The Determinants of Collateral: a Decision Tree Analysis of SME Loans

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Summary

Previous empirical research has devoted little effort on the role and determinants of business collateral and personal commitments in the credit acquisition process, even though this is a common feature of small business credit contracts. We modelled the collateralisation decision as a two decision process by investigating the differences in the determinants of the collateral decision versus the determinants of the choice between business collateral and personal commitments. The analysis was performed by a decision tree analysis. In the classification models, we concentrate specifically on relationship characteristics. The results reveal that relationship characteristics have a significant influence but not always in the direction as could be expected. Moreover, they do not seem to be the primary determinants in our classification models. The most important determinants in both decision models seem to be the loan amount, total assets and the family versus non family firm distinction.

Keywords: SME lending, business collateral, personal commitments, decision tree analysis.

1. Introduction

The pledging of collateral to secure loans is a widespread, important feature of the credit acquisition process (Berger and Udell, 1990; Leeth and Scott, 1989). Moreover, the use of personal collateral and commitments is a common feature of many small business credit contracts. Hence, the personal wealth of small business owners will play a key role in the credit acquisition process if personal commitments are a fundamental condition to obtain a loan (Avery *et al*, 1998).

During the last decades, several theoretical contributions attempting to explain the widespread use of collateral have been developed (e.g. Chan and Kanatas, 1985; Scott, 1977; Stulz and Johnson, 1985). However, the majority of these theoretical

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contributions consider 'secured' debt but do not make the explicit distinction between personal and business collateral. The few theoretical studies (e.g. Chan and Kanatas 1985) that make the distinction conclude that business and personal collateral are very similar. Nevertheless, Mann (1997b) argues that personal collateral is more effective in limiting the borrower's risk preference incentives by enhancing the likelihood that the principal will feel any losses personally.

The empirical literature (Leeth and Scott, 1989; Ang et al., 1995; Avery et al., 1998; Harhoff and Körting, 1998; Degryse and Van Cayseele, 2000; Hanley, 2002) concerning the determinants of collateral is rather scant, possibly due to data limitations. While it is well documented that small and medium-sized firms rely primarily on financial intermediaries as lenders - especially commercial banks - (Cole et al 1996), only partial clues exist as to the role of personal wealth or business wealth in the contractual details of lending arrangements. To date, as far as we are aware off, only two published empirical studies (Ang *et al.,* 1995; Avery *et al.*, 1998) investigate the topic. Both studies found that personal commitments are an important component of SME lending. However, no efforts have been made to refine such results by distinguishing the factors related to both personal commitments[4] and business collateral usage. In this paper, we try to fill the gap in the empirical secured debt literature.

This paper extends the empirical literature on the determinants of collateral in two ways. First, we model the collateralisation decision as a two-decision process by investigating the differences in the determinants of the collateral decision versus the determinants of the choice between business collateral and personal commitments. Prior research only concentrated on the determinants of business collateral or the determinants of personal commitments separately. As several recent studies indicated the importance of relationship lending on the terms of loan contracts (especially in an SME context), we concentrate in this study on relationship characteristics. Second, we use a decision tree analysis. The purpose of a decision tree is to classify cases for a dependent variable on the basis of a set of rules for the independent factors. The advantage of decision tree induction is that it clearly shows which rules (and thus which factors) are used to classify the cases. Hence, the importance of all factors and their interactions in the classification of the cases can be clearly identified.

The organization of the paper is as follows. Section 2 reviews and discusses the theoretical and empirical secured debt literature. In section 3 the empirical determinants of collateral are discussed with a focus on relationship lending. Section 4 explains the empirical methodology (decision tree induction) and the variables. The results are analysed in section 5. Section 6 concludes the paper.

2. Theory and evidence on secured debt

Throughout the years, several theoretical contributions attempting to explain the widespread use of collateral have been developed (e.g. Chan and Kanatas 1985, Stulz and Johnson 1985). From the point of view of a value-maximizing firm, collateral would impose costs and create benefits for both lenders and borrowers that influence the value of the firm.

The *costs* of collateral could be extensive. Lenders must value and monitor collateral, pay filing fees for security registration and incur administrative expenses. Borrowers have to make additional reports to financial institutions and agree with more restrictive asset usage. In addition, both parties have to resolve the conflicts of interest between secured and unsecured claimants created through the use of collateral (Leeth and Scott 1989, Mann 1997a, 1997b).

Besides these costs, the *benefits* include the reduction of agency costs, limitation of possible legal claims, reducing informational asymmetries and refraining from excessive future borrowing. First of all, the reduction of *agency costs* by pledging collateral may lower the cost of debt by preventing the problem of asset substitution (Jensen and Meckling 1976) and mitigating the underinvestment problem (Myers 1977). The asset substitution problem arises when a borrowing firm has the possibility to switch to higher risk investment projects than the original intended projects. The potential profit gains of this behaviour in case of success are entirely for the borrowing firm. On the other side, creditors receive no additional gain in case of success but bear the potential losses in case of project failure. The underinvestment problem originates where investment projects with a low positive net present value and low risk are rejected because only unsecured debt financing is available. In this

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[4] Personal commitments are defined as both personal collateral and guarantees that make owners personally liable for business debt (cfr. Avery *et al.*, 1998)

case, collateral can play its role in reducing future bankruptcy costs and as a consequence, mitigates the wealth transfer from shareholders to unsecured creditors.

Secondly, secured debt also *limits possible claims* in bankruptcy and as a consequence creates shareholder wealth (Scott 1977). In liquidation, pledged collateral allocates resources away from unsecured to secured creditors. Under conditions of perfect information, security protection lowers the interest rate of secured creditors but increases proportionally the implicit interest rate of unsecured creditors. If, due to incomplete information, some unsecured creditors do not react to this decrease in legal protection, then firms can expropriate wealth from these unsecured claimants by offering collateral to lenders (Leeth and Scott 1989).

Thirdly, as far as the minimisation of the *information asymmetry* between borrower and lender is concerned, the borrower receives, in exchange for collateral, the advantage of a lower interest rate but incurs the risk of loosing collateral when the return of the project turns out to be too low (Chan and Kanatas 1985, Bester 1985, Besanko and Thakor 1987, Chan and Thakor 1987). When the borrower considers the chance of a low return as too large, the costs associated with collateral exceed the advantages of a lower interest rate. As a consequence, the borrower will refuse the loan. The reverse is true when it concerns a project with a high probability of a high return. Thus, collateral serves to convey indirectly information between the two parties. Collateral has a 'signalling role' by showing the real value of a project. This certainly is the case when the financial institution assigns a lower value to the project due to limited information availability. Much of the theoretical literature concludes that, in equilibrium, low risk borrowers pledge more collateral than high risk borrowers. However, Stiglitz and Weiss (1981) show that collateral may introduce an adverse selection problem that associates higher levels of collateral with higher average borrower risk.

Finally, another benefit of secured credit is, according to Mann (1997a, 1997b), the fact that securing credit limits the firms' ability to obtain future loans from other lenders or reduces the risk of *excessive future borrowing*.

In general, one can conclude that, given the idea that moral hazard is the most important problem in financial relationships, collateral plays a disciplinary role in the behaviour of the borrower. As a consequence, stronger creditor protection from collateral leads to cheaper credit. Recently, Manove et al. (2001) criticized the unrestricted reliance on collateral and argued that this might have a negative impact

on credit-market efficiency. They argue that banks are in a good position to evaluate the future prospects of new investment projects. Collateral will weaken the bank's incentives to do so. Especially for small firms, banks seem to do little screening and rely excessively on collateral. From the point of view of banks, collateral and screening can be considered as substitutes.

The majority of these theoretical contributions consider 'secured' debt but do not make the explicit distinction between personal and business collateral. The few theoretical studies (e.g. Chan and Kanatas 1985) that make the distinction conclude that business and personal collateral are very similar. Nevertheless, the signalling role of business collateral, compared to personal collateral, is limited. Mann (1997b) argues that personal collateral is more effective in limiting the borrower's risk preference incentives by enhancing the likelihood that the principal will feel any losses personally. Still, pledging business collateral also reduces the freedom of the owner of the firm. He/she incurs a loss of welfare due to the restricted possibility to sell the business assets pledged in order to invest the selling value in new projects (Smith en Warner 1979) or to use it for perk consumption (John et al. 2003).

The empirical literature concerning the determinants of collateral is rather scant, possibly due to data limitations. An overview of the empirical literature is documented in appendix 1. While it is generally agreed upon that small and medium-sized firms rely primarily on financial intermediaries as lenders, especially commercial banks (Cole et al 1996), only partial clues exist as to the role of personal wealth or business wealth in the contractual details of lending arrangements. Empirical studies by Ang *et al.* (1995) and Avery *et al.* (1998) found that personal commitments are an important component of small business lending. However, in general little has been done to refine such results by distinguishing the factors related to both personal commitments and business collateral usage and the role of relationship lending.

3. The determinants of secured debt.

3.1 Relationship characteristics

Relationship banking stresses the fact that banks can improve their revenues by maximising the profitability of the actual relationship with the firm throughout time. So far, research on relationship lending mainly concerns the effect of a strong

relationship on the interest rate and credit acquisition. A relationship can be defined in numerous ways. The most common measure is the *duration* of the relationship with the bank (e.g. Petersen and Rajan 1994, 1995, Berger and Udell 1995, Ongena and Smith 2001). Previous empirical research focusing on the link with collateral has stressed this duration of the relationship and has discovered that firms with a longer relationship with their bank incur a lower incidence of collateral (Berger and Udell 1995, Harhoff and Körting 1998, Degryse and Van Cayseele 2000), as theoretically predicted by the model of Boot and Thakor (1994). The capacities and the character of the entrepreneur become obvious as the relationship continues. Also the timely repayment of acquired loans contributes to the reliability of the firm. The entrepreneur gets the opportunity to build a good reputation and gives a signal of trustworthiness. As time goes by, the entrepreneur builds up a good reputation and the moral hazard problem will diminish (Diamond 1989). A good reputation is considered a valuable asset. Consequently, the firm will prefer a low-risk project above a high-risk project, reducing the probability of repayment difficulties and keeping the value of the reputation asset intact. The fact that the incidence of collateral is lower as the relationship matures, is also consistent with banks producing private information about the borrower quality as mentionned in the financial intermediation literature. (Diamond 1991). Petersen and Rajan (1994) argue however that the reputation effect does not necessarily have to depend on the duration of the relationship. When a creditor can acquire information concerning the firm via interactions of this firm with their previous financial institution, the age of the firm can count as relationship measure. Hence, a good relationship can solve the adverse selection and moral hazard problem as it offers the possibility for the bank to get properly acquainted with the firm and can reduce the information asymmetry between banks and firms (Bornheim and Herbeck 1998).

Instead of the duration of the relationship, we can also use an alternative measure for the strength of the relationship used in previous empirical research, being the *exclusivity* of the relationship (Petersen and Rajan 1994, Degryse and Van Cayseele 2000, Berger et al. 2001, Ongena and Smith 2001). If a financial institution operates as the main banker for a firm, the firm mostly communicates with this particular bank. Obviously, this intense communication between both parties reduces the banks' risk involved in granting credit. It diminishes the information asymmetry and improves the banks' knowledge of the firm.

Additionally, we can also categorize the number of banks a firm negociates with before agreeing to a certain credit contract under the relationship header. A firm, which does not exclusively deal with one bank, can introduce competitive forces in the credit acquisition process. The threat for a bank of loosing a certain firm as borrower to a competitor can imply that this bank will diminish its initial demand concerning the pledging of collateral.

3.2 Control variables: firm and loan characteristics.

Firm size is expected to be negatively related to collateral usage. Several explanations for this expected relationship could be found. Chan and Kanatas (1985) argue that newer and smaller firms will offer more collateral in order to signal project quality when lenders have less information concerning a company's operations. According to Altman et al (1977), debt expenses for small firms may be reduced to a larger extent by collateral because of their higher probability of bankruptcy. None of these studies differentiate between business collateral, personal collateral and guarantees. However, more recent studies by Ang et al (1995) and Avery et al (1998) make the distinction. Avery et al (1998) argue that firm size is expected to be negatively related to the costs incurred by lenders, in part because larger firms are likely to be owner of more business assets that can be pledged as business collateral than smaller firms. In this case, business assets may be sufficient security for creditors while lenders expect similar levels of personal commitments from smaller firms. Therefore, one could expect that larger firms use less personal commitments than smaller firms. Moreover, size can be considered as a proxy for prior success, resulting in lower requirements for personal commitments by lenders to obtain a business loan (Ang et al 1995).

A second control variable that could have an influence on the use of personal commitments is the difference between *family* and *non-family firms*. Personal commitments could bring about potential agency problems between individual partners in small firms due to unequal risk sharing and free-riding among the partners. When all partners pledge personal collateral or guarantees, the actions of one partner can place the wealth and personal assets of all other partners at risk (Ang et al 1995). This potential agency problem is expected to be more prevalent in non-family firms. Bopaiah (1998) also argues that family firms experience less moral hazard problems because of the equity stake they have in the firm. They don't want to lose their

investment in the firm and will do everything they can to pay off their debt. Consequently, the risk for the bank is reduced. In addition, this equity stake would also imply a more conservative investment choice. Family firms would be more rooted in their surroundings and thus more eager to retain the built-up reputation (Diamond 1989). Due to the fact that banks aren't always satisfied with business collateral such as accounts receivables or inventories because of high monitoring costs and family firms often don't possess sufficient other business collateral, using personal commitments is the only alternative. By giving these kind of commitments, the bank is assured that the manager, which is assumed to have a major influence on the firm, will do his utmost to pay off the credit acquired. Personal commitments act as a security signal (Besanko and Thakor 1987).

From both a theoretical and empirical point of view, *loan size* would have a positive impact on the provision of collateral by a firm. The advantages of loans backed by collateral set forward in a previous section (e.g. preventing asset substitution, claim dilution, reducing foreclosure costs), have to be more extensive than the costs that are mainly fixed. For small loans, these benefits cited may not cover the fixed costs including monitoring costs, costs for asset appraisals and administrative expenses. Given these arguments, Jackson and Kronman (1979) conclude that larger loans should be more frequently secured. Loan size is also linked to the probability of default, since a firm that receives more credit attains a higher leverage level and so increases the risk of non payment (Leeth and Scott 1989, Avery et al 1998).

4. Methodology

4.1 Data set

The analysis is based on the database of the 1998 'National Survey of Small Business Finance' (NSSBF). This survey, conducted five-yearly by the Board of Governors and the U.S. Small Business Administration, collects information on small businesses (fewer than 500 employees) in the US. It provides us with income and balance sheet information, information on firm and owner characteristics, the use of bank loans and the collateral they have to pledge for each bank loan that was granted. This survey can be considered representative of the 5.3 million SME's in de US. The NSSBF database provides us, for each loan granted, with numerous data about the

firm. Long-term loans as well as short-term loans are enclosed in this database. All firms that are part of the 1998 NSSBF survey were still active in December 1998.

4.2 Variables

Dependent variable.

The dependent variable was treated as an ordered variable with three ordinal outcomes. The first category are credit requests approved without any collateral (341 cases). The second category are credit requests approved with only business collateral (766 cases). The third category are credit requests approved with personal commitments (1418 cases).

More than 60% of the credit requests belonging to this last category are granted provided that not only personal commitments but also business collateral is provided. So we can summarize that 13.5% of the loans are granted without any collateral requirements, 30.3% was granted provided that business collateral was given and 56.2% of the loans were granted provided that personal commitments was provided possibly in combination with business collateral.

Compared to previous NSSBF surveys of 1987 and 1993, we see an upward trend in the provision of business and personal collateral, while obtaining loans without any kind of collateral becomes more and more scarce. In 1987 only 27.9% of the loans were granted if personal commitments were pledged, in 1993 this figure had already risen till 45.7%. In 1998 this increase is continued. Throughout the years, the same increasing trend can be perceived in the granting of business collateral. These figures imply that the creditworthiness of the owner of the firm become more and more important (Avery et al. 1998). His personal belongings become crucial in obtaining the necessary bank finance for the firm.

Independent variables.

We incorporate six independent variables in our study. The stress in this study is put on those variables measuring the strength of the relationship. We incorporate three variables defining the relationship: the duration of the relationship with the bank (RELATION), the number of banks the firm negociates with before before agreeing to a certain credit contract (COMPETITION) and a dummyvariable coded "1" if the bank is the 'main bank' and "0" otherwise (MAINBANK). 72% of the loans granted

are granted by the main bank. Firm characteristics include the size of the company (ASSETS), which is measured by total assets. The distinction between family and non-family firms is measured by a dummy variable (FAMILY) coded "1" if the company is a family firm and "0" otherwise. 82% of the firms included in the sample are family firms. Also the loan characteristics are taken into account by including the loan amount in $ (AMOUNT). Summary statistics of the main independent variables in the model are reported in table 1.

Table 1: Descriptive statistics

Variable	Avg	Std deviation	Min	Max
ASSETS (total assets in 000)	3,089.97	8,001.58	0.20	99,912.00
RELATION (in months)	93.36	88.08	0.00	408
COMPETITION	1.05	1.20	0.00	12.00
AMOUNT (in $)	653,371	2,999,366	173	70,000,000
n = 2,525				

4.3 Method

We model the collateralization decision as a two-decision process by investigating the differences in the determinants of the collateral decision versus the determinants of the choice between business collateral and personal commitments. As classification method, we use decision tree induction.

A decision tree is built by means of recursive partitioning. This means that the sample is split up in different sub samples and these subsamples are further split up etc. The technique uses two sets of data, namely a training set and a test set. A decision tree is built on the basis of the training set and is tested by means of the test set.

In each stage of the building of the decision tree, the algorithm behind the technique will choose the best splitter, which is the variable that splits up best the data in sub samples where one certain class of cases dominates. To determine which is the best splitter, the algorithm (in this study the c 4.5 algorithm is used) will try every possible split of each variable. For each subsample, the best splitter will then be specified. This process proceeds until further splitting up would not cause a significant improvement of the model.

After the decision tree is built, it will be pruned to avoid overfitting. The algorithm splits up the data set in subsets that will be smaller and smaller and the final subsets will be no longer representative for the population. As such, the model will incorporate structures that are found in the data set on which the model is estimated,

but that are not representative for the population. To prevent this from happening, pruning parameters are set and the tree will be pruned , which means that branches of the tree will be deleted.

The main advantages of decision tree classification are that there are no assumptions for the underlying distribution of the data and that the tree clearly shows which rules (and thus which variables) are used to classify the cases. As such, the importance of all variables in the classification of the cases can clearly be identified.

5. Results

In this section, we discuss the empirical results concerning the importance of the determinants of collateral/commitment protection in SME lending. The two decision trees of the described model and variables are included in table 2 and table 3. Each decision rule shows two numbers between brackets. These numbers correspond respectively to the size of the set of cases that are classified with the decision rule and the confidence level. This confidence level is the proportion of records within this set that is correctly classified. This confidence level has to be compared with the percentage of a class of cases within the total sample. E.g. the classification rule in table 2: AMOUNT=< $50,000 AND MAINBANK =< 0 AND ASSETS =< $38,000 shows that 75 cases are classified by this rule and 37.3% is correctly classified as a loan granted without any collateral. This percentage has to be compared with the 13% of cases of the sample, actually receiving a loan without collateral.

Because the purposes of this study are to obtain a main structure and to get an understanding of the importance of the selected factors in the decision trees, pruning parameters were set high. We are also especially interested in the classification rules. The classification scores are of minor importance.

Due to the high pruning parameters, all variables included in the classification models can be considered as 'significant' variables. Moreover, from the decision tree we get information about the order of importance of the variables that are included: the variable appearing highest in the tree can be considered as the most important classifier or determinant. The overall significance of the classification rules can be

Table 2: Classification model collateral versus no collateral

Classification model:
AMOUNT =< $50,000
        MAINBANK=< 0
                ASSETS =< $38,000 (75.0, 0.373) → no collateral
                ASSETS   > $38,000 (394.0, 0.84) → collateral
        MAINBANK > 0 (778.0, 0.817) → collateral
AMOUNT > $ 50,000
        FAMILY =<0
                RELATION =< 182 (271.0, 0.904) →collateral
                RELATION > 182 (38.0, 0.316) → no collateral
        FAMILY > 0 (969.0, 0.928) → collateral

Sample classification:

	Number of cases	Percent
No collateral	341	13%
Business or personal coll.	2,184	87%
Total	2,525	100%

Correct classification by classification model: 85.19%

Table 3: Classification model business collateral versus personal commitments

Classification model:
AMOUNT =< $18,501
        ASSETS=< $228,000
                RELATION =< 26 (76.0, 0.645) → business collateral
                RELATION > 26 (230.0, 0.539) → personal commitments
        ASSETS > $228,000 (176.0, 0.699) → business collateral
AMOUNT > $ 18,501
        ASSETS =< $6,790,000
           AMOUNT =<$46,300
            MAINBANK =<0
                ASSETS =< $180,873 (60.0, 0.733) →personal commitments
                ASSETS > $ 180,873 (82.0, 0.537) → business collateral
            MAINBANK > 0 (252.0, 0.671) → personal commitments
          AMOUNT > $46,300 (1061.0, 0.786) → personal commitments
        ASSETS > $6,790,000
          FAMILY =< 0 (72.0, 0.667) → business collateral
          FAMILY > 0
            RELATION =< 73 (89.0, 0.708) → personal commitments
            RELATION > 73 (86.0, 0.512) → business collateral

Sample classification:

	Number of cases	Percent
Business coll.	766	35%
Personal coll.	1,418	65%
Total	2,184	100%

Correct classification by classification model: 70.60%

deducted from the number of cases and the confidence level of the decision rules.

The classification score of the *first classification model* making the distinction between no collateral versus collateral is 85.19%. The second classification model,

classifying between business collateral and personal commitments shows a correct classification percentage of 70.60%. When we consider the first classification model between collateral/no collateral, the most important classification variable appears to be the loan amount (AMOUNT). For smaller loan amounts (<$50,000), the variables MAINBANK and ASSETS are ranked as respectively the second and third determinant. For larger loan amounts (>$50,000), the variables FAMILY and RELATION are ranked as second and third determinant. The number of banks competing for granting the loan, seems to be an insignificant determinant in this first classification model.

One classification rule clearly stands out: AMOUNT >50,000 AND FAMILY > 0. Of the 969 cases classified by this rule, 92.8% is correctly classified. Family firms that obtain a large amount loan incur a higher likelihood of pledging any kind of collateral. Altruism could cause higher agency costs in family firms because of the higher likelihood of 'free riding' by family members, entrenchment of ineffective managers or predatory managers. These higher agency costs and higher risk profile of family firms are translated in a higher degree of collateral protection required by the bank. On the other side, family firms seem to be less opposed to personal commitments than non-family firms because stronger social bonds lower the risk of unequal risk sharing and free-riding among the partners in the firm.

When a non-family firm wants a loan of a larger amount, the duration of the relationship seems to determine the classification. A longer relationship with the bank increases the likelihood that the firm does not have to offer any kind of collateral in order to obtain a loan.

Smaller loans obtained at their main bank are associated with a higher likelihood of collateral. This can be interpreted as a bank exploiting the power it has over the firm when being the main bank. A similar explanation can be found by Mann (1997a, 1997b) who concluded in a US context that the main reason for banks to take collateral is that secured debt limits the firm's ability to obtain future loans from other lenders and reduces the risk of future excessive lending. However, this rule has a relatively low confidence level.

When it does not concern the main bank giving credit, having more total assets (>$38,000) as a proxy for size increases the likelihood of pledging collateral. This could be interpreted as total assets being a weak proxy for size. This variable seems to measure rather the collateral value than the size of the firm. From this point of

view, the results of the model could be logically explained: the availability of more assets to pledge as collateral increases the likelihood that a firm has to pledge collateral.

In the *second classification model*, differentiating between loans granted by offering business collateral versus personal commitments, the loan amount is again found to be the main classifier. For smaller loan amounts (AMOUNT =< $18,501), having more total assets (ASSETS>$228,000) seems to be related to a higher likelihood of business collateral. The correct classification of 69.9% of the cases classified with this rule, indicates that it concerns a rather strong rule. On the contrary, given the above discussed fact that total assets rather proxies for collateral value than size, the majority of the firms with less total assets incur a higher likelihood of pledging personal commitments. However, this classification rule is rather weak and has a possible interaction effect with the duration of the relationship. For larger loan amounts (AMOUNT >$18,501), the strongest classification rule concerns firms with ASSETS =< $6,790,000 AND AMOUNT >= $46,300. Of the 1,061 cases classified by this rule, 78.6% is classified correctly. When firms want to borrow a rather high amount and have less total (collateralizable) assets, it seems according to expectations that they incur a higher likelihood of pledging personal commitments.

When they want to acquire a lower amount loan (AMOUNT < $46,300), acquiring the loan from the main bank seems to increase the likelihood of pledging personal commitments. When the loan is acquired from another bank (not the main bank), having lower total assets (ASSETS=<$180,873) increases the likelihood of pledging personal commitments, as was expected. When it concerns a high amount loan and a firm with high total assets (ASSETS>$6,790,000), being a non family firm is associated with a high likelihood of pledging business collateral. On the contrary, family firms within this subtree, have a higher likelihood to pledge personal commitments when they have a shorter relationship (RELATION=<73) with their bank. When they have a longer relationship (RELATION>73), it lowers the likelihood to pledge personal commitments.

In general, we can conclude that relationship characteristics have a significant influence in both classification models, but not always in the direction as could be expected. Moreover, they do not seem to be the primary determinants in our classification models.

6. Conclusions

Previous empirical research has devoted little effort on the role and determinants of business collateral and personal commitments in the credit acquisition process, even though this is a common feature of small business credit contracts.

We modelled the collateralisation decision as a two decision process by investigating the differences in the determinants of the collateral decision versus the determinants of the choice between business collateral and personal commitments. The analysis was performed by a decision tree analysis. A decision tree induction allows us to clearly show which rules and which factors are used to classify the cases. Hence, the importance of all factors and their interactions in the classification of the cases can be clearly identified. In the classification models, we concentrate specifically on relationship characteristics.

Based on US data from the 1998 NSSBF database, our results suggest that relationship characteristics are significant classifying determinants in both decisions: collateral versus no collateral and business collateral versus personal commitments. However, they are not the primary determinants in both decision models.

In the first classification model (collateral/no collateral), the most important classifier is the loan amount. Within the highest loan amount category, family firms have a higher likelihood of pledging any kind of collateral. The duration of the relation with the bank is the third ranked determinant: a longer relationhip decreases the likelihood of pledging any kind of collateral. Within the lowest loan amount category, firms that obtain bank loans at their main bank have a higher likelihood of pledging collateral. This finding could suggest that the main bank exploits the market power it has over the firm. Other arguments for this behaviour can also be found in Mann (1997a, 1997b). He argues that banks often do this because secured credit limits the firms' ability to obtain future loans from other lenders and to reduce the risk of excessive future borrowing. From a pragmatic point of view, banks act in this way because of commercial reasons. Collateral creates a barrier-to-entry for other competing banks if these banks try to capture the client-firm from the main bank.

In the second classification model (business collateral/personal commitments), loan amount again seems to be the main classifier. The results suggest that when firms want to borrow a rather high amount and have less collateralizable assets, it seems that they incur a higher likelihood of pledging personal commitments. The duration

of the relationship with the bank is again less important: it is the third ranked determinant. The duration of the relationship lowers the likelihood to offer personal commitments when acquiring a loan.

7.   References

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Appendix 1 - Overview of the empirical studies on the determinants of collateral

Study	Leeth & Scott ('89)	Ang et al. ('95)	Berger & Udell ('95)	Harhoff & Körting ('98)	Avery et al. ('98)[i]	Machauer & Weber ('00)	Degryse & Van Cayseele ('00)	Hanley ('02)
subject	Collateral/no collat	Personal commitments	Collateral/ no collateral	Collateral/ no collateral	Personal vs business collat	Business collateral	Collateral/ no collateral	Collateral/ no collateral
Sample	NFIB '80 and '82	NSSBF '88	NSSBF '88, concerning lines of credit	survey German SME's for lines of credit	NSSBF '93 and SCF[5] '95	Credit files of 6 large German banks	Credit files of large Belgian bank (81% one-man business)	Credit files of UK bank
Period of study	1980, 1982	1988	1988	1997	1993, 1995	Jan '92-Dec '96	1997, granted after 1995	1999

Determinants of collateral

Relationship characteristics

Duration			-	-			-	
Number of banks				+		-		
Main bank						+	+	
Trust				-				
Lender					- non fin. institut. (compared to bank)			

Financial characteristics

Leverage		+	+	NS				
Profitability		+	NS	NS				
Sales					NS			
Current assets/ass			NS					
turnover A/R			+					
turnover Inventory			NS					

turnover A/P			NS					
Risk of default				+		+		NS
Characteristics of the firm								
Assets		-	+			NS		
Employees	-			-	NS			
Organizational form		- one-man business	NS	- family firm			+ smaller firm compared to one-man business	+ (location firm ≠ home owner)
Age	-		-	NS	+ (bus)/- (pers)		-	+
Δownership/ legal structure				NS				
Industry	- finance - profess services (comp. to 'retail')		NS	+building +retail (compared to production)	+ retail (bus) + business services (bus) - retail (pers) (compared to 'services')			
Characteristics of the debt agreement								
Term of the loan	+						+	
Loan amount	+			+	+		+	+
Kind of credit							NS	+ (fixed asset) -(working capital)
Interestrate	NS							

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[1] In this study, it's acknowledged that the results are not consistent, there are differences between the years studied (1993, 1995) and the database used (NSSBF or SCF). In this overview, only the results of the NSSBF 1993 (for lines of credit) are reported.