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The E-Finance Lab after Six Years of Success –
Strategic Review and New Structure

The Verbal Side of Financial Data Analysis –
A Study on Machine Learning Capabilities

How did Banks' Problems spill
over to the Real Sector?

A preliminary Analysis

The Financial Crisis –
Consequences for Online Banks



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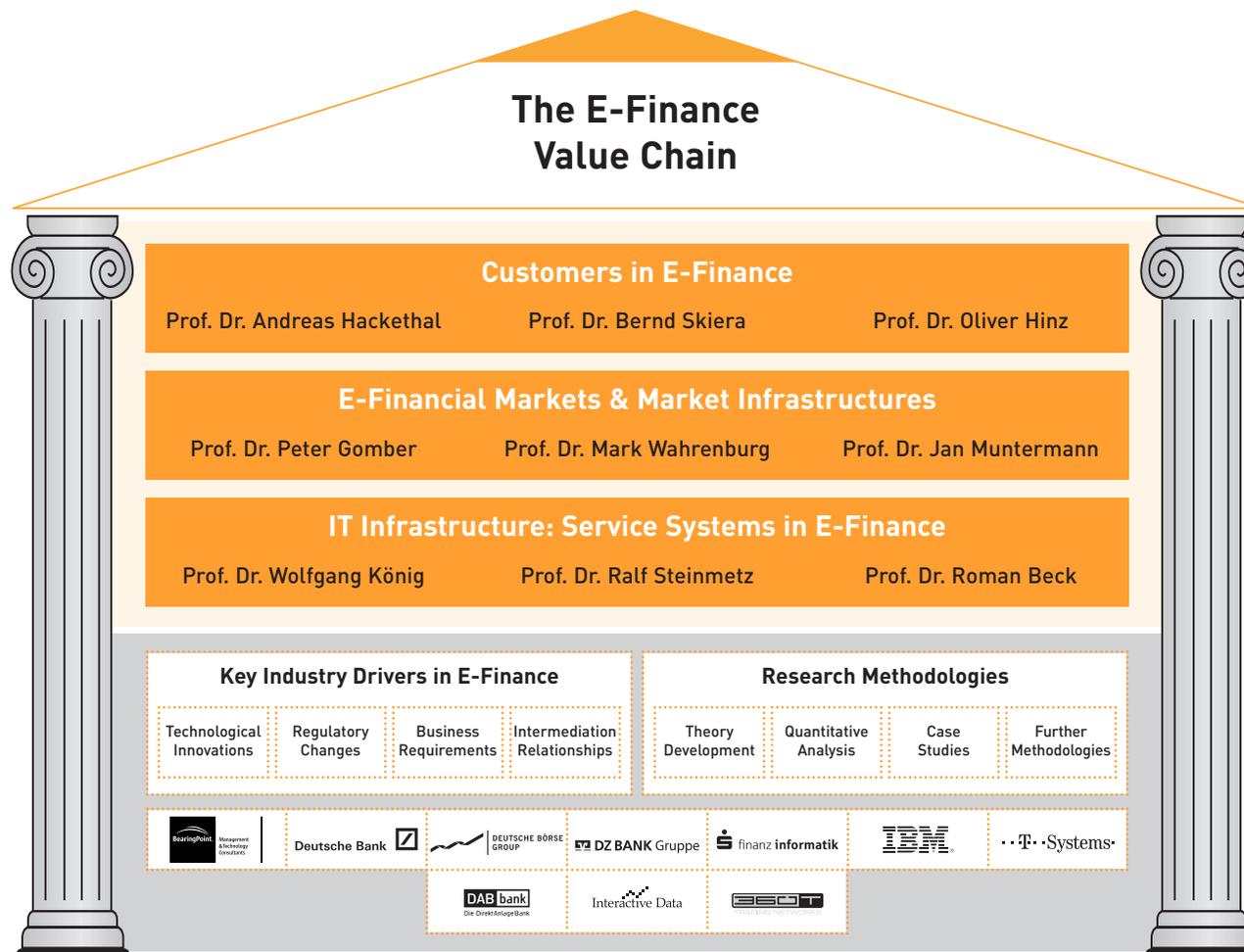
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Editorial

The E-Finance Lab after Six Years of Success – Strategic Review and New Structure

Peter Gomber Wolfgang König



For more than a year, the E-Finance Lab has been a proud resident of the House of Finance (HoF) of Frankfurt's Goethe University (www.hof.uni-frankfurt.de) – an interdisciplinary institution comprising 150 researchers and 6 research and advanced teaching institutions in finance (part of business administration), money & macroeconomics (part of economics) and corporate & financial law, complemented by expertise in information systems and technologies, and mathematics. Both the HoF and the E-Finance Lab – the largest research institute within the HoF – as well as our industry partners are affected by the financial crisis and the questions on its roots and on the effectiveness of measures taken or to be taken in its aftermath: Which lessons do we have to learn from the financial crisis? How did information systems and electronic networks contribute and how can they be used to overcome and to ease unwanted results of the crisis?

Against the background of both our integration into the HoF and the new environment for the financial industry due to the crisis, together with our industry partners, we decided after a strategic review to replace the traditional five pillar structure of the E-Finance Lab by a novel three stacked layer model (see figure) effective January 2010, each layer being jointly led by two professors plus a junior professor. Moreover, the overall research subject of the E-Finance Lab has been adjusted to "The E-Finance Value Chain" – its optimization and integration.

The objective of the reorganization is fourfold: First, we better integrate the E-Finance Lab in itself. Second, we improve interfaces to research areas within the HoF, e.g. with respect to systemic risk management or to customers in financial services institutions. Third, we want to leverage our "unique selling proposition" relative to other research institutes: the integration of research methodologies in information systems research (the „E“) with methodologies in finance. Fourth, we want to clearly and easily communicate the key focus themes of our research: IT Infrastructure, Market Infrastructure and Customers.

Research Report

The Verbal Side of Financial Data Analysis – A Study on Machine Learning Capabilities

AS A MATTER OF COURSE, QUANTITATIVE DATA SUCH AS TIME SERIES AND QUARTERLY FIGURES ARE FREQUENTLY USED IN FINANCIAL ANALYSIS. SUCH DATA CAN BE PROCESSED AUTOMATICALLY AND INTERPRETED RATHER EFFICIENTLY. HOWEVER, A SIGNIFICANT PERCENTAGE OF RELEVANT INFORMATION ORIGINATES FROM UNSTRUCTURED SOURCES, PRIMARILY TEXTUAL DATA, WHICH REQUIRE MANUAL (HUMAN) INTERPRETATION. WE EXPLORE EMPIRICALLY HOW MACHINE LEARNING TECHNIQUES CAN PROVIDE SUPPORT FOR ANALYZING AND INTERPRETING SUCH TEXTUAL DATA SOURCES.

Jan Muntermann

Introduction

Information management is one of the most challenging tasks for financial institutions. In the last two decades, much progress has been made in the development of quantitative models and approaches. While much effort has been put on the extensive analysis of quantitative data such as historical price series, little intention has been paid to the (automated) analysis of textual data in the past, which undoubtedly represents a large source of information in this context.

Prior empirical research has shown that certain news stories such as corporate disclosures can cause abnormal market behavior subsequent to their publication, which provides further evidence that textual data represents a highly

Sven S. Groth

relevant source of new information. On the basis of a dataset that comprises corporate news stories and intraday stock prices, this article explores how such textual data can be analyzed with the help of machine learning techniques.

What is Machine Learning?

Machine learning techniques comprise a family of methods that attempt to allow machines to acquire knowledge for problem solving by showing them historical cases. In a financial context, such historical cases can, for instance, be a sample of news publications that have been mapped to stock price reactions observed on the capital markets. Popular examples of machine learning techniques represent Decision Trees and Artificial Neural Networks,

which have already been successfully applied since the 1960s and the 1980s, respectively. The following Figure 1 illustrates how different generations of machine learning techniques have emerged in the last decades. Each of these techniques has specific characteristics, capabilities and shortcomings. These, for example, entail different learning strategies, dataset requirements and computing times. Since textual data is highly unstructured, the automated analysis represents a major challenge. Here, newer machine learning techniques such as Support Vector Machines (SVM) have revealed to be especially promising. In general, these methods aim at forecasting if a certain example (e.g. a newly published news story) belongs to one of two categories such as “relevant” and “not relevant”. On the basis of given training examples, the SVM builds a model that for instance aims at predicting if a future news story belongs to the “relevant” or the “not relevant” group. What “relevant” and “not relevant”

exactly means can be defined by the analyst, who might wish to evaluate whether a price reaction will be “strong or weak” or “positive, neutral, or negative” (Groth and Muntermann, 2009).

During the following analysis, we will exemplarily show the application of machine learning techniques in the financial domain. Hereby, we aim to forecast whether or not the publication of a new corporate disclosure is followed by extremely high abnormal volatility levels.

Textual Data Does Matter

Pursuing this attempt, our analysis is based on corporate disclosures and corresponding firms’ intraday stock prices that were observed prior and subsequent to the disclosures’ publication dates. For different 15 minutes intervals, realized volatilities were calculated in order to explore whether or not such publications will trigger significant capital market activities. Furthermore, the volatility observed subse-

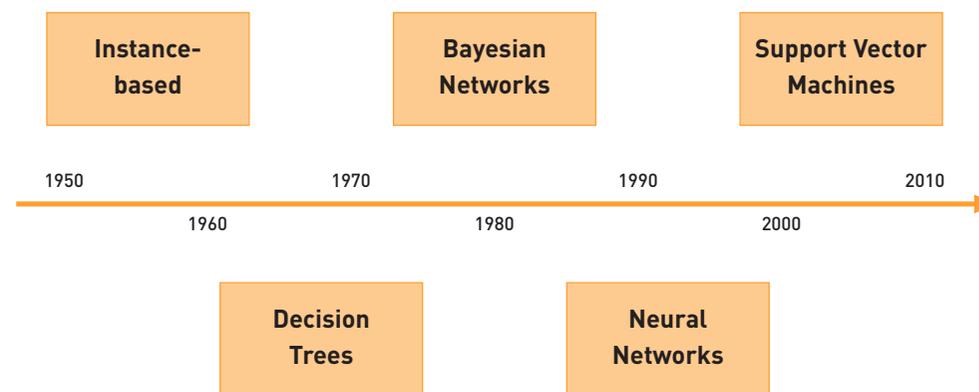


Figure 1: Machine Learning Techniques

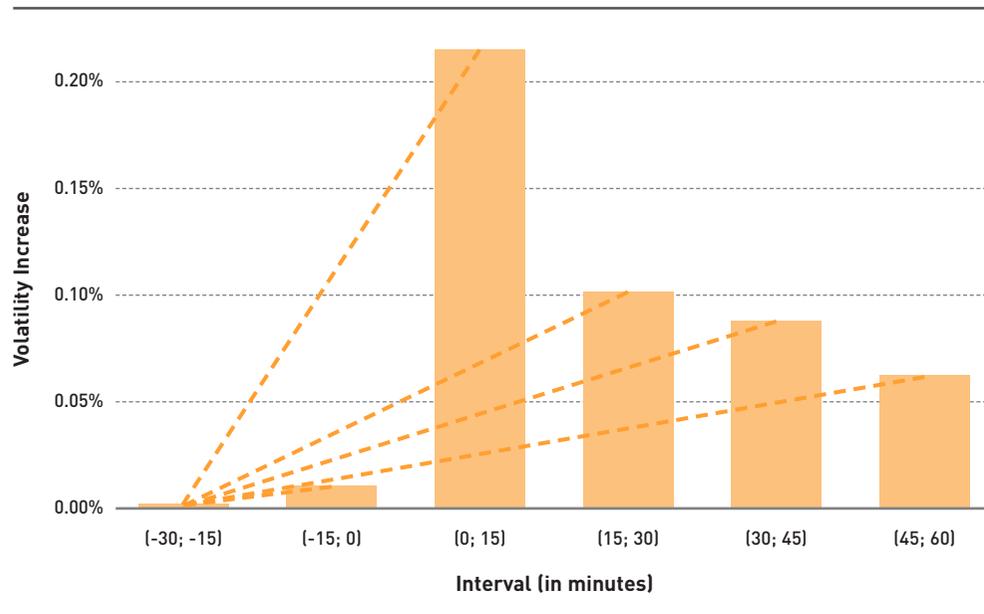


Figure 2: Volatility Shocks following News Publications

quent to the publication of corporate disclosures is adjusted by volatility levels observed during “normal” market phases. Consequently the volatility increases shown in Figure 2 are expected to be above zero during abnormal market phases only. In financial management, such volatility shocks attract much attention, especially in risk management.

As we can also see in Figure 2, negligible volatility increases can be observed for the intervals prior to the publication dates of the corporate disclosures. In contrast, significant volatility increases follow their publication. Over the course of time, the volatility adjusts to a normal level. It may therefore be concluded that the information contained in the corporate

disclosures may entail abnormal volatility levels.

“Learning Machines” that Read

Within our samples of corporate disclosures there exist some that resulted in significantly increased volatility, while others seem to attract little attention only. Traditionally, an analyst would manually review the disclosures and assess their relevance. Given the corporate disclosures and the calculated volatility increases, we define a corresponding learning task: Let a computer learn from historical data with the goal to identify those disclosures that resulted in the 25% highest volatility increases during the first 15 minutes following the disclosures’ publication. In other words, based on a disclosure’s content, automatically assign it

to either the class with expected extremely high abnormal volatility levels or the class with expected normal volatility levels. This task is divided into two sub-phases. A learning phase in which the computer develops a model from provided observations and an application phase in which the model is deployed. Here, other observations are evaluated that were not part of the learning dataset. We have used a Support Vector Machine (SVM) algorithm in order to learn a model that can be applied to the textual corporate disclosures. In simple words, the SVM aims to find two distinctive areas in a multidimensional space, where each word represents one of these dimensions and where the two areas divide existing documents into two different classes.

Forecasting Results

Our results provide evidence that the proposed machine learning approach is capable to detect patterns in the disclosure contents. We applied different evaluation metrics to evaluate how well the automated text analysis works. One has to distinguish between how many cases were identified correctly (precision) and how many of all relevant disclosures were identified (recall). Usually, a higher precision can only be achieved by accepting a lower recall and vice versa. In order to influence the inherent trade-off, we additionally included misclassification costs as a steering mechanism. We were for example able to modify settings in such a way that each corporate disclosure that was assigned to the “extremely high volatility class” actually belongs there (i.e. 100% precision). In this scenario, however,

merely 33.02% (recall) of all “extremely high volatility”-entailing corporate disclosures were grasped.

Conclusion

Latest machine learning techniques such as Support Vector Machines represent promising approaches to capitalize more efficiently on the massive amounts of available textual data in financial processes. Our empirical analyses have shown that the applied algorithms were able to detect patterns in the disclosure contents and forecasting results were significantly better than random guessing. The field of application in the financial context is manifold (e.g. Fung et al., 2005). One possible application field could be algorithmic trading, where transactions might be triggered based on analyzed textual data. This application can already be observed in latest industry developments. With regard to the observed volatility increases, market monitoring tools may support the management of intraday market risks.

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Research Report

How did Banks' Problems spill over to the Real Sector? A preliminary Analysis

THE PRESENT ARTICLE TRIES TO DEMYSTIFY THE LINK BETWEEN THE SUBPRIME BANKING CRISIS AND THE SUBSEQUENT FALL IN GROSS DOMESTIC PRODUCT. AN UP-TO-DATE REVIEW OF THE LITERATURE ON THE REAL CONSEQUENCES OF THE LOSS OF BANK LENDING CAPACITY IS PROVIDED, PRESENTING EVIDENCE OF A DECLINE IN NEW BANK LOANS ALONG WITH EVIDENCE OF CORPORATE REACTIONS TO THIS DECLINE. FINALLY, IT IS SHOWN HOW THE PRESENTED FACTS CAN ADD UP TO AN EVENT OF MACROECONOMIC DIMENSION.

Jens Kruk

Introduction

If one follows the popular press and public debates over the last two years, the impression comes up that the emergence of the current banking crisis is better understood than how problems of the banking sector spread to the macro-economy. Against this background, a careful description of the operation mode and necessity of the banking sector is provided, and it will then be shown how stress in the banking sector can spill over to the real sector.

The Key Mechanism: Costly external Finance

In a world where the renowned Modigliani Miller theorems hold, a crisis like the current one could hardly have emerged. The Modigliani Miller theorems state that the business activities of a firm are independent of the firm's financial structure and its sources of financing. Particularly, all sources of financing are equally

attractive and external financing (IPOs, seasoned offerings, bond placements and bank loans) is considered costless, because the conditions are 'fair'. In such a world, banks are not very important for corporate finance, and all profitable investment projects are carried out. However, research over the last half century presented evidence of the existence of a so called pecking order of financing. "Pecking order" simply means that companies consider internal funds cheaper than external financing. External finance is costly and firms are sometimes unwilling to raise external funds, even when these funds could alternatively be used for profitable investment projects. Companies particularly dislike issuing equity. Explaining the reasons for the pecking order is beyond the scope of this article, but they are generally assumed to be driven by asymmetric information. Information is asymmetric in the sense

that the management of a firm, acting in the interest of current shareholders, possesses superior information about risk, value and quality of the company and its investment prospects compared to potential external investors. One way to overcome asymmetric information is to produce information. Producing information includes conducting interviews

to grant loans that banks without such information would not be willing to grant. If this so called relationship lender suffers from a shortage of capital and reduces lending, a corporate could be rejected a loan and could therefore be forced to forego a beneficial expenditure. Lending from the relationship lender cannot easily be substituted by other sources of

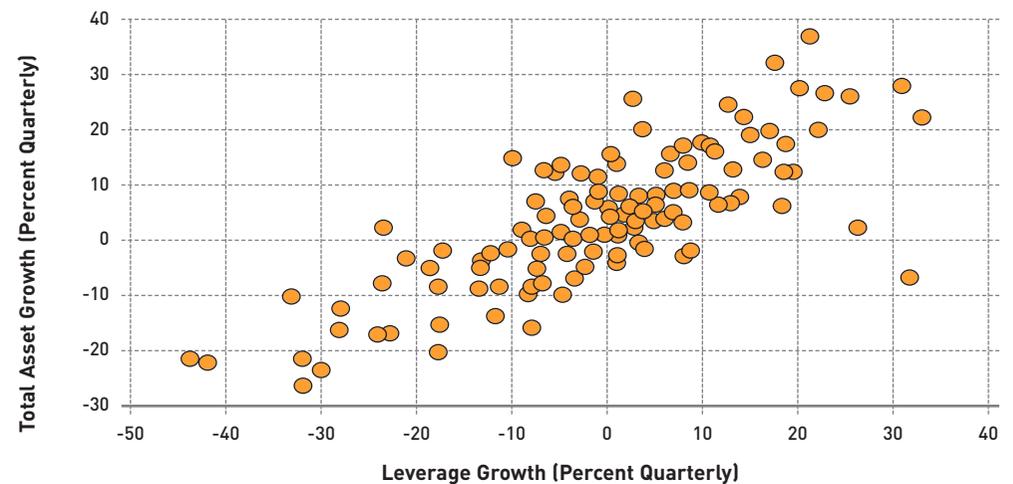


Figure 1: Changes of financial leverage of banks in times of declining asset values (Adrian and Shin, 2008).

The graph shows procyclical leverage.

with company representatives, collecting data, visiting factories and analyzing sector information. But information production is costly and is often only conducted when a long term relationship to the borrower exists or is being established, so that information produced once can be used for several consecutive loans. If a corporate uses a close long-term relation to a bank, it might pay off for the bank to acquire extensive information about the corporate and

financing, because the relationship lender has proprietary information about the prospective borrower.

The Effects of the Subprime Crisis on Banks

Causes of the problems that banks had in the last two and a half years have been well explained and well understood, e.g. tremendous capital shocks on the asset side followed by run-like problems on the liability side of the

balance sheet (Acharya and Schnabl, 2009). The most important consequence of these events is that banks lost a lot of capital and had difficulties in raising necessary funds. However, the details of the problems of banks shall not be subject of this article.

It will be taken as given that bank capital was in very short supply and the financial condition of banks was largely opaque to potential external investors. Banks, due to the reasons explained above, were unwilling to raise equity. And since banks need a certain amount of bank capital to comply with regulatory rules, they cannot simply replace equity by debt. A situation in which banks are rationing credit because they are short of capital is often called a credit crunch. Consequentially, not all corporates can refer to their relationship lender to fund investments. Such firms can react by using other sources of financing, which is problematic for the reasons mentioned above, or by reducing expenditures. There are two strands of evidence for the presented idea of a credit crunch caused by a loss of bank capital. Evidence of a reduction in bank lending and reactions of the corporate sector will be described.

Bank Lending during the Crisis

The literature recognizes three reasons for the decline in bank lending capacity since the beginning of the crisis in 2007. First, assets held by banks suffered from severe price reductions, causing massive writedowns by banks. Second, in times of financial instability, certain banks usually deleverage. Figure 1 shows that in recent episodes of financial instability, leverage

was reduced strongly (Adrian and Shin, 2008). A reduction of leverage with rigid capital results in a reduction of assets. Third, before the financial crisis, many banks held assets via off-balance-sheet entities such as conduits. Typically, banks provided liquidity or credit enhancement for their conduits and received the spread between the return on the assets held by the conduit

commercial paper, many banks took the assets of the conduits back on their own balance sheets or conduits tapped credit lines from their sponsoring banks (Acharya and Schnabl, 2009). This bound already scarce bank capital. None of the three developments described above would have been a problem if banks had been willing to raise sufficient external equity. However,

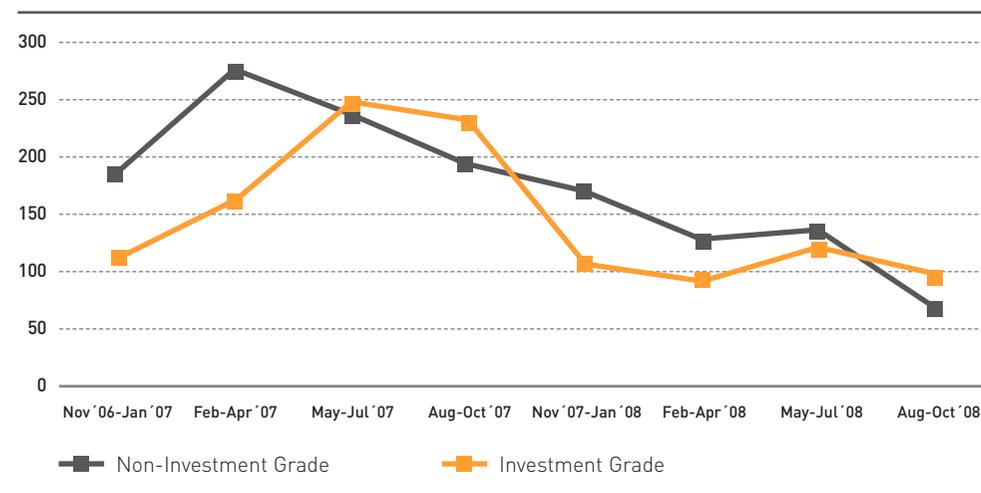


Figure 2: Development of new bank loans (in USD billions) during the crisis (Ivashina and Scharfstein, 2009).

and the interest on the asset-backed commercial paper issued by the conduit. The provision of liquidity or credit enhancement *de facto* means that the sponsoring bank insures the asset-backed commercial paper investors against credit risk and other risks of a conduit. One advantage of conduits over direct holding of the respective assets from a bank's perspective is the lower capital requirement of off-balance-sheet asset holding through conduits. After investor confidence eroded and conduits were no longer able to roll over asset-backed com-

mercial paper, many banks took the assets of the conduits back on their own balance sheets or conduits tapped credit lines from their sponsoring banks (Acharya and Schnabl, 2009). This bound already scarce bank capital. None of the three developments described above would have been a problem if banks had been willing to raise sufficient external equity. Researchers extrapolated losses of USD 250 billion of US banks, which seems to be a rather modest amount in the review, to a total contraction of lending to the real sector of around USD one

trillion (Greenlaw et al., 2008). Further calculations suggest that such a contraction of lending could be responsible for a substantial contraction of gross domestic product (Greenlaw et al., 2008). In addition, figure 2 documents a substantial decrease in new bank lending of US banks in September to November 2008 compared to the peak period in 2007 (Ivashina and Scharfstein, 2009).

Evidence from the real Sector

The analysis of bank lending will now be supplemented by an investigation of borrower behavior. First, firms which suffered particularly after the onset of the crisis are fundamentally different from firms which suffered most from the terrorist attacks of 9/11 (Tong and Wei, 2008). Firms, which suffered particularly in the four weeks following 9/11 (labeled 'Sensitivity' in figure 3), are assumed to depend strongly on consumer confidence, because the 9/11 terrorist attacks raised concerns about the future economic development and political stability, while difficulties in getting credit did not play a role during this period. Furthermore, Tong and Wei identify firms which were characterized by difficulties to obtain credit before the crisis began (labeled 'Constraint' in figure 3). Then, they compare the stock price development of these two groups after 9/11 and after August 9th 2007, when a serious escalation of the banking crisis occurred. While after 9/11, stocks of firms, that depend on consumer confidence, declined more than stocks of credit constrained firms, the opposite was observed following August 9th 2007 (see figure 3). This is evidence for the view that difficulties in obtaining

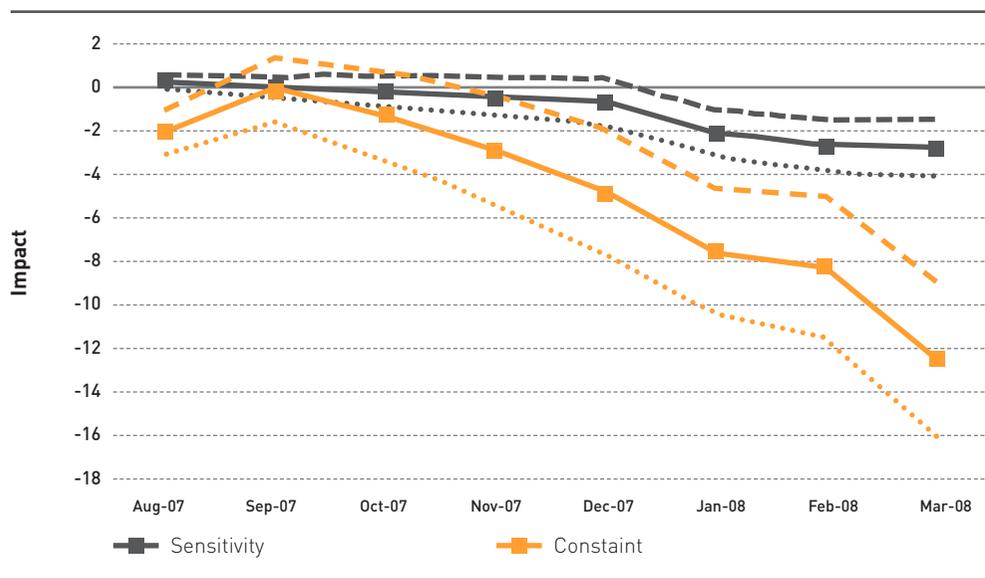


Figure 3: Effect of the subprime crisis on stock prices of firms that are credit constrained ('Constraint') or that depend on consumer confidence ('Sensitivity') (Tong and Wei, 2008)

credit are the driving force behind the current economic decline.

Second, firms which had little cash in mid 2006 reduced investment from the period mid-2006 – mid-2007 to mid-2007 – mid-2008 more than otherwise comparable firms with more cash (Duchin et al., 2009). This difference could not be detected in normal times when credit was easily available. The explanation is that in normal times, firms, which have little cash, are financing their investments externally with loans and therefore show investment behavior similar to otherwise identical cash rich firms. In times of a credit crunch, credit is difficult to obtain and firms with little cash have to cut their investments. Third, otherwise similar firms, which only

differ in terms of the maturity of their debt, exhibited different investment behavior in the crisis, while such a difference could not be discovered in normal times (Almeida et al., 2009). Firms, with debt maturing right at the onset of the current crisis, reduced investment by 2.5 percent more than otherwise similar firms with a longer duration until debt maturity. The interpretation is straightforward: when banks cut lending, firms depending on lending are hurt a lot more than firms with sufficient internal funds. So some firms' debt is not rolled over in times of a credit crunch and these firms react by a reduction of investment. The fourth type of evidence comes from a global survey of CFOs of large companies. Firms with CFOs who reported to be credit constrained reduced capital spending,

employment and planned R&D expenditures substantially more than comparable firms with CFOs who reported not to be credit constrained (Campello et al., 2009). Furthermore, such firms used existing cash and drew credit lines to make up for their difficulties in obtaining external finance. In addition, credit constrained firms far more often reported to forego profitable investment projects.

The presented evidence from exploring bank and corporate data suggests that corporate investment is important in explaining the downturn in gross domestic product. Indeed, macroeconomic statistics show aggregate investment was reduced by about 4 percent in the US between mid-2007 and mid-2008, a number that is consistent with the micro evidence presented above.

Conclusion

The analysis at hand explains how frictions in the corporate financing process can result in a credit crunch. In a world without financial frictions (where the Modigliani Miller theorems hold), it seems implausible that macroeconomic stress could originate in the banking sector.

Layer II of the E-Finance Lab is currently investigating how the relationship to a particular bank influenced the development of a firm during the crisis.

The analysis is preliminary and much more research will discuss the current crisis. However, the key mechanism explained in this article will certainly play a prominent role in further discussions.

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Insideview

The Financial Crisis – Consequences for Online Banks

INTERVIEW WITH DR. MARKUS WALCH, DAB BANK

The crisis left many clients underinvested due to continuing uncertainty in securities markets and extremely low interest rates in money markets. Could you please first of all illustrate what has changed for DAB bank as an online bank/broker during and in the aftermath of the financial crisis?

Investors are still very cautious following the financial crisis. Since autumn 2008, turnover figures of German exchanges indicate investors' reluctance to place securities transactions, which is also reflected in our customers' behavior.

Since our credit business is limited to margin loans, we are having a high debit carryover on hand. Investing those funds in a safe and sustainable manner has been a real challenge throughout the financial crisis.

But we mastered that challenge: a strong and independent product range, a balanced portfolio strategy within our treasury portfolio, and strict cost discipline lead to profitability in 2009

with earnings before taxes of 26.5m EUR already after 9 months.

Has the clients' demand for investment advice increased?

It definitely has. Typical customers of online banks can be classified as "self-directors" who look after their financial investments in a self-determined manner. For this customer base, we offer a broad set of information services and market-leading trading applications.

At the same time, one can also take notice of customers' growing demand for an "investments sparring partner" and for fair and independent advice. As a direct bank, we cover a wide range of investment advice: Either via telephone through our Private Banking Team or face-to-face through Asset Managers with whom we liaise closely in our B2B business.

What is the impact of new regulatory guidelines on the process of providing investment advice?



Dr. Markus Walch
Member of the Board
DAB bank AG

Online banks can respond to regulatory changes with clever solutions. For instance, we developed a process to communicate counseling minutes immediately after the interview. Subsequent to the counseling session, these minutes are sent to the customer via email, who is then able to confirm them through a personalized URL.

What is the impact of the crisis on the competitive playing field between direct banks/online brokers and bricks-and-mortar banks?

The financial crisis revealed to many clients that they had previously been badly advised, for instance in cases where customers' portfolios at bricks-and-mortar banks mainly held in-house products. Direct banks like DAB bank, in contrast, are better able to position their product range independently.

A recent study exposed that five million customers of bricks-and-mortar banks are currently thinking of switching to a direct bank. We assume that the financial crisis will rein-

force this trend. It will also be amplified by the growing number of online users in Germany and the increasing price sensitivity of bank customers.

Is "independent advice" in B2C business a model for the future and what is the impact on B2B relations?

It is our goal to offer every customer type appropriate investment advice and support depending on financial know-how, portfolio volume and investment horizon. This may include advice via telephone by B2C-personnel or on-site support by independent financial advisors. These approaches are not meant to compete, but rather to complement and to strengthen one another.

As you can see, online banks offer a broad range of products, which make them well prepared for the future.

Thank you for this interesting conversation.

Infopool

News

New EFL Tier-2 partner

We are pleased to announce that as of January 2010, a new Tier-2 partner has joined the E-Finance Lab: 360 Treasury Systems AG (360T) owns and maintains advanced trading technologies for foreign exchange and money market instruments capable of trading in streaming-price and quote-request mode. Furthermore, the company offers a professional white label trading technology for internal electronic trading services on a proprietary branded platform. Clients are multinational corporate treasuries, asset managers, hedge funds, broker/dealers and buy-side banks. Founded in 2000 and headquartered in Frankfurt, 360T maintains subsidiaries in New York and Singapore. Welcome to the E-Finance Lab!

Awards and dissertations

E-Finance Lab researchers Prof. Roman Beck and Robert Gregory, together with Oliver Marscholke, were awarded the best paper award at the 4th Pre-ICIS International Research Workshop on IT Project Management (www.sigitprojmgt.org) in Phoenix, USA. With their research, they show how boundary spanning mechanisms help to bridge the diverging interests of different stakeholders in IT projects. Congratulations!

Dipl.-Wirtsch.-Ing. Julian Eckert (Layer I) has received his doctoral degree on October 6th, 2009, with a dissertation on "Cross-organizational Service-based Workflows – Solution Strategies for Quality of Service Optimization". Congratulations!

On November 19th, 2009, Eva Gerstmeier (former researcher at the E-Finance Lab) successfully defended her Ph.D. thesis "Interactive Pricing Mechanisms". In particular, she analyzed in her thesis how financial service providers should react to the wider popularity of those pricing mechanisms, which are nowadays frequently used for pricing online advertisements. In 2008, a proposal for this thesis was awarded with the prize of the Horizont foundation. Congratulations!

E-Finance Lab Spring Conference 2010 "The New Financial Markets Infrastructure – Trading and Clearing", February 23rd, 2010.

The E-Finance Lab Spring Conference 2010 will be held at the Westend Campus of the Goethe-University (Casino), Frankfurt, on February 23rd, 2010 (starting at 2 pm).

For further information and registration see

<http://www.efinancelab.de/events/conferences/fruehjahrstagung-2010/>

Selected E-Finance Lab publications

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Babbling Before Banking? Online Communities and Pre-Purchase Information Seeking in Financial Services.

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For a comprehensive list of all E-Finance Lab publications see:

<http://www.efinancelab.com/publications>

Infopool

RESEARCH PAPER: BUSINESS ENTITIES: A SOA APPROACH TO PROGRESSIVE CORE BANKING RENOVATION

Recent challenges in the banking industry force banks to renovate their core banking systems in order to survive competition. Thus, a progressive renovation approach is preferable to total replacement strategies because it is less intrusive and less risky.

This paper presents an incremental core banking renovation methodology based on the concept of business entities. The methodology is implemented in order to develop a SOA solution for dynamic product bundling for an Asian bank. The corresponding renovation project provided an opportunity to explore SOA design principles regarding service component modularity, service reusability, change management and integration, and also to empirically demonstrate the advantages of the business entity-centric approach in achieving well-designed SOA solutions.

Liu, R.; Wu, F.; Patnaik, Y.; Kumaran, S.

In: IEEE International Conference on Services Computing (SCC) 2009. pp. 466–473.

RESEARCH PAPER: THE REINFORCING EFFECTS OF LOYALTY PROGRAM PARTNERSHIPS AND CORE SERVICE USAGE

The authors investigate cross-buying across loyalty program partnerships. Their results suggest that customer usage of – and satisfaction with – the core service influences customer cross-buying from loyalty program partners. The cross-buying behavior then reinforces the customer’s relationship with the core service, as cross-buying positively influences future purchases of the core service. If the objective of a loyalty program is to increase the customer’s usage of the bank’s core products and services, they should choose loyalty program partners that offer a good fit with the core product or service. Furthermore, marketing strategies that seek to increase customer satisfaction may pay off twice – once for the direct effect on core service usage and once for the indirect effect through cross-buying. This double pay-off increases the return on customer satisfaction or service quality. As a consequence, financial service providers that have set up a loyalty program with many good-fitting partners may be better able to amortize high investments in service quality through the returns, not only from repurchases but also from cross-buying from their partners.

Lemon, K. N.; v. Wangenheim, F.

In: Journal of Service Research 11 (2009) 4, pp. 357–370.

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