan, deposit and capital raising services
B	investment	investment (management) services (robo advisory)
C	payments	payments, clearing and settlement services
D	others	other non-financial related activities (insurance)
E	blockchain based technology (BCT)	emission, collateral management, real time payments, digital central bank currency, regtech (real time regulatory reporting)

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
A. funding								X			
B. investment								X			
C. payments										X	
D. others							X				
E. BCT						X				X	
scale value	disapproval				rather negative	rather positive				full approval	

Question No.7

If your rating of cluster E (i.e. BCT blockchain based technologies as in question six) is higher than 5, in which of the following use cases would you invest most, less, least and possibly not at all.

(Please make only one tick).

scale	1	2	3	4	5	6	7	8	9	10	don't know
payments, especially cross-border payments								X		X	
stock exchange and share trading				X			X				
trade finance						X				X	
digital identity verification										X X	
bookkeeping and accounting		X				X					
syndicated lending					X			X			
credit reports		X			X						
hedge funds				X	X						
crowd funding (ICO)	X		X								
peer2peer transfers						X					
regtech		X									
scale value	disapproval				rather negative	rather positive				full approval	

(ICO = Initial Coin Offering)

Question No.8 (investment in an expected positive economic environment)

Imagine that you have € 100 m of free retained earnings at your disposal and that you can expect a further € 100 m earnings over each of the next 10 years. Assuming this scenario, please indicate the ranking of priority from highest to lowest in order to minimum maintain the current status of performance!

(Please make only one tick per row).

investment in t_0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
€ 100 m as retained earnings	X X										
funding				X				X			
investment						X	X				
payments		X						X			
others (e.g. non financial services like "work cafés" in branches where clients can work together, take a cup of coffee and having their bank counsellor nearby)					X						
other investment (i.e. not mentioned up to now)							X				

If you ticked the option "other investment" please describe it!

Creation of regulated financial infrastructures (platforms). Inclusion of regulatory aspects. Service provider for financial transactions.

Question No.9 (investment in an expected negative economic environment)

Imagine that you have € 100 m in free profit reserves at your own disposal. However, this time you gradually incur losses accumulating to - € 100 m over a period of ten years leaving your *business model* without change.

Assuming this scenario, please indicate the ranking of priority from highest to lowest in order to minimum maintain the current status of performance!

(Please make only one tick per row).

investment in t_0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
€ 100 m as retained earnings											
funding											
investment											
payments											
others											
other investment (i.e. not mentioned up to now)											

If you ticked the option "other investment" please describe it!

No clear answer possible.

Question No.10 (per BCT blockchain based technologies)

Which of these typical bank segments (see following table) would in your opinion benefit (in terms of CIR (cost income ratio)) most, less, least and probably not at all from blockchain technology?

(Please make only one tick per row).

scale / segment	1	2	3	4	5	6	7	8	9	10	don't know
private clients			X					X			
private clients (wealth management)				X							
corporates clients									X X		
investment-banking								X		X	
others (Finance, Legal, HR, Treasury)								X X			
others											
In case of others pls. name them briefly!	Process topics: HR processes; documentation; archiving										
scale value	disapproval				rather negative	rather positive				full approval	

Question No.11

Please go back to question number six, position E BCT (i.e. blockchain based technology).

If you indicated that BCT is uninteresting (i.e. disapproval or don't know), can you imagine an approach to escape from the "Bermuda Triangle"? Please describe your idea in a few words.

Alternatives to escape	**don't know**
./. ./.	

Question No.12

Do bigtechs (e.g. Google, Amazon, Facebook, Apple, Alibaba, Tencent) have a more disruptive potential than fintechs?

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
your choice									X		
scale value	disapproval				rather negative	rather positive				full approval	

Question No.13

In which areas do you think bigtechs have the greatest disruptive potential?

Please describe your idea in a few words.

Alternatives to escape	**don't know**
Payments, Loans, Identification	

Question No.14

Would you prefer the machine rather than humans?

(Please make only one tick).

scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**don't know**
your choice					X						
scale value	disapproval				rather negative	rather positive				full approval	

Contact--

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0171 8154706

Annex IX. Interesting answers to the questionnaire.

(used in chapter 5.7)

Block Chain Questionnaire

C contact.center@nbg.gr

An ALEXANDER KLAUS RUHL

Antworten | Allen antworten | Weiterleiten | ...

Mi 10.04.2019 12:26

Signiert von Probleme mit der Signatur. Klicken Sie auf die Signaturschaltfläche, um Details anzuzeigen.

Dear Mr Ruhl,

We appreciate your wish to draw data from the National Bank for your project.For over 175 years, National Bank has supported education and innovation through a series of initiatives, sponsorships and programs. Every information regarding the Bank, its policies and its operations is available and freely accessible at www.nbg.gr. In our website, you may find the information which we can provide you and that you might be interested in including in your project.

Thank you for contacting us.

Kind regards

ΕΘΝΙΚΗ ΤΡΑΠΕΖΑ /
NATIONAL BANK OF GREECE
CONTACT CENTER
Δ-ΝΣΗ ΨΗΦΙΑΚΩΝ ΚΑΝΑΛΙΩΝ/
DIGITAL CHANNELS DIVISION (021)
T: 18 18 18 / +30 210 48 48 48 4
F: +30 210 4806865
www.nbg.gr

Automatic reply: Block Chain Questionnaire

B barclays.ir@barclays.com

An ALEXANDER KLAUS RUHL

Antworten | Allen antworten | Weiterleiten | ...

Mi 10.04.2019 23:44

Wir haben zusätzliche Zeilenumbrüche aus dieser Nachricht entfernt.

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Complaints

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From the UK: 0800 282 390<tel:0800282390>0 From abroad: +44 (0)207 116 7488<tel:+44(0)2071167488>

Annex X. Moody's global rating scales. (used in chapter 5.6)

Global Long-Term Rating Scale

Aaa	Obligations rated Aaa are judged to be of the highest quality, subject to the lowest level of credit risk.
Aa	Obligations rated Aa are judged to be of high quality and are subject to very low credit risk.
A	Obligations rated A are judged to be upper-medium grade and are subject to low credit risk.
Baa	Obligations rated Baa are judged to be medium-grade and subject to moderate credit risk and as such may possess certain speculative characteristics.
Ba	Obligations rated Ba are judged to be speculative and are subject to substantial credit risk.
B	Obligations rated B are considered speculative and are subject to high credit risk.
Caa	Obligations rated Caa are judged to be speculative of poor standing and are subject to very high credit risk.
Ca	Obligations rated Ca are highly speculative and are likely in, or very near, default, with some prospect of recovery of principal and interest.
C	Obligations rated C are the lowest rated and are typically in default, with little prospect for recovery of principal or interest.

Note: Moody's appends numerical modifiers 1, 2, and 3 to each generic rating classification from Aa through Caa. The modifier 1 indicates that the obligation ranks in the higher end of its generic rating category; the modifier 2 indicates a mid-range ranking; and the modifier 3 indicates a ranking in the lower end of that generic rating category. Additionally, a "(hyb)" indicator is appended to all ratings of hybrid securities issued by banks, insurers, finance companies, and securities firms.*

Note: For more information on long-term ratings assigned to obligations in default, please see the definition "Long-Term Credit Ratings for Defaulted or Impaired Securities" in the Other Definitions section of this publication.

** By their terms, hybrid securities allow for the omission of scheduled dividends, interest, or principal payments, which can potentially result in impairment if such an omission occurs. Hybrid securities may also be subject to contractually allowable write-downs of principal that could result in impairment. Together with the hybrid indicator, the long-term obligation rating assigned to a hybrid security is an expression of the relative credit risk associated with that security.*

Global Short-Term Rating Scale

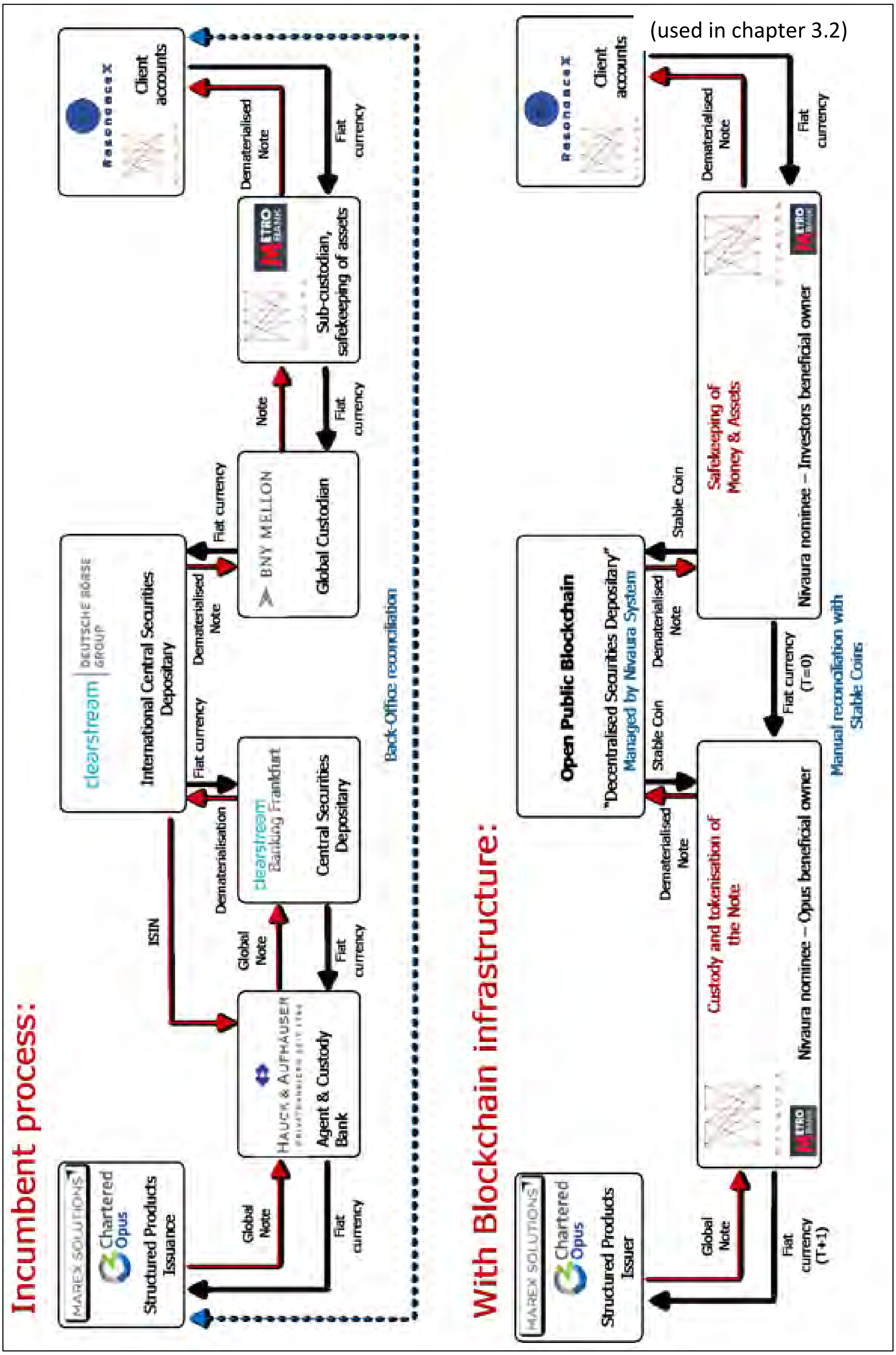
P-1	Issuers (or supporting institutions) rated Prime-1 have a superior ability to repay short-term debt obligations.
P-2	Issuers (or supporting institutions) rated Prime-2 have a strong ability to repay short-term debt obligations.
P-3	Issuers (or supporting institutions) rated Prime-3 have an acceptable ability to repay short-term obligations.
NP	Issuers (or supporting institutions) rated Not Prime do not fall within any of the Prime rating categories.

LONG-TERM RATING	SHORT-TERM RATING
Aaa, Aa1, Aa2, Aa3, A1, A2, A3	Prime-1
A2, A3, Baa1, Baa2	Prime-2
Baa2, Baa3	Prime-3
Ba1, Ba2, Ba3, B1, B2, B3, Caa1, Caa2, Caa3 Ca, C	Not Prime

Source: Representation based on (Moodys, 2020).

Annex XI. Issuance of a financial instrument via DLT.

(used in chapter 3.2)



Source: Elaboration based on https://chartered-opus.com/de/blockchain-emission-eines-strukturierten-wertpapiers/ (Chartered Opus, 2018)

Annex XII. Banks selected for quantitative analysis. (used in chapter 5.3)

Country code	Country	Financial institution	G-SIB or D-SIB/O-	International Securities Identification Number	RIC	Bloomberg Code	IFRS	CCY	Object Count	2010 FinTech 1	2011 FinTech 2	2012 FinTech 3	2013 FinTech 4	2014 FinTech 5	2015 FinTech 6	2016 FinTech 7	2017 FinTech 8	Dummy-variable FT	Dummy-variable FT
AT	Austria	Erste Group Bank	D-SIB	AT0000652011	ERST.VI	EBS AV	✓	EUR	1	0	0	0	0	0	0	1	1	2	0,2727273
AT	Austria	Raiffeisenbank International	D-SIB	AT0000606306	RBIV.VI	RBI AV	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
BE	Belgium	Belfius Banque SA	D-SIB	BE0002483585	BE0002483585	DEXB BB	✓	EUR	0	0	0	0	1	1	1	1	1	5	0,6363636
BE	Belgium	KBC Groep NV	D-SIB	BE0003565737	KBC.BR	KBC BB	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
CY	Cyprus	Bank of Cyprus Plc	D-SIB	IE00BD5B1Y92	BOCH.CY	BOCH LN	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
CY	Cyprus	Hellenic Bank Plc	D-SIB	CY0000300117	HBNK.CY	HB PZ	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
CZ	Czech Republic	Komercni Banka as	D-SIB	CZ0008019106	BKOM.PR	KOMB CP	✓	CZK	1	0	0	0	0	0	0	0	1	1	0,1515152
DE	Germany	Commerzbank	D-SIB	DE000CBK1001	CBKG.DE	CBK GR	✓	EUR	1	0	0	0	0	1	1	1	0	3	0,3939394
DE	Germany	Deutsche Bank	G-SIB	DE0005140008	DBKGN.DE	DBK GR	✓	EUR	1	0	0	0	0	1	1	1	1	4	0,5151515
DK	Denmark	Danske Bank Plc	D-SIB	DK0010274414	DANSKE.CO	DANSKE DC	✓	DKK	1	0	0	0	0	0	0	0	0	0	0,030303
EL	Greece	Alpha Bank	D-SIB	GRS015003007	ACBR.AT	ALPHA GA	✓	EUR	1	0	0	0	0	0	0	0	0	0	0,030303
EL	Greece	National Bank of Greece	D-SIB	GRS003003027	NBGR.AT	ETE GA	✓	EUR	1	0	0	0	0	0	1	1	1	3	0,3939394
ES	Spain	Banco Santander	G-SIB	ES0113900J37	SAN.MC	SAN SM	✓	EUR	1	0	0	0	0	1	1	1	1	4	0,5151515
ES	Spain	BBVA	D-SIB	ES0113211835	BBVA.MC	BBVA SM	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
FI	Finnland	Nordea Bank Finland Plc	D-SIB	SE0000427361	NDA.ST	NDA SS	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
FR	France	BNP Paribas	G-SIB	FR0000131104	BNPP.PA	BNP FP	✓	EUR	1	0	0	1	1	1	1	1	1	6	0,7575758
FR	France	Société Générale	G-SIB	FR0000130809	SOGN.PA	GLE FP	✓	EUR	1	0	0	0	0	0	1	1	1	3	0,3939394
IE	Ireland	Allied Irish Banks plc	D-SIB	IE00BYSZ9G33	AIBG.I	ALBK ID	✓	EUR	1	0	0	0	0	0	0	1	1	2	0,2727273
IE	Ireland	Bank of Ireland Group plc	D-SIB	IE0030606259	BIRG.I	BKIR ID	✓	EUR	1	0	0	0	0	0	1	1	1	3	0,3939394
IT	Italy	Gruppo Intesa-Sanpaolo	D-SIB	IT0000072618	ISP.MI	ISP IM	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
IT	Italy	Unicredit Group	G-SIB	IT0005239360	CRDI.MI	UCG IM	✓	EUR	1	0	0	0	0	1	1	1	1	4	0,5151515
LT	Lithuania	AB DNB bankas	D-SIB	939940 (DNB ASA)	DNB.OL	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
LT	Lithuania	AB SEB bankas	D-SIB	SE0000148884	SEBa.ST	SEBA SS	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
LU	Luxembourg	Deutsche Bank Luxembourg S.A.	D-SIB	DE0005140008	DBKn.DE	DBK GR	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
LU	Luxembourg	Société Générale Bank & Trust S.A.	D-SIB	873403 (Societe Generale)	SOGN.PA	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	1	1	0,1515152
LV	Latvia	Akciju sabiedrība "Citadele banka"	D-SIB	CBLBR.RI	CBLBR.RI	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
LV	Latvia	AS DNB banka	D-SIB	NO0010031479	DNB.OL	DNB NO	✓	NOK	1	0	0	0	0	0	0	0	1	1	0,1515152
MT	Malta	Bank of Valletta Group (BOV)	D-SIB	MT0000021338	BOV.MT	#N/A Field Not App	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
MT	Malta	HSBC Bank Malta plc (HSBC)	D-SIB	923893	HSBA.L	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
NL	Netherlands	ABN AMRO Bank N.V.	D-SIB	NL0011540547	ABND.AS	ABN NA	✓	EUR	1	0	0	0	0	0	1	1	1	3	0,3939394
NL	Netherlands	ING-Bank	G-SIB	NL0011821202	INGA.AS	INGA NA	✓	EUR	1	0	0	0	0	0	0	1	1	2	0,2727273
PT	Portugal	Banco Comercial Português	D-SIB	PTBCP0AM0007	BCP.LS	BCPL LN	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
PT	Portugal	Caixa Geral de Depósitos	D-SIB	XS0230957424	0	#N/A Field Not App	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
SE	Sweden	AS SEB Bank	D-SIB	SE0000148884	SEBA.ST	SEBA SS	✓	SEK	1	0	0	0	0	0	0	1	1	2	0,2727273
SE	Sweden	Swedbank AS	D-SIB	SE0000242455	SWEDA.ST	SWEDA SS	✓	SEK	1	0	0	0	0	0	0	1	1	2	0,2727273
SI	Slovenia	NLB (Nova Ljubljanska banka)	D-SIB	not oficially quoted	IPO-NOVA.LJ	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	1	1	0,1515152
SI	Slovenia	SID BANKA DD LJUBLJANA	D-SIB	SEDABI	0	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
SK	Slovakia	Ceskoslovenska obchodna banks as	D-SIB	0	0	#N/A Invalid Securi	✓	EUR	0	0	0	0	0	0	0	0	0	0	0
SK	Slovakia	Všeobecná úverová banka a.s.	D-SIB	SK1110001437	1VUB02AE.BV	VUB SK	✓	EUR	1	0	0	0	0	0	0	0	1	1	0,1515152
UK	England	Barclays	G-SIB	GB0031348658	BARC.L	BARC LN	✓	GBP	1	0	0	0	0	0	1	1	1	3	0,3939394
UK	England	HSBC	G-SIB	GB0005405286	HSBA.L	HSBA LN	✓	USD	1	0	0	0	0	0	0	1	1	2	0,2727273
CH	Swiss	UBS Group AG	G-SIB	CH0244767585	UBSG.S	UBSG SW	✓	CHF	1	0	0	0	0	0	0	0	1	1	0,1515152
CH	Swiss	Credit Swiss Group AG	G-SIB	CH0012138530	CSGN.S	CSGN SW	✓	CHF	1	0	0	0	0	0	1	1	1	3	0,3939394
				FI with fintech reference in financial statement						0	0	1	2	6	12	18	31		
				FI without fintech reference in financial statement						31	31	30	29	25	19	13	0		
				Total sample					**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**		

Source: Own elaboration

Annex XIII. List of quantitative variables.

(used in chapter 5.2)

Y (dependent) variables

OUT PT ROE	**Return on Equity**
OUT PT ROA	**Return on Assets**
OUT_NII_TA	**Net interest income in relation to total assets**
OUT_LLP_TA	**Loan Loss Provision**
OUT_COM_TA	**Commission & Fee Income in relation to total assets**
OUT_OTHER_TA	**Other income in relation to total assets**
OUT_TRAD_TA	**Trading results in relation to total assets**
OUT_CIR	**Cost Income Ratio**
OUT_NI_EMP	**Workforce**

X (independent) variables

FT	**Fintech adoption time**
BM	***Business model* => Reinvestment rate**
SP	**Share Price => Price-to-book ratio**
NPL	**Non-performing loans**
CDA	**Customers' digital accessibility**

Annex XIV. Definition of dependent variables (Y). (used in chapter 5.2)

Variable	Thomson Reuters Eikon Source	Content
profitability ratios (y dependent variables)		
Pre tax ROE	Ratios - Key Metrics	This item represents the return on assets before taxes. It is calculated as Income Before Tax for the fiscal interim result divided by the Average Total Assets for the same period and is expressed as percentage.
Pre tax ROA	Ratios - Key Metrics	This item represents the return on equity before taxes. It is calculated as Income Before Tax for the fiscal interim result divided by the Total Equity and is expressed as percentage.
Net interest income/Total assets	Income/Balance	Net interest income as reported in the income statement divided by total assets as reported in the balance sheet. The ratio is expressed as percentage.
Loan loss provisions/Total assets	Income/Balance	Loan loss provisions as reported in the income statement divided by total assets as reported in the balance sheet. The ratio is expressed as percentage.
Net commission income/Total assets	Income/Balance	Net commission income as reported in the income statement divided by total assets as reported in the balance sheet. The ratio is expressed as percentage.
Net trading income/Total assets	Income/Balance	Net trading income as reported in the income statement divided by total assets as reported in the balance sheet. The ratio is expressed as percentage.
Other net income/Total assets	Income/Balance	Other net income as reported in the income statement divided by total assets as reported in the balance sheet. The ratio is expressed as percentage.
operational performance ratios (y dependent variables)		
CIR (Cost income ratio)	Income	Self calculated: The counter includes the components of operating expenses (labour & related expenses; depreciation expense; amortization of intangibles and other expenses) divided by the denominator containing the gross profit components (interest income; non interest income)
Total revenue per employee	Income/Segment	Self calculated: The counter includes the component "total income" as reported in the income statements and "employees" as stated in the segment reports.

Source: Own elaboration.

Annex XV. Definition of independent variables (x).

(used in chapter 5.2)

Variable	Source	Content
x independent variables		
α regression constant	*	The constant α corresponds to the y-intercept in which the regression line intersects.
β slope coefficient of characteristic FT	*	The regression coefficient of the characteristic FT is estimated using the least squares method.
FT Fintech adoption time	self calculated	FT is a dummy variable. It reflects the point in time when private universal banks report cooperation with fintechs for the first time in their audited and thus evaluated Group Annual Report (IFRS).
γ slope coefficient of characteristic BM	*	The regression coefficient of the characteristic BM is estimated using the least squares method.
BM characteristic business model Reinvestment rate	Reuters Ratios - Key Metrics	This ratio is calculated by dividing retained earnings for the fiscal interim result by the average common shareholders equity for the same period and is expressed as percentage. Retained earnings represent income available to common equities excluding extraordinary items minus gross dividends (common stock).
δ slope coefficient of characteristic SP	*	The regression coefficient of the characteristic SP is estimated using the least squares method.
SP characteristic share prices	Bloomberg Price-to-book-ratio	This control variable reflects the view of the shareholders on the enterprise value. The Bloomberg Price-to-book-ratio is used.Ratio of the stock price to the book value per share. Calculated as: Price to Book Ratio = Last Price / Book Value Per Share Where: Last Price is PR005, PX_LAST Book Value Per Share is RR020, BOOK_VAL_PER_SH Data from the most recent reporting period (quarterly, semi-annual or annual) used in the calculation. Portfolio: Computed as the Total Market Value (IN089, INDX_MARKET_CAP) divided by the sum of Book Value from holdings. Contributions are computed as the value of Book Value Per Share (RR020, BOOK_VAL_PER_SH) of the security multiplied by the number of shares held.
Θ slope coefficient of characteristic NPL	*	The regression coefficient of the characteristic NPL is estimated using the least squares method.
NPL characteristic non performing loans	Bloomberg NPL	Gross Nonperforming Loans, which are loans in default or close to default, and do not accrue interest. All loans that have an impairment provision are classified as non-accrual. This field returns for Banks and Finance companies.
ω slope coefficient of characteristic CDA	*	The regression coefficient of the characteristic MP is estimated using the least squares method.
CDA characteristic customers' digital accessibi	EU commission	The ratio shows the use of internet for online banking per population.
ε random disturbance term	*	This variable reflects the usual error term capturing all other factors which could influence the dependent y variable except the x regressors.

* authors calculation (by Excel ANOVA)

Source: Own elaboration.

Annex XVI. F-test for overall significance. (used in chapters 5.2, 6.1)

Country code	Financial institution	G-SIB or D-SIB/O-SIIs	OUT PT ROA	OUT PT ROE	OUT_NII_TA	OUT_LLP_TA	OUT_COM_TA	OUT_TRAD_TA	OUT_OTHER_TA	OUT_CIR	OUT_NI_EMP
AT	Erste Group Bank	D-SIB	8,74907E-19	3,91106E-20	1,50413E-10	2,25392E-11	0,001156171	0,024384925	0,010688151	7,65574E-13	1,37626E-15
AT	Raiffeisenbank International	D-SIB	7,40729E-13	1,58407E-12	4,18173E-11	8,48082E-08	6,02623E-06	0,007593352	0,810422335	6,05906E-13	2,29702E-15
BE	KBC Groep NV	D-SIB	6,1713E-14	1,90077E-14	9,9058E-07	0,035327266	0,031787215	0,155937914	0,018246789	2,81388E-06	8,8364E-13
CY	Bank of Cyprus Plc	D-SIB	1,64369E-11	8,54688E-19	0,656148174	0,153098746	0,496088127	0,077917469	0,008596438	0,000264899	2,93756E-13
CY	Hellenic Bank Plc	D-SIB	1,16157E-11	1,0032E-18	0,223320067	0,000675426	0,17713154	0,84798406	0,021897692	0,352533309	0,001781549
CZ	Komercni Banka as	D-SIB	0,006864151	0,03948502	3,77237E-17	0,005434535	5,92116E-16	0,002074847	0,080973667	0,098392905	0,210721681
DE	Commerzbank	D-SIB	2,89751E-07	3,86388E-16	0,063384081	3,98116E-05	0,087316759	0,00560418	0,327700284	4,50032E-12	5,55519E-19
DE	Deutsche Bank	G-SIB	5,72097E-12	2,13803E-20	0,39979497	0,018222019	0,00041195	0,079306902	0,012661217	5,34556E-05	5,90486E-05
DK	Danske Bank Plc	D-SIB	1,50255E-08	1,69636E-10	0,0002201	2,56899E-11	0,000480413	0,316167496	6,60246E-05	1,17659E-09	0,007243962
EL	Alpha Bank	D-SIB	9,25388E-07	8,66677E-09	0,629879888	0,702423055	0,818494008	0,948949509	0,270552547	0,080683828	0,184778757
EL	National Bank of Greece	D-SIB	5,28159E-20	1,82582E-30	0,000156149	0,001037437	0,001844398	0,236624479	0,000211136	0,007802514	0,044205213
ES	Banco Santander	G-SIB	3,16352E-24	1,16615E-24	3,00973E-16	1,02357E-13	1,12176E-10	0,000160517	1,64788E-08	0,000144976	0,218495007
ES	BBVA	D-SIB	0,607299154	0,535795578	0,000884541	0,000252855	0,377233787	0,187599745	0,01280644	0,4676772	0,247385935
FI	Nordea Bank Finland Plc	D-SIB	1,63242E-07	0,024195533	1,58093E-05	1,23691E-05	0,000301973	n/a	0,999777513	0,010183824	0,404638781
FR	BNP Paribas	G-SIB	0,000327218	2,34023E-07	0,044376079	0,002547143	2,78408E-06	0,023152716	0,830523495	0,259093814	0,037848345
FR	Société Générale	G-SIB	0,001444682	1,05204E-05	4,68439E-10	0,007702114	3,54767E-10	0,100859239	0,017724554	0,050105704	0,377678904
IE	Allied Irish Banks plc	D-SIB	6,77494E-14	2,40211E-27	9,76607E-09	3,00267E-06	1,72715E-06	0,042814054	0,042189996	0,171427687	5,46378E-11
IE	Bank of Ireland Group plc	D-SIB	1,51004E-17	4,84522E-21	8,84921E-06	2,20779E-06	0,033204197	0,063989791	0,239319645	0,070197292	3,41093E-11
IT	Gruppo Intesa-Sanpaolo	D-SIB	1,32597E-05	2,64886E-07	0,091960836	0,034189849	0,000647823	0,029294761	0,000165437	0,000448427	3,24438E-20
IT	Unicredit Group	G-SIB	1,5859E-19	7,95127E-24	0,168936107	1,68152E-06	0,36731501	0,770676396	0,114998036	9,03657E-05	3,72289E-14
LV	AS DNB banka	D-SIB	0,012062842	0,000940372	5,68831E-09	0,000103234	0,062774983	0,907424414	0,00028296	8,7273E-05	5,44363E-11
NL	ABN AMRO Bank N.V.	D-SIB	7,23278E-05	1,58277E-06	0,721144893	0,024778103	0,302542122	0,180972444	0,131189321	1,3431E-06	9,95059E-19
NL	ING-Bank	G-SIB	4,31676E-06	2,22317E-06	0,445901866	0,014533201	0,018206007	0,570040916	0,06668036	3,71758E-07	9,06211E-16
PT	Banco Comercial Português	D-SIB	1,67077E-35	5,26249E-05	1,64058E-05	0,001127447	0,817754599	0,105599308	0,016318786	1,78795E-08	4,63448E-09
SE	AS SEB Bank	D-SIB	0,200224453	0,102580209	0,300415953	0,110484943	4,46509E-05	0,418068288	0,117318989	0,019735713	1,67891E-11
SE	Swedbank AS	D-SIB	0,045793799	0,014707351	0,49090667	0,098843298	2,00845E-07	0,334912889	0,263294123	0,005830482	9,9274E-10
SK	Všeobecná úverová banka a.s.	D-SIB	4,49349E-07	2,7393E-06	0,001939025	0,0007916	0,000309356	0,00928116	0,125261478	1,01257E-05	9,61224E-11
UK	Barclays	G-SIB	1,56436E-22	3,84794E-18	0,000152228	0,000154804	3,43873E-09	0,486531649	0,00049507	0,110516867	2,2703E-08
UK	HSBC	G-SIB	2,15736E-07	1,64136E-10	0,151288153	0,001268591	0,143994921	0,110120154	0,001133435	0,441165096	3,87406E-12
CH	UBS Group AG	G-SIB	1,77242E-06	2,99183E-06	0,016382573	0,156597711	3,09423E-09	0,336515698	3,69106E-08	5,64435E-06	3,94268E-08
CH	Credit Swiss Group AG	G-SIB	6,77614E-12	1,38359E-13	0,443271647	0,001034792	0,061679317	0,028847814	0,090807663	4,62624E-09	0,001656503
		not accepted	2	3	11	5	13	16	12	9	7
		accepted	29	28	20	26	18	15	19	22	24
			31	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**

Source: Own elaboration.

Annex XVII. Analyse of p-values.

(used in chapter 5.5)

Y VAR				PT ROA	PT ROE	NII_TA	LLP_TA	COM_TA	TRAD_TA	OTHER_TA	CIR	NI_EMP
FT	Sum	Scale		*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
	38	0<=0,01		4	7	5	2	6	1	1	1	11
0,21942446	12	0,01<=0,02		4	2	2	1	1	0	1	0	1
61	11	0,02<=0,05		1	2	1	1	2	2	0	1	1
	45	0,05<=0,2		7	4	4	4	5	4	7	6	4
0,78057554	57	0,2<=0,5		4	6	7	6	9	9	3	7	6
217	115	0,5<=1,0		11	10	12	17	8	14	19	16	8
1	278	Test		VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR
		pro	%	0,290322581	0,35483871	0,258064516	0,129032258	0,290322581	0,1	0,064516129	0,064516129	0,419354839
		contra	%	0,709677419	0,64516129	0,741935484	0,870967742	0,709677419	0,9	0,935483871	0,935483871	0,580645161

Y VAR				PT ROA	PT ROE	NII_TA	LLP_TA	COM_TA	TRAD_TA	OTHER_TA	CIR	NI_EMP
BM	Sum	Scale		*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
	92	0<=0,01		24	25	5	10	5	3	3	16	1
0,417266187	3	0,01<=0,02		1	0	0	0	0	0	1	1	0
116	21	0,02<=0,05		0	1	1	6	2	2	4	4	1
	44	0,05<=0,2		3	2	7	7	3	6	8	4	4
0,582733813	47	0,2<=0,5		1	2	5	5	9	6	4	5	10
162	71	0,5<=1,0		2	1	13	3	12	13	11	1	15
1	278	Test		VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR
		pro	%	0,806451613	0,838709677	0,193548387	0,516129032	0,225806452	0,166666667	0,258064516	0,677419355	0,064516129
		contra	%	0,193548387	0,161290323	0,806451613	0,483870968	0,774193548	0,833333333	0,741935484	0,322580645	0,935483871

Y VAR				PT ROA	PT ROE	NII_TA	LLP_TA	COM_TA	TRAD_TA	OTHER_TA	CIR	NI_EMP
SP	Sum	Scale		*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
	18	0<=0,01		2	4	1	3	3	2	0	1	2
0,147482014	6	0,01<=0,02		1	1	0	2	0	0	0	1	1
41	17	0,02<=0,05		3	0	3	3	0	0	2	3	3
	54	0,05<=0,2		6	11	8	3	3	5	4	6	8
0,852517986	70	0,2<=0,5		5	7	9	9	9	9	6	9	7
237	113	0,5<=1,0		14	8	10	11	16	14	19	11	10
1	278	Test		VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR
		pro	%	0,193548387	0,161290323	0,129032258	0,258064516	0,096774194	0,066666667	0,064516129	0,161290323	0,193548387
		contra	%	0,806451613	0,838709677	0,870967742	0,741935484	0,903225806	0,933333333	0,935483871	0,838709677	0,806451613

Y VAR				PT ROA	PT ROE	NII_TA	LLP_TA	COM_TA	TRAD_TA	OTHER_TA	CIR	NI_EMP
NPL	Sum	Scale		*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
	26	0<=0,01		1	2	1	2	4	2	2	1	11
0,197841727	9	0,01<=0,02		0	1	3	1	2	1	1	0	0
55	20	0,02<=0,05		2	2	3	2	1	1	1	6	2
	58	0,05<=0,2		6	8	5	10	5	7	8	3	6
0,802158273	69	0,2<=0,5		15	7	6	9	5	3	9	11	4
223	96	0,5<=1,0		7	11	13	7	14	16	10	10	8
1	278	Test		VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR
		pro	%	0,096774194	0,161290323	0,225806452	0,161290323	0,225806452	0,133333333	0,129032258	0,225806452	0,419354839
		contra	%	0,903225806	0,838709677	0,774193548	0,838709677	0,774193548	0,866666667	0,870967742	0,774193548	0,580645161

Y VAR				PT ROA	PT ROE	NII_TA	LLP_TA	COM_TA	TRAD_TA	OTHER_TA	CIR	NI_EMP
CDA	Sum	Scale		*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
	55	0<=0,01		5	2	12	8	5	2	3	4	14
0,327338129	12	0,01<=0,02		0	1	1	2	2	1	1	3	1
91	24	0,02<=0,05		2	2	3	1	4	2	4	2	4
	45	0,05<=0,2		7	4	3	8	5	4	4	4	6
0,672661871	56	0,2<=0,5		6	10	5	5	9	5	9	5	2
187	86	0,5<=1,0		11	12	7	7	6	16	10	13	4
1	278	Test		VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR	VAHR
		pro	%	0,225806452	0,161290323	0,516129032	0,35483871	0,35483871	0,166666667	0,258064516	0,290322581	0,612903226
		contra	%	0,774193548	0,838709677	0,483870968	0,64516129	0,64516129	0,833333333	0,741935484	0,709677419	0,387096774

Source: Own elaboration.

Annex XVIII. Pairwise multicollinearity. (used in chapters 5.4, 6.2)

Correlation matrix of the independend variables

	FT	BM	SP	NPL	CDA
FT	1	0,10658906	-0,01950494	-0,5282266	0,75115351
BM	0,10658906	1	0,03848434	-0,13109844	0,03163596
SP	-0,01950494	0,03848434	1	-0,09942638	0,36657678
NPL	-0,5282266	-0,13109844	-0,09942638	1	-0,293937
CDA	0,75115351	0,03163596	0,36657678	-0,293937	1

Source: Own elaboration.

Annex XIX. Shapiro Wilk test of normal distribution.

(used in chapter 6.1)

Erste Group Bank AT

Country code	Country	Financial institution	G-SIB or D-SIB/O-SIIs	International Securities Identification Number	RIC	Bloomberg Code	No	Bloomberg Code	TRE date of data extraction	TRE date of data extraction	Object Count	EXCHANGE	CCY
					RIC				2012-2017	all periods			Mio
AT	Austria	Erste Group Bank	D-SIB	AT0000652011	ERST.VI	EBS AV	1	#NAME?	05.12.2017	10.01.2018	1	Vienna Stock E:	EUR

Step 1

Data Sorted

	Self	Reuters	Bloomberg	Bloomberg + Reuters	EU Commission
	X	X	X	X	X
	TimeDummy	%	%	%	% of individuals
	FT	BM	SP	NPL	CDA
x1	0,030303	-0,1210	0,3878	3,84%	37,9464
x2	0,030303	-0,0940	0,4156	4,06%	37,9464
x3	0,030303	-0,0540	0,435	4,35%	37,9464
x4	0,030303	-0,0400	0,4723	4,65%	37,9464
x5	0,030303	-0,0240	0,523	4,87%	43,9418
x6	0,030303	-0,0080	0,5864	5,46%	43,9418
x7	0,030303	-0,0040	0,6348	5,85%	43,9418
x8	0,030303	0,0000	0,691	6,10%	43,9418
x9	0,030303	0,0010	0,7002	6,68%	45,3466
x10	0	0,0060	0,7148	7,40%	45,3466
x11	0	0,0070	0,7618	8,67%	45,3466
x12	0	0,0070	0,7665	9,23%	45,3466
x13	0	0,0080	0,7707	10,44%	47,952
x14	0	0,0090	0,8	10,63%	47,952
x15	0	0,0090	0,8052	10,79%	47,952
x16	0	0,0100	0,8063	11,49%	47,952
x17	0	0,0110	0,807	11,63%	48,6049
x18	0	0,0120	0,8352	11,85%	48,6049
x19	0	0,0170	0,8384	11,88%	48,6049
x20	0	0,0180	0,8508	12,00%	48,6049
x21	0	0,0210	0,8799	12,05%	51,0279
x22	0	0,0210	0,8802	12,15%	51,0279
x23	0	0,0220	0,8936	12,19%	51,0279
x24	0	0,0220	0,9065	12,19%	51,0279
x25	0	0,0250	0,9203	12,20%	53,3403
x26	0	0,0250	0,9461	12,44%	53,3403
x27	0	0,0250	0,9591	12,44%	53,3403
x28	0	0,0260	0,9769	12,45%	53,3403
x29	0	0,0260	1,0053	12,62%	57,4939
x30	0	0,0270	1,0331	13,38%	57,4939
x31	0	0,0280	1,1693	13,51%	57,4939
x32	0	0,0290	1,2132	13,57%	57,4939
x33	0	0,0490	1,2427	13,58%	57,4939

Step 2 weights a_i for sample size n 33

				Step 3		Step 3		Step 3		Step 3	
				BM		SP		NPL		CDA	
n	33	A	B	diff (A-B)	a*diff	diff (A-B)	a*diff	diff (A-B)	a*diff	diff (A-B)	a*diff
	SW table 1										
a1	0,4156	x33	x1	0,1700	0,070652	0,8549	0,35529644	0,0974	0,04049772	19,5475	8,123941
a2	0,2876	x32	x2	0,1230	0,0353748	0,7976	0,22938976	0,0951	0,02734036	19,5475	5,621861
a3	0,2451	x31	x3	0,0820	0,0200982	0,7343	0,17997693	0,0916	0,0224512	19,5475	4,7910923
a4	0,2137	x30	x4	0,0670	0,0143179	0,5608	0,11984296	0,0873	0,01864827	19,5475	4,1773008
a5	0,1880	x29	x5	0,0500	0,0094	0,4823	0,0906724	0,0775	0,01457332	13,5521	2,5477948
a6	0,1660	x28	x6	0,0340	0,005644	0,3905	0,064823	0,0700	0,01161331	9,3985	1,560151
a7	0,1463	x27	x7	0,0290	0,0042427	0,3243	0,04744509	0,0659	0,00964235	9,3985	1,3750006
a8	0,1284	x26	x8	0,0250	0,00321	0,2551	0,03275484	0,0633	0,00813324	9,3985	1,2067674
a9	0,1118	x25	x9	0,0240	0,0026832	0,2201	0,02460718	0,0552	0,0061722	7,9937	0,8936957
a10	0,0961	x24	x10	0,0160	0,0015376	0,1917	0,01842237	0,0479	0,00459929	5,6813	0,5459729
a11	0,0812	x23	x11	0,0150	0,001218	0,1318	0,01070216	0,0351	0,00285407	5,6813	0,4613216
a12	0,0669	x22	x12	0,0140	0,0009366	0,1137	0,00760653	0,0292	0,00195489	5,6813	0,380079
a13	0,0530	x21	x13	0,0130	0,000689	0,1092	0,0057876	0,0161	0,00085181	3,0759	0,1630227
a14	0,0395	x20	x14	0,0090	0,0003555	0,0508	0,0020066	0,0136	0,00053868	0,6529	0,0257896
a15	0,0262	x19	x15	0,0080	0,0002096	0,0332	0,00086984	0,0109	0,00028537	0,6529	0,017106
a16	0,0131	x18	x16	0,0020	0,0000262	0,0289	0,00037859	0,0035	4,6464E-05	0,6529	0,008553
a17	0,0000	x17	x17	0,0000	0	0,0000	0	0,0000	0	0,0000	0
	for odd n median will not used										
Sum b					0,1705953		1,19058229		0,17020254		31,899449
Step 4											
SS	sum of squares of deviations				0,039412242		1,4692171		0,03472822		1093,3653
b	sum of a*diff				0,1705953		1,19058229		0,17020254		31,899449
W	testvalue				0,738419196		0,96479015		0,83416037		0,9306815
0	SW table 2 (p-values)			0		0,1	0,942	0		0,1	0,942
0,01	SW table 2 (p-values)			0,01	0,906	0,5	0,968	0,01	0,906	0,5	0,968
p-value	SW table 2 (p-values)				-0,269301339		0,14938226				0,6741306
result					reject		accept		reject		accept

Alpha Bank EL

Country code	Country	Financial institution	G-SIB or D-SIB/O-SIIs	International Securities Identification Number	RIC	Bloomberg Code	No	Bloomberg Code	TRE date of data extraction	TRE date of data extraction	Object Count	EXCHANGE	CCY
					RIC				2012-2017	all periods			Mio
EL	Greece	Alpha Bank	D-SIB	GRS015003007	ACBR.AT	ALPHA GA	1	#NAME?	29.10.2017	10.01.2018	1	Athens Stock Exchange	EUR

Step 1

Data Sorted

	Self X TimeDummy FT	Reuters X % BM	Bloomberg X % SP	Bloomberg + Reuters X % NPL	EU Commission X % of individuals CDA
x1	0,030303	-1,5590	0,0652	6,61%	5,3824
x2	0	-1,0160	0,087	7,18%	5,3824
x3	0	-0,7330	0,1354	10,12%	5,3824
x4	0	-0,1540	0,166	10,77%	5,3824
x5	0	-0,1510	0,2194	10,97%	5,7068
x6	0	-0,0610	0,2759	12,09%	5,7068
x7	0	-0,0560	0,2997	13,62%	5,7068
x8	0	-0,0320	0,3014	14,34%	5,7068
x9	0	-0,0290	0,308	15,60%	8,5956
x10	0	-0,0240	0,3119	16,66%	8,5956
x11	0	-0,0150	0,3175	22,21%	8,5956
x12	0	-0,0150	0,3428	22,93%	8,5956
x13	0	-0,0120	0,3635	30,01%	9,1305
x14	0	-0,0120	0,3636	32,97%	9,1305
x15	0	-0,0110	0,393	33,03%	9,1305
x16	0	-0,0080	0,4016	33,53%	9,1305
x17	0	-0,0020	0,4176	34,85%	10,7217
x18	0	-0,0010	0,4343	35,56%	10,7217
x19	0	0,0000	0,4648	35,56%	10,7217
x20	0	0,0000	0,4865	36,00%	10,7217
x21	0	0,0000	0,5821	36,57%	13,8697
x22	0	0,0000	0,6174	36,65%	13,8697
x23	0	0,0020	0,6297	38,65%	13,8697
x24	0	0,0040	0,6955	39,07%	13,8697
x25	0	0,0040	0,7864	39,13%	19,1595
x26	0	0,0040	0,9202	39,69%	19,1595
x27	0	0,0050	0,9351	39,92%	19,1595
x28	0	0,0080	0,9412	40,12%	19,1595
x29	0	0,0080	0,9595	40,20%	25,1218
x30	0	0,0210	0,9596	40,30%	25,1218
x31	0	0,0420	0,9782	40,98%	25,1218
x32	0	0,0630	0,9842	43,38%	25,1218
x33	0	2,8330	2,224	51,93%	25,1218

Step 2 weights a_i for sample size n 33

Step 3

				BM		SP		NPL		CDA	
n	33	A	B	diff (A-B)	a*diff	diff (A-B)	a*diff	diff (A-B)	a*diff	diff (A-B)	a*diff
	SW table 1										
a1	0,4156	x33	x1	4,3920	1,8253152	2,1588	0,8971973	0,4531	0,1883112	19,7394	8,2036946
a2	0,2876	x32	x2	1,0790	0,3103204	0,8972	0,2580347	0,3620	0,1041056	19,7394	5,6770514
a3	0,2451	x31	x3	0,7750	0,1899525	0,8428	0,2065703	0,3086	0,0756475	19,7394	4,8381269
a4	0,2137	x30	x4	0,1750	0,0373975	0,7936	0,1695923	0,2953	0,0631069	19,7394	4,2183098
a5	0,1880	x29	x5	0,1590	0,029892	0,7401	0,1391388	0,2923	0,0549443	19,4150	3,65002
a6	0,1660	x28	x6	0,0690	0,011454	0,6653	0,1104398	0,2803	0,0465312	13,4527	2,2331482
a7	0,1463	x27	x7	0,0610	0,0089243	0,6354	0,092959	0,2630	0,0384699	13,4527	1,96813
a8	0,1284	x26	x8	0,0360	0,0046224	0,6188	0,0794539	0,2535	0,0325497	13,4527	1,7273267
a9	0,1118	x25	x9	0,0330	0,0036894	0,4784	0,0534851	0,2354	0,0263128	10,5639	1,181044
a10	0,0961	x24	x10	0,0280	0,0026908	0,3836	0,036864	0,2240	0,0215307	5,2741	0,506841
a11	0,0812	x23	x11	0,0170	0,0013804	0,3122	0,0253506	0,1645	0,013355	5,2741	0,4282569
a12	0,0669	x22	x12	0,0150	0,0010035	0,2746	0,0183707	0,1372	0,009181	5,2741	0,3528373
a13	0,0530	x21	x13	0,0120	0,000636	0,2186	0,0115858	0,0657	0,0034802	4,7392	0,2511776
a14	0,0395	x20	x14	0,0120	0,000474	0,1229	0,0048546	0,0303	0,0011979	1,5912	0,0628524
a15	0,0262	x19	x15	0,0110	0,0002882	0,0718	0,0018812	0,0252	0,0006613	1,5912	0,0416894
a16	0,0131	x18	x16	0,0070	0,0000917	0,0327	0,0004284	0,0203	0,0002655	1,5912	0,0208447
a17	0,0000	x17	x17	0,0000	0	0,0000	0	0,0000	0	0,0000	0
	for odd n median will not used										
Sum b					2,4281323		2,1062065		0,6796505		35,361351
Step 4											
SS	sum of squares of deviations				12,06465491		5,4838269		0,5264723		1487,3764
b	sum of a*diff				2,4281323		2,1062065		0,6796505		35,361351
W	testvalue				0,488685877		0,8089434		0,8773961		0,8406918
0	SW table 2 (p-values)			0	n/a	0	n/a	0	n/a	0	n/a
0,01	SW table 2 (p-values)			0,01	0,906	0,01	0,906	0,01	0,906	0,01	0,906
p-value	SW table 2 (p-values)				-0,685523538		-3,7415086		n/a		n/a
result					reject		reject		reject		reject

Source: Own elaboration.

Declaration in lieu of oath.

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