

E-Business Tools for active Credit Risk Management – A Market Analysis

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Abstract

This paper analyses the impact of ICT on the value creation system of loans and its respective business models and focuses on credit risk management of commercial banks. Whereas ICT impact on loan origination has been studied already in earlier papers there are no in-depth studies available mainly focused at credit risk management, which reaches beyond mere origination. After presenting a general analysis about ICT impact on value creation in the financial industry, this paper provides a state-of-the-art analysis of e-business tools for credit risk management emphasizing their value proposition with respect to credit risk management. The analysis is based on the hypothesis that only by innovative e-business solutions traditional loan business can convert into active credit risk management. As a result the research comes up with three categories of tools which are valuation platforms, rating tools, and trading platforms. It can be shown that ICT leads to the deconstruction of the traditional loan business model.

1. Introduction

From inception, Information and Communication technologies (ICT) have impacted value creation. The financial industry was one of the first to apply ICT on a large scale even before the advent of the Internet. Since the emergence of the World Wide Web (the Web) much has been written about its abilities to impact traditional value creation systems on enterprise (intra-organizational), inter-organizational, and industry level. Prior to the occurrence of the Web, Information and Communication technologies (ICT) have impacted value creation systems. One crucial question for both researchers and practitioners is to what extent observed impacts are sustainable and thus fundamental to a certain value creation system.

Our research will focus on credit risk management within the financial industry, namely at commercial banks. We will examine existing e-business tools in this

area providing a cutting edge analysis of their value proposition with respect to credit risk management. The analysis is based on the hypothesis only by innovative e-business solutions can loan business convert into active credit risk management. So far, the literature has solely dealt with the impact of ICT on loan origination. Other than origination, credit risk management also includes transactions on secondary markets to manage existing loan portfolios, e.g. hedges and true sale transactions. We have arrived at various conclusions with regards to the ICT impact on this specific business.

Accordingly, in this paper we address the issue of changing value creation systems of loans by focusing on both structural issues and respective business models. This includes a market analysis of e-business tools for credit risk management. Loans are understood as typical information goods and, more specific, as web-based information goods as they are nowadays – at least on secondary markets - traded through web-based platforms.

The research is based on the study of literature as well as field research. As a starting point we summarize briefly the theoretical foundations and present a framework to analyze the impact of ICT on value creation systems. We then give an overview of the impact of ICT (specifically of the Web) as related to the financial industry in general. Then we go into detail on the loan business and the challenges this business sector faces when applied to active credit risk management. However, as it is beyond the scope of this paper, we will not elaborate further on the complexity of credit risk management. After analyzing the market, we found three categories of e-business tools that create value for credit risk managers. Accordingly, we analyze representative samples in a variety of categories with respect to their value proposition. Finally, we interpret our findings and formalize our conclusion. The results of our study may serve as a basis for a further research approach similar to the one conducted by Hess and Kemerer [11] or Steinfield et al [24].

In summary, this paper contributes to the research on ICT impacts to industrial structures and respective business models by providing a profound literature review focusing on the loan industry, the analysis of emerging business models in this industry as well as a market

analysis of e-business tools for emerging secondary loan markets.

2. Impact of ICT on Value Creation in the Financial Industry

In the first two chapters we discuss the issue of ICT impact on value creation in general. This is followed by a more focused analysis within the financial industry applying both analysis in the real world and literature study.

2.1. General Impact of ICT on Value Creation

Without doubt, the emergence of ICT since the 1960s continues to have a major impact on value creation. In order to analyze the ICT impact we will look at structures, processes, products, and infrastructures of value creation systems from an industry and intra-organizational perspective following [28]. Developments towards the Digital Economy can be analyzed along these four interrelated dimensions. For example, new players to a market - addressing the market structure - providing new services and applying different processes based on new infrastructures. The model is based on an analysis in the 'real world' as well as on literature analysis.

Concerning the industry structures we observe a clear trend towards networked and more fluid value creation systems which are called the BusinessWeb [25], ValueNet [5], and others. Based on the deconstruction of traditional value chains, many industries were modularized and especially in the financial sector new intermediaries emerged [7]. Outsourcing is a common practice in many industries. From a more theoretical perspective these developments have been covered by two major debates: (a) the debate 'move-to-the-markets' vs. 'move-to-the-middle' addressing the governance structures of value creation systems, and (b) the dis- vs. cyber-mediation debate focusing on intermediation. Both debates are grounded in transaction cost theory.

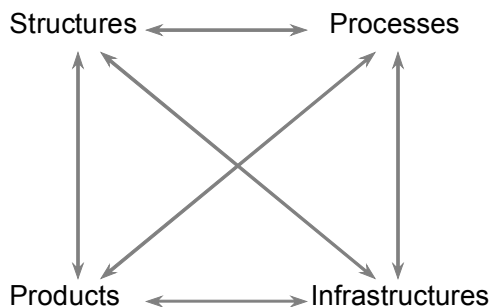


Figure 1: Main characteristics of the digital economy (based on [28])

The 'move-to-the-market' hypothesis, which is also called the Electronic Markets hypothesis, was originally developed by Malone et al. in their seminal paper [17] basically saying the use of ICT will lead to reduced transaction costs and thus to less hierarchical and more market-like governance structures.

Clemons and Reddi [6] developed a contrary hypothesis stating lower costs, better monitoring capability of ICT and lower relationship specificity of ICT investments will cause firms to engage in outsourcing to a greater degree. Moreover, these increased outsourcing activities will come from a reduced set of suppliers with whom firms have long-term cooperative relationships. This rebuttal is also called the 'move-to-the-middle' hypothesis.

Concerning disintermediation due to the emergence of ICT Benjamin and Wigand [3] have hypothesized on the effects of the proliferation of the Web on the restructuring and redistribution of profits along the stakeholders value chains. Disintermediation is one of the main effects. Whereas Sarkar et al. [22] argue a number of factors in the emerging electronic marketplace have contributed to making intermediated transactions an attractive option. So called Cyber-mediaries can achieve cost advantages for intermediated transactions by negotiating favorable deals, bundling and pooling services on the supply side and demand on the other side.

Regarding value creation processes it has been analyzed from practitioners as well as from theoretical perspective that customers get more and more integrated into value creation processes. These processes are even initiated by customers, and many of those processes incorporate more market like coordination mechanisms. For example, Lawer and Knox [15] give a comprehensive summary of the 'reverse-marketing' - discussion in scholarly literature. The issue of mass customization is one example for new value creation processes in this respect which has broadly been covered in literature, e.g. see Pine et al. [19].

With respect to products, we would like to mention the emergence of new kinds of information products based on digitalization as a source of unbundling of traditional services. Rayport and Sviokla addressed the issue of dis-aggregation of traditional goods and services in their paper [19]. Shapiro and Varian elaborated the issue of information goods in-depth in their book [23].

As a necessary prerequisite for new business models in the digital economy, new infrastructures have emerged. These are (1) network infrastructures like the Internet or mobile networks, i.e. a set of technological specifications, standards, protocols, and their technical implementation and (2) an infrastructure of market services necessary to enable electronic commerce transactions. The notion of 'generic market services' was developed in the mid 90s, but only recently unfolded its full potential through the development of service oriented architectures. In the con-

text of electronic marketplaces typical market services are contracting, trust, payment, logistics, or certification services.

In the following, we would like to focus specifically on the impact of ICT on value creation structures on the industry level.

2.2. Impact of ICT on the Financial Industry

Li stated that developments in ICT are “shaking the foundations of the banking industry” [16]. We will apply the above mentioned model in order to briefly analyze the recent developments in the financial industry.

With the emergence of electronic commerce in the early nineties many new companies, in most cases independent from traditional financial institutions, appeared in the financial industry largely in the US but also in Europe. Many of them could be considered as financial intermediaries supporting the cybermediation hypothesis of Sarkar et al. [22] and thus having an impact on the existing industry structure. A selection of various financial intermediaries is presented in [28]; well known examples at that time have been Quicken.com, DigiCash, ELOAN, or InsWeb. The emergence of these new actors was based on new infrastructures in the sense mentioned above. They provided new kinds of services to customers, applying new value creation services that were quite often originated by the customer through, e.g., a financial portal site. Most of these cyber-mediaries disappeared towards the end of the nineties, but as noticed by observation this ‘hype’ had a sustainable impact on the industry. Overall, new business models emerged around the concepts of ‘deconstruction’, ‘fragmentation’, ‘unbundling’, or ‘dis-intermediation’ [16], as well as ‘industrialization’.

Already in 1994 Hess and Kemerer [11] looked at the impact of ICT to industry structures within the loan industry through testing the Electronic Markets hypothesis. Specifically, Hess and Kemerer studied computerized loan origination in the residential mortgage industry. They recognized the emergence of electronic markets could have a long gestation period, and may be impacted by other factors such as complexity of the transaction, frequency of transactions and current market structure. But Hess and Kemerer found only little evidence of the emergence of electronic markets over hierarchies despite the availability of technology and favorable characteristics of the product.

Steinfeld et al. analyzed the US home mortgage industry ten years later, focusing especially on the impact of inter-organizational systems (IOS) at the industry level. They concluded, the use of industry IOS can result in greater consolidation and furthermore, can “lead to increased dis-integration and use of outsourcing that create greater opportunities for smaller and more niche-oriented

players” [24]. Thus, they proved sustainable structural changes in the US mortgage industry were possible.

Li analyzed the banking industry but was taking a broader view on the industry [16]. He looked at Internet banking in general coming up with eight different models allowing the conclusion, the use of ICT had a definitive impact on the financial industry concerning structures, processes, products, and infrastructures.

Additionally, the research by Batiz-Lazo et al. provides a historical perspective on the main drivers determining the adoption of technological innovation in commercial banking markets concluding “there is evidence to suggest that in a historical perspective, technological innovation and, in particular, increasing applications of telecommunications in bank markets ... have effectively modified the external and internal nature of the banking organization.” [2].

Overall, it can be concluded, based on observations in the real world as well as literature studies, the use of ICT has a sustainable impact on the financial industry. However, the speed of development is by far slower as many assumptions had believed, e.g., during the Internet hype, which could be considered as a ‘trial and error’ period as well, from today’s perspective.

However, as mentioned in the introductory remarks, it becomes obvious, literature and empirical findings have so far only focused on the ICT impact on loan originations. Modern credit management reaches far beyond the origination stage including management of existing loans on secondary markets for credit risk. This consideration drives the research focus and supports the contribution of our paper as we analyze the ICT impact on credit risk management.

3. Focus: Impact of ICT on Credit Risk Management

Loan Business is still the most important business segment for a commercial banks success. Being as dealing with loans implies handling credit risk, the focus of this article is based on the ICT impact on credit risk management of commercial banks.

Credit risk can be defined according to [10] and [1] as the possibility of losing the outstanding loan partially or totally, due to credit events (default risk). In a very wide interpretation, it also includes the risk of an upgrade or downgrade in a counter party’s credit rating, resulting in adjusted credit spreads (migration risk) [13]. Credit events usually include events such as bankruptcy, failure to pay and restructuring [12].

3.1. New Business Model for Credit Risk Management

Banks' business model for credit risk management currently undergoes a change of paradigm mainly driven by ICT as it deconstructs the traditional business model. Traditionally, a **buy-and-hold** business model is applied where banks, mainly in Europe, originate the loan keeping it on the balance sheet until it either defaults or reaches maturity as expected. Risk management in this integrated business model is performed on a decentralized basis (it often even lacks the separation between origination and credit control) and only on individual loan level. Loans are highly illiquid and are meant to remain on the bank's balance sheet without being traded or hedged.

Lately, this model of passive risk taking was challenged and had to be changed into active risk management because the application of ICT throughout the entire value chain of credit offers the required options. "The deconstruction of the value chain in banking is not as distant and futuristic as many think. In fact, it has already happened." [7]

ICT mainly drives the development in credit risk management as it enables for example, electronic servicing and administration of loans. Thus, reducing transaction costs within the bank and allowing the realisation of economies of scale. From a risk management perspective, data-warehousing of credit and loss data, and its accessibility on aggregated portfolio level is crucial. This data is important in analyzing the risk and return of a loan portfolio and subportfolios. By offering the possibility to calculate risk measures on portfolio level and run simulations of the loan loss distribution within a reasonable time frame due to highly effective computing power, ICT enables the implementation of a risk-adjusted pricing throughout the bank. Risk-adjusted prices can be provided via online applications to the origination units and credit risk management can be transformed into an active risk management approach.

Accordingly, this new dynamic approach can be described as an **originate-and-distribute** business model. Credit is now considered an asset class of its own, requiring management and trading at the portfolio level. On the one hand, this innovation requires new processes and structures within the bank (former integrated divisions, e.g. origination and credit risk control, must be separated and credit portfolio management must be initiated). After reorganization, the deconstruction of the bank's internal value chain permits make-or-buy decisions for every division that does not add value on a risk-adjusted performance basis [26]. On the other hand, functional and liquid secondary markets for trading and hedging credit risk are required, as this is crucial for a flexible and centralized credit risk management on the portfolio level.

In the literature [8], three different types of future bank strategies with regards to credit risk management are discussed, i.e.

- the investment banking paradigm (banks as intermediaries without direct risk taking),
- the reinsurance paradigm (banks as risk takers, buy insurance against large losses) or
- the asset backed finance paradigm (banks as risk managers).

Those paradigms may not be applied in their pure form. However, different risk management approaches for different asset classes (large loans versus SME facilities) seem to be likely and require a changed organization form within the bank. See figure 2 for an illustration of an idealized new business model for commercial banks, introducing separation of origination and credit control and the new function of portfolio management for loans.

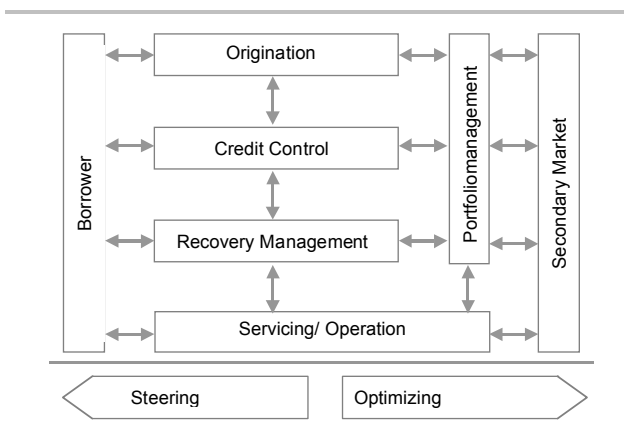


Figure 2: New Business Model "Credit"

3.2. Managing Credit on Portfolio Level

The portfolio manager in this business model is responsible for the optimization of the risk-return ratio of the portfolio. There are two options to do so. First, one needs to define the risk costs of the loan prices (expected loss and costs of economic capital). Ideally, benchmark credit spreads from bonds or credit derivatives traded on the secondary markets are available to compare internal mark-to-model prices to the market (avoid arbitrage against the bank). Those prices are usually not available for mid-market assets, which drives the need for innovative market solutions. However, the characteristic features of this new approach are the development of **internal markets** for credit risk and transfer prices influencing loan origination.

Second, the portfolio manager can buy and sell assets on the secondary market via synthetic credit default swaps (without selling the underlying loan), securitiza-

tions, portfolio swaps, syndications or true sale transactions to diversify the portfolio and avoid concentration risk (modern portfolio theory). This new role of **intermediation to the capital market** is only possible if platforms, instruments and market participants to do so exist, and internal rating information can be shared with the market.

Even though the modern portfolio theory by Henry Markovitz influenced the management of portfolios consisting of equities and bonds for almost thirty years, the application of this theory to loan portfolios is still in its infancy [21]. This is due to the fact, returns on loan portfolios cannot be considered normally distributed, which creates the need to simulate the respective loss distribution, calculating risk measures at the portfolio level. Furthermore, the lack of data, limited flexibility in traditional commercial loan business (no short selling, no hedging) and that returns are heavily influenced by both the actions of individuals and the credit policy of the bank, limit the application of modern portfolio theory.

According to the theory, a portfolio manager should not only select individual assets analyzed on a stand-alone basis but consider the correlation of the asset with the existing portfolio. By doing so, a portfolio manager could optimize the risk-return ratio of the portfolio and increase the efficiency of the position in terms of risk and return. As discussed, the portfolio manager may either influence the origination of new loans via pricing or manage the existing portfolio by instruments offered in secondary market. The latter is far more efficient as it gives more **flexibility** to the portfolio manager. Instruments offered by secondary credit markets allow the isolated trading of credit risk (separation of underlying loan and attributed risk). Thereby, they offer the possibility to create an individual and optimal risk-return combination for a given loan portfolio: The portfolio could get closer to the efficient frontier, earnings volatility of the bank being reduced and ultimately increasing shareholder value.

As discussed, the new paradigm in loan business is mainly driven by ICT. However, there are of course other important drivers which need to be mentioned, i.e.

- endogenous drivers (high credit losses in the early 90's due to integrated business models and not appropriate separation of competencies, adverse selection due to lack of risk-adjustment in credit prices)
- exogenous drivers (initialization of secondary credit markets, the introduction of the new Basel Capital Accord)
- methodology developments (establishment of sophisticated models to measure and analyze credit risk also on portfolio level, development of hedging strategies for loans).

Secondary credit markets for SME loans (mainly in Europe) are very young and suffer from information asymmetries and a lack of liquidity. However, increased

demand by shareholders for economic value added (also on a risk-adjusted basis) supports the need for sophisticated credit risk management on a portfolio level. The following sections discuss the challenges of performing credit risk management for loan portfolios of commercial banks.

3.3. Challenges to Credit Risk Management

Trading credit risk on secondary loan markets is the most efficient way to manage a loan portfolio. However, specifically when talking about commercial bank loan portfolios, efficient credit portfolio management is challenged by various issues.

First, the analysis of the **fair value** of credit risk is an issue. Banks use internal rating models based on quantitative and qualitative parameters to attribute an expected default frequency to a counterparty risk. This internal view needs to be shared with the markets in order to trade this risk. Mainly for SME risks there are no external ratings available and this complicates communication between market participants as they lack a common 'language'. Furthermore, banks use different portfolio models calibrated on internal loss distributions. This leads to different model prices for the loans. As well, the fair value of transactions, i.e. asset backed finance transactions is difficult to find as models of the rating agencies differ enormously and finance literature on valuation is still in its infancy [4, 9, 14].

Second, the lack of **transparency** driven by asymmetric information distribution between different agents and principals is challenging. Due to relationship banking, which is typical for SMEs, banks gather much more information about a counterparty than they are able to share with the markets. This complicates the trading of the company's loan. Additionally, as can be seen from credit spread moves on the secondary loan market [18], insider trading is a problem, as information flows within the bank, e.g. between the credit and the trading department, are not strictly prohibited by Chinese Walls. Furthermore, moral hazard exists after hedging or selling a loan, as a bank has no more incentives to service the loan as it would do with the credit risk on the balance sheet.

Third, as already mentioned, **secondary markets** are very young and highly inefficient in terms of information efficiency. Liquidity is limited, there are only a few market participants actively trading in the market, no exchange traded products are available and the market is organized on OTC (over the counter) platforms only. Transaction costs are still very high and there is empirical evidence for the market to pay a premia over a fair value for credit risk (which is again a proof of inefficiency). [8] However, as the market for credit default swaps (CDS) is growing at exponential rates, market inefficiencies are expected to be solved for this segment. For SME loans

though, hedging on single name basis, namely by CDS, is not an option due to the asymmetric information distribution coming from relationship banking.

In summation, ICT drives the possibility for banks to move from passive risk taking to an active risk management role with a deconstructed internal value chain. However, to reach the full potential of credit risk management, the above mentioned challenges need to be overcome. This can again be done by ICT, or by the establishment of electronic markets for secondary credit risk trading respectively.

4. E-Business Tools for Secondary Loan Markets

As outlined in the above section, active management of loans still faces substantial challenges. However, due to a lack of traditional market structures, there are activities developing in electronic markets, which seek to overcome challenges and create an efficient and sustainable market.

In the following, categories of platforms are defined and illustrated by describing representative examples of tools per category. The value proposition of the respective tools establishes the criteria to categorize and systematize the entire universe of existing platforms. The value proposition is – according to the focus of this article - always evaluated from a commercial bank's credit risk manager point of view with regards to the challenges discussed in the section above.

The tools are categorized in three different groups, i.e. Valuation Tools, Rating Tools and Trading Platforms. The examples within the various groups are all described following the same structure, i.e. first a short description of the main functions and second the value proposition for a credit risk manager.

4.1. Valuation Platforms

Regulators, investors, and senior management are requiring financial institutions to improve credit risk management both on a single loan and at portfolio levels. Measuring and managing portfolio performance requires forward-looking data, leading-edge analytics, and experienced insight. Additionally, the convergence of loan, bond and credit default swap (CDS) markets, mark-to-market valuation steadily gains importance as a means of managing credit portfolios.

The tools (or platforms) discussed in this section offer services to support this valuation requirement for single loans, portfolios or secondary market transactions such as Collateralized Loan Obligations (CDO).

CDO Navigator Analytics

Description: CDO Navigator Analytics is designed to meet the analytic needs of those who monitor, structure, analyze or own CDOs. It consists of five modules: The Structure Module allows clients to view and/or edit the structure of a CDO. The Binomial Module offers the Moody's model for generating cash flows of a CDO. The Structural Data Service is a library of existing structures of deals in the marketplace. The Collateral Portfolio Data Service is a data feed of current portfolio composition for each CDO. Finally, the Simulation Module provides a Monte Carlo simulator to run scenarios on a portfolio. Also, detailed portfolio and performance information on Moody's rated CDOs are available.

Value Proposition: The tool supports analyses and valuation of secondary markets transactions such as CDOs. Thereby, it reduces transaction costs by cutting short both negotiation time with rating agencies (shortened structuring phase of transactions) and information time for investors (transactions get comparable based on a common valuation basis). This results in faster time to market of transactions, which helps to actively manage a credit portfolio. Overall, this tool enables secondary markets to grow at a higher speed as more transactions could be launched faster.

CreditGrades

Description: The tool provides company-specific risk measures providing an external source for default probabilities and credit spreads. The tool's output is an indicative five-year credit spread, calculated based on equity price history, balance sheet information and a standard set of modeling assumptions. The model produces credit spreads for other maturities, as well as a term structure of default probabilities. Designed to provide indicative credit spreads to, the tool also provides a timely indication when a firm's credit becomes impaired.

Value Proposition: The tool delivers a model for investors to understand how the equity and credit markets pricing credit risk. It can serve as a pricing indicator for an illiquid credit, or as a monitoring device to identify significant credit spread movements. It can also be used as a relative value/hedging tool to take advantage of relationships between credit and equity markets analyzing how these markets may respond to major changes in a company's capital structure. Thus, it helps to overcome valuation discrepancies for illiquid loans and creates a possibility to determine mark-to-market indications as a basis for trading credit risk. This contributes enormously to overcome fair value and transparency requirements.

CDO Manager

Description: The analytical tool combines credit modeling of collateral portfolios with handling of the CDO waterfall structure (cash-flow analyses). The heart of the

analytics is a Monte Carlo simulation of the default times of the individual pieces of collateral.

Value Proposition: This tool allows analysis of complex CDO structures and base critical financial decisions on sound transaction analyses. Specifically the inclusion of waterfall structures enables the simulation of the transaction's cash flows in a consistent framework for all kinds of CDO transactions (cash flow, synthetic and hybrid). This eliminates the need for bulky spreadsheet models, increases transparency, time to market and facilitates negotiations with investors and rating agencies. The value proposition is comparable to the CDO Navigator as complex transactions to transfer credit risk become easier in terms of structuring and modeling.

Moody's KMV Credit Mark

Description: The tool is a mark-to-market platform enabling users to value credit instruments on a daily basis by combining market data, valuation models, portfolio data as well as instrument terms and conditions. Traders and originators can price new deals and portfolio managers can revalue term loans, revolving and other credit instruments with current market information.

Value Proposition: The mark-to-market valuation approach of this tool provides a benchmarking opportunity that complements traditional accrual accounting. It allows portfolio managers to identify assets requiring immediate attention, calculate capital requirements and quantify the value-added of their buy, hold and sell decisions. In addition, mark-to-market valuation provides benchmarks for transfer pricing of new assets as they move from origination to portfolio management (in contrast to mark-to-model prices only). Finally, credible market-based values facilitate negotiation between buyers and sellers when assets are hedged or securitized. Therefore, via a valuation method, transparency is increased and in the long run also secondary markets should benefit from better valuation models.

KMV CreditEdge Plus

Description: The tool provides daily EDF credit measures for publicly traded firms, observing market spreads in the bond and CDS markets. It establishes a framework to understand what the equity, bond and CDS markets are implying in relation to the price of a given entity, including its debt instruments, by focusing on credit spreads.

Value Proposition: The equity, bond and credit derivative markets emanate signals that must be understood in order to estimate an issuer's default risk and gauge the fair value of its debt instruments based on the probability of default. The platform bridges the various markets, enabling an understanding of their impact on credit risk. This information, extracted from the equity markets, lets users value the debt and credit derivative instruments that issu-

ers buy, hold, sell, hedge and securitize. Again, via valuation, secondary markets become more transparent and benefit from this tool. The tool however only provides additional/benchmark information, which can ultimately reduce the impact for credit risk management.

4.2. Rating Tools

Institutions are faced with an ever-increasing demand to quantify both public and private firm credit risk to better manage risks and mitigate losses. This demand comes not only from regulators and shareholders, but also from internal risk managers seeking to maximize their institutional return on risk.

In contrast to valuation tools, which focus either on credit spreads or valuing transaction structures of CDOs, rating tools focus on risk rather than price. Usually, risk is measured by the expected default frequency (EDF). EDF measures have become the de facto standard for lenders and investors as every internal rating system has EDFs attributed to each class of the nominal rating scale. Therefore, EDFs are the language to translate bank internal rating opinions into external. Only via EDFs does a mapping between various scales emerge as possible and communication between market participants becomes an option.

KMV Credit Edge

Description: The well-established tool provides a platform to deliver daily expected default frequency (EDF) credit measures and financial analysis data for publicly traded firms to support trading and investment decisions. A public firm's probability of default is calculated from three drivers - the market value of its assets, its volatility, and its current capital structure. It also offers notification of changes in EDF credit measures based on customized risk thresholds.

Value Proposition: External EDFs support the risk managers decision-making process, also functioning as a benchmark for internal rating models (with internal EDFs attributed) and can be incorporated into valuation and portfolio models. Therefore, this tool helps to actively trade loans on secondary markets as EDFs and enable ratings for publicly traded companies to become available. Ratings support valuations and thereby provide significant benefit trading both on primary and secondary markets. Specifically, as external ratings help to overcome the asymmetric information problems based on relationship lending. To summarize, this tool is absolutely crucial to overcome all of the above noted challenges, i.e. fair value, transparency and development of efficient secondary markets.

Moody's KMV RiskCalc

Description: This product enables users to characterize the credit risk of private companies in terms of EDF credit measures. It utilizes the Moody's KMV Credit Research Database on private companies as a basis, containing 13 million financial statements on 2.5 million businesses and over 200,000 private company defaults. As private company credit risk drivers differ between countries, private firm data is combined with local knowledge of default drivers in different countries.

Value Proposition: The value proposition is extremely similar to those of Credit Edge, except that it provides information for private and not for public firms. This makes the tool extremely powerful for risk manager of commercial banks, as the majority of loans do not have external ratings or publicly traded shares. Accurate default probabilities provide a common metric for communicating with regulators and internal staff especially for illiquid loans. Again, these rating tools are extremely powerful in this elaborately analyzed context.

Moody's Portfolio Manager

Description: The tool provides a methodology for the measurement and benchmarking of credit portfolio risk. This contains risk contributions of individual positions to portfolio risk, portfolio loss and value distributions, Monte Carlo-based risk measures for loss volatility and tail risk. This is opposed to the above mentioned credit risk on single loan level, which is measured by EDF. The approach used is based on empirical credit migration data and validated data on correlations through two business cycles. It allows users to examine the drivers of portfolio risk and economic capital, and to gain a more detailed understanding of the impact of rating, recovery, term, industry, size and other drivers of portfolio risk.

Value Proposition: The tool helps risk managers to make comparisons between sectors by providing jointly estimated correlations on actual data across retail, SME and large corporate credit risks. As banks move to allocate economic capital to customers and business units to increase the risk-return ratio of the loan portfolio, this clarity on risk drivers at the portfolio level is crucial. Even though the tool is useful for internal strategic decisions, it only indirectly supports the market development in terms of fair value, transparency or development of the market itself.

4.3. Trading Platforms

Trading platforms for credit risk establish an electronic marketplace. Principally, as credit cannot be traded over established exchanges and is organized as a mere over-the-counter business, it is vitally important for efficient trading to attract enough market players to provide volumes and liquidity. The following tools are examples

of trading platforms for credit risk either in the form of credit derivatives or in loans.

Creditex

Description: Creditex is the leading platform for e-trading in Credit Derivatives with trading possibilities for CDS indices, single-name CDS and standardized structured credit products. Creditex offers clients the flexibility of hybrid execution services through a combination of electronic and voice trading to varying degrees. These are based on factors including: the clients' location, market conditions, trading sector, product type and/or the size of the trade. The platform provides price and trade transparency allowing traders to place live orders. Furthermore, it provides straight-through-processing (STP) services for electronic, hybrid and voice trading. Clients are also able to receive intra-day and end-of-day electronic feeds of live index prices as well as trade confirmations.

Value Proposition: The platform provides a liquid market place for standardized credit derivatives transactions. It can be used for actual trades, but as a benchmark for credit spreads on the entire spectrum of credit risks traded. Also it eliminates some of the operational risks associated with the trade reconciliation process: It reduces operational costs and risks by eliminating the need for traders to manually enter trade details into their trade capture systems. Additionally, hybrid trading provides the flexibility to execute trades according to the portfolio manager's specific needs and preferences. This is not only a new feature but also very beneficial for managing middle-market, non-standard loan portfolios.

Credit Trade Portal

Description: Risk Insight, a software by Fusion Technology Group, has been developed into a product called Credit Trading Portal. Risk Insight allows the benchmarking of loan deals during origination with regard to the bank's portfolio and credit risk model. As several banks use this model, the possibility occurs of banks being able to trade their loans on a comparable basis without model arbitrage opportunities. Based on the same models, the trade portal allows banks to measure their loans both against their own portfolio as well as against other banks in different markets and regions around the world.

Value Proposition: The Credit Trade Portal offers the opportunity to swap portfolios with other banks, reduce regional or industry concentration thereby reducing the portfolio risk via diversification. Transaction costs are reduced as the structuring of cumbersome CDO transactions is no longer necessary and information costs are limited as the portal provides information on the optimal trading partner. However mutually trading of a bank's concentration area is highly exposed to reputational risk towards shareholders. The tool supports the development

of secondary markets as well as transparency and fair value analyses on a shared model basis.

Q-WIXX

Description: Q-Wixx is an electronic platform for trading large portfolios of single-name credit default swaps (CDS) based on an electronic auction process. It facilitates bulk execution of credit derivative transactions such as "bids wanted in competition" or "offers wanted in competition" portfolios (lists regularly containing over 100 credit derivative names). It provides straight through processing via a settlement platform known as T-Zero, which checks trades between dealers and their customers immediately after they are made.

Value Proposition: The platform (newly launched in June 2007) is expected to save market participants significant amounts of time and effort when they wish to buy or sell an entire set of different credit default swaps at the same time. It reduces market risk, operational risk and costs by eliminating the cumbersome, manually intensive price discovery, execution and trade booking processes often associated with credit derivative list trading. The system allows efficient execution of single-name CDS portfolios with competitive pricing from participating dealers. Therefore, it contributes to the secondary markets development, fair value and transparency like Creditex does. However, the product traded is only of limited use to a commercial bank's credit risk manager.

4.4. Overview of E-Business Tools

Based on the detailed discussion with respect to the various e-business tools and their respective value proposition for credit risk management of commercial banks, the impact can now be summarized.

To do so, Table 1 gives an overview of the impact of the tools on the challenges to credit risk management. Firstly, the fair value of transactions, single loans or loan portfolios. Secondly, reaching transparency in the markets to overcome asymmetric information distribution and thirdly the development of an efficient and liquid secondary market for credit risk.

As discussed, every category contributes substantially to the solution, i.e. the development of an active credit risk management system allowing active trading and flexible position taking comparable to other asset classes like equities or bonds. No category of tools is redundant as they all contribute value within the defined frameworks, which indicates sustainability and supports their continued existence. Based on these first results, future research might quantify the value creation of the tools in detail to be able to deviate a likely future market structure for credit risk management.

Classifi- cation	Tool	Impact on		
		Fair Value	Transparency	Secondary Markets
Valuation	CDO Navigator	high	low	mid
	CreditGrades	high	high	low
	CDO Manager	high	mid	mid
	Credit Mark	high	mid	mid
	Credit Edge Plus	mid	mid	mid
Rating	Credit Edge	high	high	high
	RiskCalc	mid	high	high
	Portfolio Manager	mid	low	low
Trading	Creditex	mid	mid	high
	Credit Trade Portal	high	high	high
	Q-Wixx	mid	mid	high

Table 1: Overview E-Business Tools and their value proposition for challenges to credit risk management

5. Conclusions

This paper focuses on the impact of ICT on value creation focusing on the financial industry and, more specific, on credit risk management of commercial banks. We have presented a framework which can be used to analyze the impact on value creation by looking at various issues, such as when focusing on the loan business of commercial banks we emphasized the industry **structure** issue. The analysis of e-business tools in the area of credit risk management results in three distinct categories all of which are valuation platforms, rating tools, and trading platforms. The analysis demonstrates clearly these tools support the deconstruction of the traditional loan business model and lead to new business models - addressing **processes** - leading to new market players like trading and rating platforms - addressing **structures**. They result in new services in the loan business like credit derivatives as a new asset class - addressing **products** - based on ICT infrastructures.

Furthermore, we have shown that not only loan originations have been impacted by ICT means so far but the credit risk management as well. This again has an effect on the origination and thus the business model as such. This supports the finding that the impact on the loan business is sustainable and irreversible and is changing the business step by step. Nevertheless, it can also be seen very clearly as well that developments with respect to adoption to the business are progressing on a protracted basis.

A systematic validation of our findings is still missing. We would like to propose that based on the presented results and further research a more thorough validation could be done similar to the ones done by Hess and Kemerer [11] or Steinfield et al. [24]. Hess and Kemerer tested predictions derived from the Electronic Markets hypothesis against empirical results of five case studies focusing on computerized loan origination. This paper, its material and results could serve as a starting point for a similar study. A comparison of the findings would be extremely valuable for scholars as well as practitioners.

Furthermore, concerning the limitations of the paper, it has to be stated the analysis is based on the evaluation of tools available in the market as of mid 2007. It is obvious and also proved by prior analyses by Westerfeld [27] that in this specific field the emergence and development of tools is gaining pace and the analysis provides a snapshot only.

Beyond validation of the results the further developments of innovative business models for the loan business will be subject to further research.

“However, the way in which future technological innovation is likely to modify banking organizations, both externally (product or service) and internally (operational function), continues to be uncertain” [2].

6. References

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