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RÉSUMÉ OF THE PH.D. THESIS

Nóra Ágota Felföldi-Szűcs

Lending in case of defaulting customer

The credit decision of the bank and the supplier

Ph.D. dissertation

Supervisors:

Júlia Király, Ph. D.
honorary professor

Péter Csóka, Ph. D.
associate professor

Budapest, 2011

Department of Finance

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Contents

1. Research preludes and the justification of the topic

The main thought of my thesis is relatively wide circle of financial problems which are due to the non-paying customer. The topic connected to non-paying customers appears in more dimensions from the additional credit rationing the supplier has to face to the analysis of a concrete customer portfolio.

The credit rationing is a central element in my thesis, so as a first step I give a short definition for the term. When firms apply for external financing there is informational asymmetry amongst the parties, what gives wide room for moral hazard. The answer of the financers to this situation is credit rationing. Some of the clients will have a smaller loan, than it is requested at the given level of interest, or not every client who is capable for paying back the loan will be financed. If the value creating projects with positive net present value can not be realized because of the lack of financing, then we are facing with a harmful situation at the social level, therefore it is economically reasonable to ease this problem.

The structure of the dissertation is justified by an association connected to credit rationing. The first part of the association leads us to the countries of the distant Third World to the poorest of the poor.

Due to micro-lending, and especially due to the innovation of group lending the „unbankable" layer become financeable, moreover the maintenance of the lending institutes, the MFI's is imaginable in the long run.

The second part of the association, that however the national micro and small- and medium-size enterprises (SME) could function as the engine of economic growth, the SME's of our region are suffering from sub-capitalization, and the lack of financing. It can be said that next to the known bank constructions more firms would like to get a loan, than the amount who receives the loan. Thus the suspicion arises, that the sector faces credit rationing. The relationship of bank financing and credit rationing is already determined by the literature that's why I have stepped forward with one thought in theoretical modeling. The other practical problem of the SME's is – not only in Hungary- the chain debt and overdue customers. By combining the two information I have examined how the non-paying customers increase the already existing credit rationing in SME financing.

Combining the two parts of my association I am looking for the answer whether the credit rationing caused by the non-paying customer can be resolved by one of the frequent elements of group-lending, by joint liability.

Accordingly the preludes of the three main parts of the thesis can be deducted to very different topics within the field of finance and economics. The first part about microlending is based on group lending, within this joint liability.

The thicker and thicker literature doesn't spend too much time by defining the term microfinance. However the definition varies from author to author. According to Ledgerwood (2000): „*The term (sic. Microfinance) refers to provision of financial services to low-income clients..*" (Ledgerwood, 2000:1.p.) Armanderiz de Aghion and Morduch (2005) in their definition specifically point out the lack of the collateral and the owned resources: The microfinance is *a collection of banking practices built around providing small loans (typically without collateral) and accepting tiny savings deposits"*. (Armanderiz de Aghion and Morduch, 2005: 1. p.)

For group lending there is no evident definition, it is frequently mixed – mainly by the authors of the critique works – with joint liability. The palette is colorful, depending on which constructions are named as group loans. It can refer to individual constructions, where the debtors pay their actual payments on common meetings, trainings in front of each other or even to the most strictly judged loans with joint liability. A frequent element of these constructions is the conditional loan renewal and the sequential lending.

The literature can be structured by the market failures occurring in lending situations, because each of the authors think that the key of the success of the group loans is that they can successfully treat or decrease at least one of the problems, like adverse selection, high monitoring costs, moral hazard, high audit costs, lack of enforcement.

A new trend in the theoretical literature are the multi period models of group lending. The authors focus on two central questions. First, what are the necessary elements of group loans which lead to the success of joint liability constructions? Second, which constructions without joint liability are able to incite the borrowers and reach the payback ratios of joint liability contracts. To answer these two different questions one will use the same construction elements (sequential lending and contingent renewal) which has to contribute also to the sustainability of the program.

The main conclusion of the previous literature is that the group and the individual loans are constructions following each other, they are suitable for serving different segments of the market. Initial capital gathering – the creation of what later becomes the physical collateral –

is provided for the clients – who, when they possess enough capital, can apply for individual loans – only by group loans. Joint liability, what is an important element of the group loans can be replaced by dynamic incentives in many cases. These can be for instance the sequential lending and the conditional credit renewal.

It is questionable whether the credit rationing decreasing effect of joint liability counterbalances the connected very high expenses, namely the extra weights caused by the non-paying partners.

In the second part while keeping an eye on this opened question, I have modeled the external financing of two neighbor members of a supply chain, namely the financing of a supplier and his or her customer.

The modeling happens in a contract-theoretical framework, where I have improved the base-model of Tirole (2005) from his book: The Theory of Corporate Finance. Tirole describes a version for one contractor how the informational asymmetry between the financer and the borrower can lead to credit rationing. But also other works of theoretical literature on corporate loan contracts are available, for instance papers of Fudenberg and Tirole (1990), Rajan (1992), Hart and Moore (1998), Holmström and Tirole (2000). The modeling of the trade credit can be primarily connected to the name of Schwartz (1974) and Myers (1977).

The application of joint liability amongst firms can be questionable, that is why Philip Bond's (2004) extended joint liability is a central element of the thesis. The idea used for modeling is that I am applying joint liability for a not typical micro-financing situation, for the two neighboring members of a supply chain.

But there are many essential differences between the microloans and the markets of SME-financing. The local SMEs have a legal personality, they are originally connected to a looser social network, and it differs from the natural person's connections. SMEs, which can allow, are likely to choose legal forms with limited liability. Then the firms's bankruptcy fully differs from that which is affecting the owner as a private person. Namely the owner's pay-off function is convex: it's loss is limited, on the other hand it's profit is only limited by the efficiency of the company. The essential difference between the two target-groups is important, because the profit maximalization of a natural person can differ from a company's profit orientation.

A possible solution of the above described problem can be found in Philip Bond's (2004) paper where he extends the concept of joint liability. Bond examines the joint liability of the clients of a financial intermediary. Because the receivers of individual loans will only get future loans, if the financing institute remains on its feet, what depends on the repayment of

the other individual borrowers, in total amongst the affected borrowers a general joint liability can be seen.

In the third part of the thesis I am examining the paying habits of a customer portfolio, and I am identifying the factors influencing non-payment, and forecasting non-payment in advance.

The non-payment of the supplier payable is an event with a lower consequence than the omissions towards the bank and as a result this event is a less severe credit risk event. Although the lower severity I have mainly based my thoughts on the authors of the topic of credit risk.

First let us define the term credit risk. According to the guideline published by HFSA (Hungarian Financial Supervisory Authority) and based on the recommendations of the Basel Committee on Banking Supervision:

„Credit risk: in the narrow sense it is the risk that the other contractual party will not be able to meet its obligations (arising from a loan, a deferred payment arrangement or any other credit-like legal relation) in accordance with agreed terms, potentially causing the financial institution to incur a loss. In the broad sense, any risk arising from non-fulfillment is considered credit risk, including risks arising from the non-fulfillment of sales contracts (settlement risk, open account trade risk) and from the future fulfillment of sales contracts (replacement risk)." (Source: HFSA, 2001)

Theoretical studies agree with the above definition, yet delve into a more detailed account of it. For a more detailed credit risk definition see Jorion, 1999; McNeil, Frey and Embrechts, 2005; Crouhy, Galai and Mark, 2005.

The literature of credit and default risk modeling is rather abundant. Thus, first of all, I will try to systematize the literature I read, without going into details about the specific models. The authors used the following aspects to classify the models:

- Historical / chronological order (e.g. Carling, Jacobson, Linde and Roszbach, 2007)
- Individual vs. portfolio models
- The size of the company to be examined (e.g. Falkenstein, Boral, Carty, 2000). This is equivalent to a classification by lending techniques (*transaction banking*, *relationship banking*). (E.g. Allen, DeLong and Saunders, 2004.)
- Classification by content, where models might be used for analytical, measurement / risk management or pricing purposes (e.g. Altman, Saunders, 1997 or partly McNeil, Frey and Embrechts, 2005)
- The methodology used

- The type of the data used (market vs. accounting; exogenous vs. endogenous).

These individual classification criteria can be combined and matched with or complemented by each other. In the below description, each model is going to be categorized by each above-mentioned aspect.

The methodology used in the dissertation is based on early works from a historical aspect, further on I will mainly apply logistic regression where the input data is provided by accounting information for the forecasting of the individual bankruptcy of small firms. With this choice, I have chosen a very narrow portion of the literature of credit-risk.

The accounting-based models are based on the financial ratios made from financial reports of the firms, where they group the examined firms into two groups depending on the value of the financial ratios; these are the bankrupt and the non-bankrupt firms. (Virág, 2004)

Beaver in his article published in 1966 is separating his sample based on one single variable to bankrupt/non-bankrupt groups, in his study when looking for the most suitable indicator he is examining 30 different financial ratios. The multivariate discriminant analysis (MDA) was used by Altman to create his first model in 1968 and also for the famous ZETA-model. In the first case Altman is forming a linear bankruptcy-function from his sample containing mid-sized firms. In the **ZETA-model**, by taking into account this tendency, that there is often a bankruptcy proceeding against many large firms, accordingly he expands the composition of the sample: the model examines 58 surviving and 53 bankrupt companies. (Virág, 2004)

The strongest critique of the model, that the classification power within the sample is suitable, however when they are making an ex-ante prediction for a different sample with it, the quality of classification decreases at least by 10%. The cause of this phenomenon is the temporal instability of the data and the difference between the certain industries. So it could be more effective to use the relative ratios where the financial ratio of the firm is compared to the industrial average, as suggested by the Platt-Platt author-duo (Platt-Platt, 1990). But the method of MDA still provides some more doubtful element (assumption of normality) which can be easily handled by the logistic regression the more widespread methodology in this topic.

The central question of the works specially focusing on SMEs – which are also working with the logistic regression most frequently – is the circle of the information used for modeling. Most of the authors vote for the combination of financial and non-financial (often called qualitative) information. Based on the models estimated specifically for the SME clients it seems, that in their case the discriminative power of the non-financial indicators are high.

Altman, Sabato and Wilson (2010) were probably the first to apply non-financial indicators. For the period between 2000-2008 they could work based on 5.8 million observations from the United Kingdom. They have found that the model's discriminative power was increased by 8-10%, if next to the used, limitedly provided financial indicators they have taken in non-financial information as well. Lehman (2003) has carried out researches on 20.000 German SME's. From a bank's aspect besides the traditional financial indicators some information on behavioral aspects can help in the separation of the good and the bad clients. Lehman's (2003) conclusion is similar to that of Altman's and his authors-partners. Although the introduced, non-financial variables by themselves are not more significant than the financial ratios, their entry to the model is improving the model's discriminative power.

The history of the national bankruptcy models compared to the international literature is relatively new - the regulation of the bankruptcy procedure and of disposal was born in 1991, thus the topic as an area of research only exists since then. The first bankruptcy model is related to the name of Miklós Virág and Ottó Hajdú (1996), who had analyzed the insolvency of the firm on a sample from the processing industry of 154 elements, relying on the reports from 1990-91. The also innovative work of the cited authors is the bankruptcy model-family made for the Hungarian national-economy branches and sub-branches (Virág, 1996). The chosen methodology was the discriminant analysis, and there was an even internationally significant sample provided for the researches with 10.000 elements. The result of modeling is a model for the whole national economy, 10 models for the national-economy branches and 30 models for the sub-branches. Earlier I have cited, that according to the recommendation of Platt-Platt (1990) it worth's to apply relative financial ratios compared to the industrial average, principally on a sample what is heterogeneous from the aspect of the industrial classification. Virág and Kristóf (2006) have also used this result and on their sample with 156 elements, which was built on the earlier cited sample of 154 companies, they have used discriminant analysis, logistic regression, recursive partitioning algorithm and neural network to work out their model.

By looking at the work of Virág and Kristóf from 2006, we can see that the Hungarian literature does not confine itself to the traditional models like the discriminant analysis and the logistic regression either. The application of the neural networks after the work of Benedek (2000) appeared in the writing of Virág and Kirstóf (2005) and in Kristóf's (2008) dissertation. Imre (2008) in his PhD dissertation also bases his calculations on the methodology of accounting based bankruptcy models. The reader who is interested in the further details can read more on this topic in the writings of Virág and Kristóf. Naturally the

circle of the applied methods is wider, than I have written in the previous paragraphs. Nowadays for instance the new method in the field of the national bankruptcy forecasting the multi-dimensional scaling is related to the name of Virág and Kristóf (2009).

2. Methodology

The literature summed up in the first part of the dissertation and also the modeling of the second chapter are examining the particular topics in a contract-theoretical framework. I am working with a more colorful methodology in the third part of the dissertation.

The methodology applied in this chapter can be found in details in more Hungarian sources. In the work of Füstös et al. (2004) many examples from real researches help the understanding of the theoretical approach, Sajtos and Mitev (2007) help the reader in the practical application, and give advices to solve the appearing methodological dilemmas, Kovács (2006) in his short theoretical review makes the steps of understanding and application easier.

The trade credit database consists of a customer portfolio (1398 items) of a real-life company. The supplier is trading in construction materials. Besides the open receivables from all the 1400 customers of the company, a record of overdue amounts and an aged balance of accounts receivable was also provided. These being stock variables, the figures relate to one specific day in May 2009. The records, however, also show all open and overdue accounts from one week earlier, as well. In addition to the agreed credit limit, information (partly of a qualitative nature) on the customer, its manager and its payment history also appear in the database. For 905 customers also the financial reports are available.

The paying patterns of the portfolio were determined by K-mean clustering. A disadvantage of this method is that the number of clusters is to be given by the researcher in advance. This firstly I have called the hierarchical agglomerative models to provide some input to the decision. The simple linkage, the method of the closest neighbor is usually applied to help in the identification of outliers because it tends to create clusters with a small amount of units and a couple of larger clusters. Sajtos and Mitev (2007) recommend the Ward-method in order to determine the amount of units of the cluster. The related SPSS outputs (the illustration of the dendograms and the coefficients) helped to determine the amount of the clusters between 8-12. Finally I decided to create 12 clusters.

I analyzed weather the non-payment in Subsample I created by self-employed entrepreneurs is related to any of the available non-financial variables of these customers. For the used

methodology, contingency table analysis and Chi-square test, see Hunyadi László and Vita László (2002), Kovács Erzsébet (2006) or Sajtos László and Mitev Ariel (2007).

In the Subsample II where the financial reports of the customers were also available I forecasted the non-payment using logistic regression. This methodology came from the area of credit risk modeling, more especially of bankruptcy models. During the modeling I had to face two special issues. First, I was dealing with SMEs and not with corporate. Second, I was modeling the non-payment to suppliers instead of more severe credit risk events like default on a bank loan or even bankruptcy itself.

The works expressly concentrating on SME clients do not spend much time on the question: which accounting based model shall be used. The most spread procedure is thought to be logistic regression (Atiya, 2001; Laitinen and Laitinen, 2000), and most of the authors are doing their own estimations with the help of logistic regression (for instance Altman and Sabato, 2007; Falkenstein, Boral and Carty, 2000). Thus I am going to use this method in the dissertation.

The other even more thick part of the literature of modeling SME's credit risk events is not concerning methodology, but the financial indicators used as independent variables in the scoring models. Theoretical works on the variables with appropriate discriminant force are very rare. Laitinen and Laitinen (2000) refer to relatively earlier writings in this topic (Aziz, Emanuel and Lawson, 1988; Scott, 1981; Keasey and Watson, 1987), but according to their critique the recommendations are too general and simplifying for providing real help for modeling.

The empirical examinations choose the appropriate variables based on earlier publications or by factor analysis. Another possibility is the backward and forward method. The backward method firstly builds in all of the available variables to the model, and then drops out the insignificant indicators, one by one. The forward method is building in the variables one by one to the model, till the variable built in as last won't already improve the model's explanatory power. Relying on the literature (Altman-Sabato, 2007; Falkenstein, 2000; partially Kristóf, 2008a-b) I have used the Forward Stepwise Likelihood Ratio algorithm at every model variation with 5% entry and 10% exit significance level. I have divided the sample to training and test sample, also duly to the literature in a proportion of 75% and 25% (for instance Imre, 2008).

The second specialty of the models is – as I have already mentioned – the dependent variable, the non-payment to the supplier. This credit risk event is partially depending also on paying willingness and not only on paying ability like the default on a bank loan. In the analyzed case

the financial ratios of well performing and non-paying customers differs less than in a database built for defaults on bank obligations. As a result of this specialty the classification power of the elaborated models is lower than the generally accepted level in the literature. But this phenomenon is not unique. Imre (2008) modeled the default defined according to Basel II (which defines a defaulted borrower as anyone who is more than 90 days behind with their payments). His findings regarding the classification power of his models correspond with my results.

The classification power of the models was measured by AUC (area under the curve). To define this measure one has to be familiar with the term cutoff ad ROC curve.

The cutoff means the threshold, where if the estimated non-paying probability is lower than the cutoff value for the examined client the model is forecasting the precise payment in advance, but if the estimated non-paying probability is higher than the cutoff value, then the model classifies the specific client as a non-payer.

The selection of the cutoff value happens in a very different way by the authors. The most widespread decision tool in the current literature is the cutoff given by the largest AUC (area under the curve) value. The dissertation is going to follow this latest aspect.

The ROC curve is a graphical plot of the true positive rate, versus the false positive rate as the cut-off threshold varies. The classification ability of a random model is described by a straight line (45 degrees), the model resulting in a perfect classification is characterized by a line osculating with the point of (0, 1) coordinates. The estimated models are between these two endpoints, as further their ROC curve lies from the diagonal, the examined model is classifying better. This aspect is quantified by the AUC or the AUROC indicators, what describes the size of the area under the ROC. Arising from the earliers in case of random classification the AUC is 0.5 while a perfectly classifying model, results in an AUC with a value of 1. In practice the AUC with the value of 0.7 is already suitable. (Oravecz, 2008; Imre, 2008; Tang-Chi, 2005).

3. The results of the dissertation

On the following pages I introduce the main results of the thesis.

3.1.   A survey on joint liability lending

The first part of the dissertation is innovative from the aspect that it is providing in Hungarian a detailed survey of the theoretical and the empirical literature of group lending.

3.2.   The bank financing of the neighbor members of the supply chain

Based on Jean Tirole's (2006) model, in the second part of the dissertation I have built my own model for the bank financing of two neighbor members in a supply chain, where the trade credit provided by the supplier to the customer is exposed to default risk. In the contract-theoretical framework there is an informational asymmetry between the bank and the contractors regarding the efforts done for the success of the project, what gives room for moral hazard.

In the model the bank decides whether to provide the loan or not at the beginning, in the first period the customer can face with a liquidity shock, and as a result of this he/she might not be able to pay the actual supplier payable, and in the second period the payment of the bank loans are due.

The main assumptions of the model:

- The actors are risk-neutral; they make their decisions based on expected value.
- The bank faces with a perfect competition at its own market, thus its expected profit is zero.
- The actors do not have preferences regarding the timing of his/her clash flow.
- The expected net present value of the project (NPV) is only positive in case if the contractors' efforts are higher, in other cases, even if the profit from shirking is taken into account, it is negative.

Three main model variations were made:

- In the first model variation the non-paying customer is liquidated by his/her supplier and by the bank.

- In the second model variation, if necessary, the bank is providing a liquidity loan at the end of the first period, what is used by customer to pay off his/her supplier.

- In the third model variation, if necessary, the bank is giving a liquidity loan at the end of the first period, for which both the customer and the supplier are going to be jointly responsible. The customer is going to be responsible for the supplier's original debt, received in period 0 to the same extent.

I have evaluated the model variations from the following aspects: the borrowing capacity of the contractors, the utility measured by the expected NPV, the continuation rule of the bank and from the aspect of the expected NPV, what is measuring social utility. The main results of the comparison are:

- I have concluded that in case of a non-paying customer in the first model variation the supplier's and evidently the customer's **borrowing capacity** is decreasing, compared to the case, where the customer always pays promptly. However in the second model variation regarding the supplier the non-paying customer does not have such a credit rationing increasing effect, only the customer will receive less financing. This second model, the continuation next to the individual liability of the customer is providing a larger loan for the two contractors altogether, than the third model, the joint liability. Joint liability can only provide a higher financing, than the first variation, where the non-paying partners are liquidated.

- The **utility** of the two **contractors** are measured by the expected owner's NPV. It is not surprising that the supplier prefers, when he/she does not have to take responsibility for the continuation, instead the risk of continuation are taken by the bank and by the customer. In case of the customer however the case is reversed, he/she prefers joint liability – since the weights of the continuation are partially put on the supplier at this time. If we suppose the possibility of compensation amongst the two contractors, then by examining their expected owner NPV together the construction of joint liability is only the second most advantageous construction.

- **Social welfare** is measured by the expected NPV of the projects. The distribution of the responsibility is only redistributing the utility between the contracting parties; it does not affect social welfare.

- If the bank prefers joint liability, then despite of what I described above, the two firms can be forced to choose a form of financing, what is suboptimal for them. However at the market with perfect competition by examining the **bank's** profit maximizing

decision rule, the expected net pledgeable income maximalization, I also had to throw this option away. Although the bank receives double collateral for the additionally provided loan, and for one portion of the loan already processed in the period 0 to the supplier, it is also destroying the motivation of the two contractors. This has to be compensated, that is why the bank's absolute value of the bank's pledged income cannot exceed the pledgeable income of the individual continuation.

To sum up the results of modeling: the extended joint liability existing between the customer and his/her supplier - in a Bondian (2004) sense - is not suitable for decreasing the credit rationing as a special collateral.

Some of the authors claim that with group-lending the liability taken for others means an excessive expense; we can make a similar conclusion regarding the two neighbor members of the supply chain. This conclusion is also interesting, because the alternatives are not the same in the two cases. Instead of the group loans at the individual loans there is no relation between the clients, who are financed by the same MFI. In case of the individual lending of the customer and the supplier the dependence between the two contractors, the credit risk connected to the trade credit still exists. His/her extra weights will not disappear, since they appear in the additional credit rationing.

By examining the different variations of the models of joint liability, I have found that the conclusions are robust. It worth's to highlight the model variation, which describes **factoring** from this examination. By comparing factoring and the continuation with individual liability, even though factoring does not decrease credit rationing, but it will provide the bank a higher expected profit, that is why next to factoring the bank will determine a less strict continuation rule, than in the regular continuation model. It can be imagined, that the two contractors in order to assure a better continuation rule for themselves ex ante, they have to decrease the size of the project and choose the construction with factoring.

3.3.   The analysis of a trade credit portfolio

In the third part in order to analyze the customer portfolio consisting of SME clients I provide a survey on the main credit risk models and on the methodological literature. This chapter mainly concentrates on the methodology applied to SME clients. I take as one result of the thesis the classification of the models by different aspects (alloying), and the introduction of the literature by more dimensions. The data-analysis results of the empirical chapter are

important and valuable parts of the dissertations, because amongst the academic works it is rare that a whole customer portfolio is provided for the researcher. (Even though amongst the practitioners this task is not unique at all.) The analysis has consisted of three parts.

3.3.1. The patterns of the paying habits

Firstly I have identified the patterns of the customer portfolio using cluster analysis based on the variables describing the structure of the customer receivables. The k-mean clustering has created 12 clusters altogether. The clusters of the GOODS (composed of two clusters - they are not delayed), the BADS (composed of two clusters - they are late over 180 days) and the group of the PROMPT PAYERS were separated from each other evidently.

The seven intermediary clusters - somewhat arbitrarily - were classified into the groups of the DELAYERS and the NON-PAYERS according to the typical expiration structure. We can find clusters containing small, mid-sized and larger firm, where the behavioral variables can show differences. Overall the non-cluster forming criteria, mainly the non-financial criteria significantly differ amongst the formed clusters.

3.3.2. Factors affecting the paying habits of self-employed entrepreneurs

As a second step I have worked on the I. sub-sample derived from the examined customer-portfolio, which has contained self-employed entrepreneurs.

According to cross-chart analysis the gender does not influence the paying habits at all, on the other hand, the violation of the provided credit-line, a negative record in the paying history of the firm and the paying habits show a significant relationship with the paying pattern.

The result is in accordance with the claims of the bankruptcy models and with the claims of the literature of scoring and credit-risk models, according to which the non-financial, perhaps the qualitative information are usually, but especially with the decrease of the firm size important inputs of the lending decision.

3.3.3. Modeling of the customer's non-payment

As a third step of the empirical analysis I have used the methodology of the bankruptcy models for the modeling of the customer non-payment. I have estimated logistic regression

models using different inputs, where instead of bankruptcy payables more than 90 days past due were identified as defaulted exposures. This definition is referring to the II. Basel regulation, where the delay over 90 days on obligations toward the financial institute means the default event.

- Based on the modeling I have illustrated, like Lehman (2003) and Altman, Wilson and Sabato (2010) that the building in of the non-financial information to the model has improved the classification accuracy in every case. I measured this improvement by AUC, which is an indicator used by the current literature. The AUC increased with 0.04-0.09.

- It is widespread in the literature that the inputs of the logit-model are identified with factor-analysis, and the classification accuracy of the models estimated this way is higher, than that of their counterparts building on individual indicators. The estimated models in case of the training samples did not support this hypothesis; on the other hand the models built on principal component-analysis were doing better on the test-sample, than the models of the individual indicators.

- Mainly the non-financial indicators describing behavior are classifying so successfully by themselves, that they have overperformed the model only using financial indicators from this aspect.

This latter result justifies and supports the practice of the firm, which has provided the data for me, according to which the determination of the credit line for trade credit is mainly based on information like the credit history of the managers of the firm, the delays towards a third party, paying habits. The results of the empirical analysis suggest that the claim management firm could improve the decision mechanism, if it would gather even more behavioral information on the customers, what is suggested by the literature too. For instance these can be the age of the customer relationship, the number of the employees, the education of the managers, the experience of the managers measured in years in the industry, the standard deviation of the balance of the debts, the industry and the industrial average bankruptcy rate. The examination of the classification power of this information would be also an additional research question.

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