LAZY ENTREPRENEURS OR DOMINANT BANKS?

AN EMPIRICAL ANALYSIS OF THE MARKET

FOR SME LOANS IN THE UK

Otto Toivanen*

Email: toivanen@hkkk.fi

Economics Department, Helsinki School of Economics

PO Box 1210, 00101 Helsinki

Finland

and

Robert Cressy

Email: R.Cressy@city.ac.uk

City University Business School

London

United Kingdom

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ABSTRACT

An encompassing model of a business loan contract with the bank is constructed to establish the roles and relative importance of asymmetry of information, market power, borrower (entrepreneurial) effort and quality in explaining contract features. Special cases of the model include symmetric versus asymmetric information regimes, competition versus monopoly power, adverse selection versus moral hazard. The model is tested on a large SME database from a large UK bank. Results indicate that the model is a good description of the data; that the bank has considerable market power; and that there is moral hazard but no adverse selection in the market

Keywords: optimal loan contracts, adverse selection, moral hazard, symmetric information, monopoly, empirical contract theory

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I. INTRODUCTION

A considerable research effort has been directed to further our understanding of the characteristics and determinants of loan contracts. One objective has been to explain the stylized facts of such contracts: there is growing evidence that interest rate margins, loan sizes and the level of collateral vary between seemingly similar customers (see e.g. Cressy and Toivanen, 1998). But whilst during the last two decades, much progress has been made in advancing our theoretical knowledge on how asymmetric information affects optimal loan contracts (see Jaffee and Russell, 1976; Stiglitz and Weiss, 1981; Bester, 1985; and Broecker, 1990). As is so often the case in economics, theoretical work has predated the applied: very little has been achieved in terms of structural empirical analysis. In addition to the general interest in what conditions prevail when real world contracts are designed and how these conditions affect the nature of the contracts, theoretical research would ideally need empirical results for guidance.

The objective of this paper is therefore to contribute to the literature firstly, by theoretically modeling optimal loan decisions under both symmetric and asymmetric information when the loan contract has several (up to four) dimensions instead of the usual two (interest rate and collateral); secondly, by allowing explicitly for imperfect competition in the banking market (see Besanko and Thakor, 1987, for such a model); and thirdly, by testing the model using loan level data from a representative UK bank. We will use as a starting point of our analysis our recent paper by (Toivanen and Cressy, 1998) where we built and estimated a model with a three dimensional (loan size, collateral, and interest rate) loan contract, exogenous effort and competitive banking markets that explained the stylized facts of credit markets under both symmetric and asymmetric information (adverse selection). We found support for the model's predictions, and could not reject the null hypothesis of symmetric information.

Most of the existing theoretical literature adopts modeling structures that result in a first best equilibrium where collateral plays no role. As we argued in (Toivanen and Cressy, 1998, (CT), such models, although well suited for generating theoretical insights, do not lend themselves to the task of generating testable hypotheses on the informational structure of the credit market as they by assumption rule out one possible structure, that of *symmetric* information. Likewise, the bulk of the emerging empirical literature testing for a regime of asymmetric information (Puelz and Snow, 1994, Chiappori and Salanie, 1996, 1997, and Dionne et al., 1997) relies on reduced form estimations. Though again well suited for the specific task of testing for an asymmetric information regime, do not yield results on the wider issue of the characteristics of the optimal contract. The existing empirical papers on loan contracts (Berger and Udell, 1990 and 1992, Boot et al., 1991) also tend to focus on one or the other dimension of the loan contract, and do not (explicitly) test the nature of the informational regime. In addition, to the best of our knowledge, CT is the only paper that explicitly derives an econometric test of the nature of the informational regime from a theoretical model, and executes this test.

In the current paper we avoid the problems (from an empirical standpoint) present in most of the theoretical banking literature by constructing a model that has a role for collateral even under symmetric information. The intuition behind the result is very straightforward: collateral represents an alternative means of payment. By pledging collateral the customer raises the expected profit of the bank and can therefore expect a lower interest rate in return. The customer then optimizes between these alternative ways of paying the loan. Concentrating on banking and loan contracts allows us to assume that both contracting parties are risk-neutral: we thereby avoid the modeling problems presented by risk-aversion of one or the other party.

We use as a starting point the modeling framework of CT, but relax several of the assumptions made there. Whereas they assumed competitive banking markets, we allow for imperfect competition. This is done by modeling theoretically the two polar cases of a monopolistic bank and a bank operating in fully competitive markets. We are then able to show (in all but one version) of the model that only one parameter of the loan contract (the interest rate) differs when the market structure assumption is changed, and that one can therefore easily build an empirical model that encompasses the two versions (monopoly, competitive markets) of the theoretical model. A corollary of this is that our model of optimal loan contracts gives a theoretical justification for the approach taken in several industrial organization-based studies on banking competition (e.g. Spiller and Favaro, 1984, Suominen, 1994) where the researchers have only modeled the interest rate, not the whole loan contract. One novelty of our model is that it allows us to measure the degree of market power by using data from a single firm (bank).

Whereas in CT we assumed that the type of the customer is exogenous, we allow for the possibility that the type (i.e., the success probability) is an endogenous variable. It turns out that this has distinct effects on the form of the optimal contract both under symmetric and asymmetric information (moral hazard). The consensus view in the literature in what is becoming known as 'empirical contract theory' seems to be that one cannot distinguish moral hazard from adverse selection econometrically. One contribution of this paper is to show that this indeed can be done. In fact, we show that more than this is possible as we demonstrate a test for endogeneity of effort even under symmetric information. Conditional on the model fitting the data, we are thus in a position to test i) whether effort is endogenous or exogenous; ii) whether information is symmetric or asymmetric; and iii) the degree of market power that the bank possesses.

The next Section of the paper presents the basic model. We then solve in Section III the monopoly and perfect competition versions of the model under the twin assumptions of exogenous effort and symmetric information. After that, we relax the assumption of symmetric information to allow for adverse selection, and again solve the model under both competition regimes. We then proceed to analyze the case of endogenous effort first under symmetric and then under asymmetric information (moral hazard), and under both modes of competition, in Section IV. In Section V we discuss how to build an empirical model that nests the different versions of the theoretical model so as to allow the econometrician to test different assumptions. In the sixth Section, we present the data and the estimation results. Section VII concludes and summarizes.

II. THE BASIC MODEL

The basic structure of our model follows closely that adopted in CT. A risk neutral entrepreneur maximizes expected profits by investing L either in a riskless project with a rate of return r or in a risky project with gross return $R(X_i, L)$ in success states and 0 otherwise. R is an increasing, strictly concave and twice continuously differentiable function of L, the size of the loan. $\boldsymbol{X_i}$ is a vector of observable, quantitative entrepreneurial characteristics. Entrepreneurs have to finance their projects entirely by bank loan.[1] The success probability, denoted $p(X_i, q_i)$, is a function of $\boldsymbol{X_i}$ and a potentially endogenous and/or unobservable variable q_i called "effort". We assume that if exogenous, q_i is distributed according to some known density function with support $\left[\underline{q},\bar{q}\right]$. If endogenous, it is chosen from the interval $[\underline{q},\infty[$. The success probability satisfies the following assumptions: $p(X_i,q_i) > 0$, $p' > 0$, $p'' < 0$ (where primes denote derivatives w.r.t q_i) and $p(X_i,\infty) < 1$. These assumptions capture the essential features of effort: that there is some lower limit of effort that results in a positive probability of success; that the success probability is increasing in effort, but at a decreasing rate; and that no level of effort guarantees success. The entrepreneur negotiates the loan terms with a risk neutral, profit-maximizing bank. The loan terms consist of loan size *L*, interest rate a, collateral *C* and possibly (under the assumptions of endogenous effort *and* symmetric information) the level of effort q. As in CT, we assume that the cost of pledging collateral, $f(X_i,C)$, is an increasing, twice differentiable, strictly convex function of *C*. In order to allow that some firms find it optimal to pledge zero collateral, it is assumed that $f(0) \geq 0$ and $f'(0) £ b$, where a prime again denotes a derivative,[2] and b is a parameter of the model (see below). In case of default, the firm's value is zero in excess of whatever collateral was pledged: this assumption (taken from CT) allows us to treat inside and outside collateral equally, and conforms with the real-life definition of default.

The bank manager uses available quantitative information $\boldsymbol{X_i}$ to categorize[3] entrepreneurs into different groups *i*, $i=1,...,k$, where the number of entrepreneurs in group *i* is denoted N_i. The success probability *p* varies over entrepreneurs *i*, and within each group with q. Under symmetric information and exogenous effort the bank is able to identify those customers within group *i* that have the same $q = q_j$. The number of customers within these subgroups is n_{ij}, which satisfies $\sum_{j=1}^{J} n_{ij} = N_i$. The bank hence optimizes the loan for customers that exhibit similar characteristics, and is assumed to be able to discriminate a) between customers with different observable and quantifiable characteristics under all informational regimes and, b) between customers with different observable, exogenous, qualitative characteristics under symmetric information and exogenous effort. When effort is endogenous and information symmetric, we assume that there exists some enforcement mechanism that enables the bank to write the contract contingent on the effort level promised by the entrepreneur. We do not specify in any more detail what form such a mechanism might take.

The entrepreneur's objective function is then given by:

$$p^F = p(X_{pi}, q)[R(X_{Ri}, L) - aL] - (1 - p(X_{pi}, q)) f(X_{fi}, C) - V(X_{Vi})q \qquad (1)$$

where $V(\boldsymbol{X}_{Vi})$ is a cost of effort multiplier, and the cost of effort (in line with most of the literature) is linear in the level of effort q_i. The vectors $\boldsymbol{X}_{ji}$, j$\in\{p,R,f,V\}$, may contain common elements. This formulation allows for both exogenous effort (in which case $V(\boldsymbol{X}_{Vi})=0$ for all i, and q_i is fixed) and endogenous effort. The objective function of the bank is

$$p^B = p\ aL + (1-p)(bC - d) - rL - K = 0 \qquad (2)$$

where r is the bank's exogenously given cost of funds (deposit or world bond market interest rate), $K>0$ is a fixed cost of writing the loan contract and b and d are parameters. We assume $0 < b \leq 1$ and $d \geq 0$ to hold. This set up allows for the possibility that the bank does not recover the full market value of collateral in case of default, and for the possibility that the bank has to incur some fixed cost in liquidating the collateral.

Different combinations of assumptions on the symmetry of information, the endogeneity of effort, and the level of competition in the loan market yield a total of eight different regimes for which the model has to be solved. We will analyse this, and state the results, in the following two Sections.

III. EXOGENOUS EFFORT

A. Symmetric Information

We start the analysis by assuming that the bank is able to discover the value of q_i, which is here assumed to be exogenous. In other words, entrepreneurs in group N_i vary, but the bank is able to find out the value of the qualitative characteristics of the entrepreneurs, and can discriminate on the basis of that information. This means it can offer loan contracts conditional on the value of q_i.

To solve for the optimal loan contract under the assumption of competitive loan markets we solve the following program:

$$\max imize_{a,L,C}\, p^F \text{ s.t. } p^B \geq 0 \tag{3}$$

It is easily established that the objective function is (strictly) concave and the constraint (strictly) convex in their arguments,[4] and hence the first order conditions of (3) characterize the unique maximum. Based on these we can state the following Proposition (see CT for a proof):[5]

PROPOSITION 1: a) Under the assumptions of i) competitive loan markets, ii) exogenous effort and iii) symmetric information,

a) the optimal loan size is given (implicitly) by

$$R'(L^*) = \frac{r}{p} \tag{4}$$

b) the optimal interest rate is given by

$$a^* = \frac{r}{p} + \frac{1}{p}\frac{K}{L^*} - \frac{1-p}{p}\frac{(bC^* - d)}{L^*} \tag{5}$$

c) and the optimal level of collateral (implicitly) by

$$f'(C^*) = b \qquad (6)$$

*where * denotes the equilibrium (optimal) value.*

It follows from Proposition 1 that the level of collateral depends only on exogenous variables; that entrepreneurs with a high probability of success get a larger loan; and that they pay a lower interest rate than entrepreneurs with a low probability of success if and only if $(bC^* - d) < a^* L^*$ (or, equivalently, $bC^* - d < rL^* + K$). Although it is an empirical matter to establish whether the last claim holds, we will from now on in the theoretical treatment assume this to be the case. When we change the assumption of competitive loan markets to one of a monopoly bank, the program that yields the optimal loan terms changes to

$$\max imize_{a,L;C}\, p^B \text{ s.t. } p^F \geq 0 \qquad (7)$$

Again, it can be shown that the first order conditions yield a unique maximum which we characterize in the following Proposition:

PROPOSITION 2: a) Under the assumptions of i) a monopoly bank, ii) exogenous effort and iii) symmetric information,

a) the optimal loan contract is otherwise determined by the same equations as in Proposition 1, but the interest rate is given by equation

$$a^* = \frac{R(L^*)}{L^*} - \frac{1-p}{p}\frac{f(C^*)}{L^*} \qquad (8)$$

b) One can empirically nest the monopoly bank and competitive loan market models by estimating the following interest rate equation:

$$a^* = g\left[\frac{R(L^*)}{L^*} - \frac{1-p}{p}\frac{f(C^*)}{L^*}\right] + (1-g)\left[\frac{r}{p} + \frac{1}{p}\frac{K}{L^*} - \frac{1-p}{p}\frac{(bC^* - d)}{L^*}\right] \qquad (9)$$

where g *(satisfying* $g \in [0,1]$*) is a measure of the monopoly power of the bank.*

The intuition behind these results is that as the size of the loan determines the total surplus, a monopoly bank has every incentive to give a loan that maximizes this. The bank then uses the interest rate to capture the surplus left after the optimal amount of collateral has been pledged. As the loan size (and therefore the surplus created by the entrepreneur) is an increasing function of q_i, the interest rate is also an increasing function of q_i. Proposition 2b follows simply from attaching weights to the interest rate equations generated under the monopoly bank and competitive loan market assumptions respectively. Under the current assumptions, we are thus able to infer from the coefficient of the bank's cost of funds (*r*) the level of market power enjoyed by the bank.

B. Asymmetric Information (Adverse Selection)

We now change the assumption of symmetric information to allow for the possibility that the bank is not able to find out the value of q_i. This means that within each category N_i, the bank has to resort to incentive compatible contracts. For simplicity, and in line with most of the literature (and CT), we assume that q_i can take two values that satisfy $q_G > q_B$ (subscripts stand for "Good" and "Bad" borrowers respectively). This assumption yields the following probabilities of success: $1 > p_G > p_B > 0$. We further assume that the bank knows the proportion c of Good borrowers in group N_i ($cN_i = n_{iG}$)

If the loan market is competitive, the bank makes zero expected profits from the loans it grants to entrepreneurs, and the program that the bank has to solve for entrepreneur of type *j* (within group *i*) takes the form[6]

$$\max imize_{a,L;C} p_j^F \text{ s.t. } p^B \geq 0, \qquad p_j^F(a_j, L_j, C_j) \geq p_j^F(a_k, L_k, C_k),$$

$$p_j^F(a_j, L_j, C_j) \geq 0 \quad j{=}G{,}B, \quad j \neq k$$

(10)

The new constraint is the familiar incentive compatibility constraint. As is common in this type of models, the only constraint that binds (in addition to the bank's zero profits constraint) is the incentive compatibility constraint of the Bad borrower. We summarize the results in Proposition 3 without proof (as the Proposition is identical in content to that of Proposition 2 in CT):

PROPOSITION 3: Under the assumptions of i) competitive loan markets, ii) exogenous effort and iii) asymmetric information, a separating equilibrium exists where

a) the optimal loan contract of the Bad borrower is identical to that described in Proposition 1;

b) A Good borrower's optimal loan contract is otherwise similar to that described in Proposition 1, but she pledges more collateral than a Bad borrower as determined by equation (11):

$$f(C_G*) = f(C_B*) + \frac{p_B}{1-p_B}\{[R(L_G*) - a_G * L_G*] - [R(L_B*) - a_B * L_B*]\} \qquad (11)$$

We thus obtain the standard adverse selection result where the Good borrower pledges more collateral than she would under symmetric information. This she does in order to avoid dissembling by the Bad borrower. We next change the assumption of competitive loan markets to that of a monopoly bank. The program that the bank solves then takes the form

$$\max imize \;\; c p^B_{G,G} + (1-c) p^B_{B,B} \text{ s.t. } p_j^F(a_j, L_j, C_j) \geq p_j^F(a_k, L_k, C_k),$$

$$p_j^F(a_j, L_j, C_j) \geq 0 \quad j{=}G{,}B, \quad j \neq k$$

(12)

where the first subscript stands for the type of the entrepreneur, and the second for the type of entrepreneur for whom the contract has been designed (i.e., $p^{B}_{G,G}$ gives the profit of the bank from a contract that is designed for a Good borrower, and made with an entrepreneur who is a Good borrower[7]). An important feature to be noted is that under the current assumptions, it is the Good borrowers' participation constraint that is binding (if any). This is a consequence of characterizing the types via first order stochastic dominance and hence holds e.g. in the models of Besanko and Thakor (1987) and Wang and Williamson (1994; see Vauhkonen, 1997). In our model, it can be shown that as long as the optimal contract is a separating one, the optimal loan sizes are not affected by the other characteristics of the contract. The loan sizes in turn determine in our model the surplus created by the contract, and from this fact and the above feature of the model it follows that the bank can use the other dimensions of the contract to capture this surplus without having to fear that the size of the surplus is thereby affected. The bank would then ideally want to design contracts where the participation constraints of both types bind: it can be shown that this is possible in our model if and only if there are no non-pecuniary costs of bankrupCTy, i.e., $f(0)=0$. If this condition does not hold, the bank has three options: it either designs a pooling contract such that the participation constraint of one or the other type is binding (as in Besanko and Thakor, 1987), or it designs a separating contract where the Bad borrowers' participation constraint is binding. Which of these three emerges as the equilibrium contract depends on the (relative) expected surpluses created by the two types, and the proportion of the types in the customer population. The results from solving the program (12) are summarized in Proposition 4:

PROPOSITION 4: a) Under the assumptions of i) a monopoly bank, ii) exogenous effort and iii) asymmetric information, *a) if $f(0)=0$ holds, the optimal loan sizes and interest rates of the Bad and the Good borrower are identical to those described in Proposition 2, the optimal level of collateral of the Good type is identical to that described in Proposition 2, and the optimal collateral of the Bad type is zero*

b) if $f(0)=0$ does not hold, the bank either

i) chooses a pooling contract that is identical to the contract of the Good or the Bad borrower as described in Proposition 2 (which of these depends on the relative profitability of the two contracts, and the proportion of Good and Bad types in the customer population: see Appendix A for precise characterizations) or

ii) designs a separating contract.

The changes induced by a change in the assumption of the competitiveness of the loan market are thus more dramatic under asymmetric information than symmetric information when effort is exogenous. The result of Proposition 2b,i) resembles that of Besanko and Thakor (1987) who in a model with exogenous loan size found that a monopoly bank may set the interest rate such that Bad borrowers do not participate, and the Good borrowers' participation constraint is binding. Our results imply that credit rationing in equilibrium is less likely than in the model of Besanko and Thakor: the reason for the difference is that in our model, loan size is endogenous, and the cost of collateral to the entrepreneur nonlinear. The above Proposition has crucial repercussion to empirical testing of our model. These are summarized in the following Corollary:

COROLLARY 1: If the bank is a monopolist, one can empirically distinguish an exogenous effort, symmetric information version from the exogenous effort, asymmetric information version of the model as long as the optimal contract under *asymmetric information is a separating contract. One can also test whether the observed contracts are pooling or separating contracts.*

The Corollary means that the test employed in CT to test for adverse selection is *not* sensitive to the level of competition in the market as long as the optimal monopoly contract under adverse selection is not a pooling contract.[8]

IV. ENDOGENOUS EFFORT

A. Symmetric information

In this Section we change the assumption of the exogeneity of q_i and assume that it is endogenously chosen after the loan contract is signed. As discussed earlier, we assume that under symmetric information the bank and the entrepreneur are able to write a contract that is contingent on the level of effort exerted after the contract is signed, and that there exists some mechanism that allows the bank to enforce the agreed level of effort. This setup means that the loan contract has as its fourth dimension the level of effort, and under the assumptions of symmetric information and a competitive loan market the program to be solved changes from (3) to (14):

$$\max imize_{a,L,C,q} p^F \text{ s.t. } p^B \geq 0 \tag{14}$$

where $p(X_i, q_i)$, is a function of q_i, which in turn is endogenously determined. Our assumptions define a decreasing returns to scale technology with respect to producing success with effort. The cost of effort is assumed linear as stated in (1). Solving (14) yields Proposition 5:

PROPOSITION 5: Under the assumptions of i) competitive loan markets, ii) symmetric information and iii) endogenous effort,

a) the optimal loan size, interest rate, and level of collateral are determined by equations (4) - (6) as described in Proposition 1;

b) the following comparative statics w.r.t to the effort hold:

$$\frac{\partial \theta}{\partial L} > 0\,,\quad \frac{\partial \theta}{\partial C} = 0\,,\quad \frac{\partial \theta}{\partial \alpha} = 0\,,\quad \frac{\partial \theta}{\partial \rho} = 0\,,\quad \frac{\partial \theta}{\partial \varsigma} < 0\,.$$

What emerges is that the equations determining the interest rate and loan size are robust to the endogeneity of effort, as is the collateral equation (when compared to the exogenous effort, symmetric information model). As effort is now part of the contract, Proposition 5b defines the comparative statics of it with respect to other variables of interest. It turns out that effort is an increasing function of loan size. None of the other endogenous variables nor the bank's cost of funds affects on effort. Not surprisingly, increasing the cost of effort leads to a decrease in the level of it.

When changing the assumption from competitive loan markets to a monopoly bank the program to be solved becomes

$$\max imize_{\alpha,L,C,\theta}\, \pi^B \text{ s.t. } \pi^F \geq 0 \qquad (15)$$

The results of solving (15) are summarized in Proposition 6:

PROPOSITION 6: Under the assumptions of i) monopoly bank, ii) symmetric information and iii) endogenous effort,

a) the optimal loan size, interest rate, and collateral are determined as described in Proposition 2;

b) the comparative statics w.r.t to the effort are as described in Proposition 5.

A monopolistic loan market shares the same features regardless of whether or not effort is endogenous. The one departure from this rule is naturally the endogeneity of effort: in this respect monopolistic and competitive loan markets are identical.

B. Asymmetric information (Moral Hazard)

We now relax the assumption that the bank observes the level of effort, and that the parties can contract on it. Our assumptions on the technology and preferences enable us to use the first-order approach (see e.g. Grossman and Hart, 1981, Rogerson, 1985). In our model this means adding the constraint

$$p'\left[R(L) - \alpha L + f(C)\right] - V \geq 0 \tag{16}$$

to the program which, if the banking market is competitive, now becomes

$$\max imize_{\alpha,L,C,\theta}\, \pi^F \text{ s.t. } \pi^B \geq 0 \text{ and (16).} \tag{17}$$

This results in Proposition 7:

PROPOSITION 7: a) Under the assumptions of i) competitive loan markets, ii) asymmetric information and iii) endogenous effort,

a) the optimal loan size and interest rate are give by equation (4) and (5) as described in Proposition 1;

b) the following comparative statics w.r.t to collateral hold:

$$\frac{\partial C}{\partial L} \gtrless 0 \text{ when } R' \lesseqgtr \alpha\ ,\ \frac{\partial C}{\partial \alpha} > 0,\ \frac{\partial C}{\partial \rho} = 0,\ \frac{\partial C}{\partial V} > 0$$

c) the following comparative statics w.r.t to effort hold:

$$\frac{\partial \theta}{\partial L} \gtrless 0 \text{ when } R' \gtrless \alpha\ ,\ \frac{\partial \theta}{\partial C} > 0,\ \frac{\partial \theta}{\partial \alpha} < 0,\ \frac{\partial \theta}{\partial \rho} = 0,\ \frac{\partial \theta}{\partial V} < 0$$

This time the changes compared to symmetric information are large: whereas under symmetric information the level of collateral is a function of exogenous variables only, under asymmetric information it is a function of loan size and interest rate in addition to being a function of exogenous variables. Also should be noted that whereas the exogenous variables work under symmetric information only through the cost of collateral function *f(.),* they now affect the level of collateral in addition through the probability of success and the cost of effort functions *p(.)* and *V(.).* When one compares the comparative statics of effort, the most important (and anticipated) difference is that under asymmetric information the level of collateral affects positively on the level of effort, i.e., collateral can be (is) used to induce the entrepreneur to exert effort. Under symmetric information there was no need for this. In addition, the level of effort is a negative function of the interest rate. One should also note that the collateral and effort comparative statics with respect to loan size are intertwined: when the former is positive (negative), the latter has to be negative (positive).

With moral hazard, the level of collateral is identical for all customers within a given group *i*. This level of collateral can be zero if the cost of effort is sufficiently high. In such a case, the bank offers customers within a group a contract that is based on their success probability when their effort level is $\underline{q}$. Empirically we observe however that the level of collateral varies within groups (see Table 2 in CT). The reason for this could be, e.g., that our vector of exogenous variables is not identical to that used by the bank.

Changing the assumption on the competitiveness of the loan market to a monopoly results now in the following program

$$\max imize_{a,L,C,q}\, p^{B} \text{ s.t. } p^{F} \geq 0 \text{ and (16)} \tag{18}$$

and Proposition:

PROPOSITION 8: Under the assumptions of i) a monopoly bank, ii) asymmetric information and iii) endogenous effort

a) the optimal loan size and the interest rate equation are determined as described in Proposition 2;

b) the comparative statics w.r.t to collateral and the level the effort are identical to those described in Proposition 7.

Once again, the only change that a shift in the competitiveness of the loan market induces is a change in the interest rate equation. Otherwise the monopoly bank's optimal loan contract is determined by the same equations, and same comparative statics, as that of a bank facing a competitive loan market.

V. THE ECONOMETRIC MODEL

A. The general model

The aim in this Section is to build an econometric model that nests the different versions of the theoretical model explored in the two previous Sections. The equations that determine the optimal loan contract under different assumptions are presented in Table 1. As can be seen, the loan size equation is not affected by changes in the assumptions about the symmetry of information, endogeneity of effort, or level of competition. Although the equation stays the same, there is a difference between the two effort assumptions in that when effort is endogenous, the loan size is a function of one other endogenous variable (effort) whereas under exogenous effort it is determined solely by exogenous variables. The interest rate equation depends on the level of competition, but not on the symmetry of information or the endogeneity of effort. As stated earlier, one can therefore easily build an estimation equation that nests both the competitive loan market and the monopoly bank interest rate equations. The level of collateral depends on whether information is symmetric or asymmetric, and (under asymmetric information) on whether effort is endogenous or not. Lastly, optimal effort (when endogenous), is affected by the assumption on the symmetry of information, but not by the competitiveness of the loan market.

[TABLE 1: PREDICTIONS OF THE THEORY]

The above theoretical model suggests the following system of estimating equations that nests all the eight different regimes that have been studied:

$$L^* = g_1(p^*, r, \boldsymbol{X_{Li}}) \qquad (17)$$

$$a^* = g_2(L^*, C^*, p^*, r, \boldsymbol{X_{ai}}) \qquad (18)$$

$p^* = g_3(a^*, L^*, C^*, r, \boldsymbol{X}_{pi})$ (19)

$C^* = g_4(a^*, L^*, p^*, r, \boldsymbol{X}_{Ci})$ (20)

Where the $\boldsymbol{X}_{ji}$ are vectors of exogenous variables. Our exogenous variables are a vector (43) of industry dummies; a vector (6) of purpose of loan dummies; year and quarter dummies indicating the timing of the loan; bank's cost of funds (bank's Prime rate); GDP in the quarter of making the loan contract; duration of the loan and its square; and interactions between these. We include industry dummies into all equations; purpose of loan dummies into the loan size and collateral equations; year dummies into the interest rate, collateral and success equations; quarter dummies into all equations; GDP into all others but the loan size equation (it was insignificant in the loan size equation and therefore dropped); and finally, purpose of loan dummy- and duration of the loan-bank's cost of fund interactions into the loan size equation. We discuss the identification of the model in more detail below.

We will proxy effort by the probability of success as the comparative statics for these two are (almost) identical.

B. The Estimation Strategy

Based on the above general empirical model (equations (17)-(20)), one can then use the following estimation strategy to test the model and its different assumptions:

1. The validity of the model can be tested using the loan size equation (17) and the interest rate equation (18). Neither of them is affected by the endogeneity of effort (apart from having to use instruments instead of observed values for some variables) or the symmetry of information.

2. The level of bank market power: The interest rate equation will also produce a measure of the market power of the bank as equation (8) tells that the coefficient of *r* is $(1 - g)/p$, and g is a measure of the market power of the bank. If the loan size and interest rate equations show that the model fits the data, we can proceed to test

3. The endogeneity of effort with equation (19). If effort is endogenous, it will be a function of loan size; if exogenous, it will not be affected by any of the endogenous variables. The comparative statics differ with changes in the symmetry of information, and under asymmetric information effort is increasing in the level of collateral and decreasing in the level of the interest rate, in addition to being a function of loan size. The effort equation can therefore also be used to test whether there is

4a. Symmetric or asymmetric information if effort turns out to be endogenous.

Our comparative statics tell that collateral is also an increasing function of effort if either effort is endogenous, or if effort is exogenous, but there is asymmetric information. It is hence possible that we could detect a positive correlation between these two variables in both the effort and the collateral equations. However, the timing of events in the case of moral hazard suggests that the causality is one way, and more specifically, that it runs from collateral to effort. The sequence of events in a standard moral hazard model as ours is that at the time of contracting the parties agree on the level of collateral, and the agent (the entrepreneur in our model) *thereafter* exerts the amount of effort that is in her best interest, conditional on the terms of the contract. The timing of events in the endogenous effort case suggests thus that the level of effort in the collateral equation measures the existence of adverse selection.

Finally, no matter what the results from the effort equation, we can use the collateral equation to test for

4b. (A)symmetry of information: if the effort estimation revealed that effort is exogenous, the possibility of adverse selection still remains. In this case we include the variable proxying success into the collateral equation as an exogenous variable to test for adverse selection (as done in CT). Under symmetric information collateral is not a function of the success probability, whereas under adverse selection the Good borrowers are more likely to pledge collateral than Bad borrowers if the market is competitive or the monopoly bank chooses separating contracts.

If, on the other hand, the effort estimation proves that effort is indeed endogenous, the collateral equation will bring (further) light to the question of whether or not loan contracts are made under symmetric or asymmetric information. Under symmetric information collateral is a function of exogenous variables (those relating to the type of the entrepreneur) only, whereas under asymmetric information (moral hazard) it is a function of loan size (with a sign that is opposite to that in the effort equation) and an increasing function of the interest rate.

C. Identification and Estimation

We identify each equation using exclusion restrictions. We instrument loan size using purpose of loan – bank's cost of fund interactions; the interest rate by the bank's cost of funds; and collateral mostly by purpose of loan dummies. In the interest rate estimation we include the purpose of loan dummies into the second stage equation, and therefore have to use a different instrument for collateral. We resort to the same solution that we apply to the instrumenting of effort (our proxy for effort is whether or not the loan succeeded): we use as an instrument the predicted value from a semi-parametric (probit) estimation of the endogenous variable on a 3rd degree polynomial of exogenous variables. The reason for using this approach is that linear instruments turned out to work badly with effort. The reason for this is twofold: firstly, only a relatively small proportion of all loans default; secondly, the relationship between exogenous variables and success turned out to be highly nonlinear.

For each estimation equation, we report i) a Hausman test of the endogeneity of each endogenous explanatory variable; ii) a Bound et al. (1998) test of instrument validity, again for each endogenous variable separately;[9] and iii) a Hausman test of overidentification restrictions. We thus statistically test for the need of instrumenting and the properness of our instruments both in the sense of them being sufficiently correlated with the endogenous variable they instrument, and in the sense of not using as instruments variables that ought to be included into the structural equation(s).

Two of our endogenous variables are discrete, suggesting the use of nonlinear estimation methods. However, Angrist (1991) reports Monte Carlo evidence that when the functional form is misspecified, a linear probability model (LPM) yields good results especially when a dummy endogenous variable is used as an explanatory variable. Both conditions apply to our data. It is unclear what the correct distributional assumption is for the collateral and success equations (although CT report that their collateral equation results are robust to changes in the functional form assumptions). Both equations also contain a dummy endogenous variable. We therefore report LPM estimates for both success and collateral. Also, we do not employ 3SLS to avoid letting the misspesification of one equation affect the estimation of others.

VI. DATA AND EMPIRICAL RESULTS

A. Data

We employ the same data set as in CT; it consists of 2767 term loans granted to small and medium sized enterprises by a single, representative UK bank between April 1st, 1987 and December 31st, 1990. We observe the industry of the entrepreneur, the purpose of the loan (6 categories), its duration (in months), and the time of granting the loan (by year and quarter). These are all treated as exogenous variables. In addition we have collected information on the level of GDP in the quarter the loan was granted (this was not used in CT). We also observe the bank's prime rate in each quarter, and use that to measure the bank's cost of funds. The overall descriptive statistics are presented in Table 2.

[TABLE 2: DESCRIPTIVE STATISTICS]

We treat the size of the loan and its interest rate as endogenous variables. Our other two endogenous variables are discrete, namely whether or not collateral is part of the loan contract, and whether or not the loan 'succeeded' (did not default fail by end of Quarter 1, 1993). Table 3 (reproduced from CT) gives the industry weighted averages of the most important variables. The loans are small on average (£19 000) and the interest rate margin is circa 3 percentage points. Over 60% of loans are collateralized, and the average duration is 90 months. Some 8 per cent of the loans defaulted (yielding a zero value for the success variable). As can be seen, there is large variation (e.g. measured by the coefficient of variation) in each of the contract variables. As CT discuss at length, this variation remains even when one controls for the industry of the entrepreneur, and the purpose of the loan.[10]

[TABLE 3: INDUSTRY AVERAGES]

B. Empirical Results

Estimation results are presented in Table 4. In the lower half of the Table, we report for each estimation the exogenous variables included into the (2^{nd} stage) equation, and the results of the tests discussed above. In the first column we report the results of the loan size equation. As can be seen, the exogeneity of success is strongly rejected.[11] However, in line with our theoretical model, better firms (those with higher effort) get a larger loan. This result leads us to reject the existence of a pooling equilibrium (a possibility with a monopoly bank and adverse selection in our model; and in other settings, too. See e.g. de Meza and Webb, 1989). In a pooling equilibrium all types would get the same contract, and a positive and significant SUC coefficient implies that Good applicants get a larger loan than Bad applicants. Loan size is a decreasing function of bank's cost of funds. Notice that the total effect of bank's cost of funds consists of the linear coefficient plus the coefficients of the purpose of loan-bank's cost of fund interactions, and the duration of the loan-purpose of the loan interaction coefficient. The relationship between loan size and duration of the loan is nonlinear, as already documented by CT. Our instruments for SUC pass both the Hausman overidentification test and the Bound et al. test.

[TABLE 4: ESTIMATION RESULTS]

In Column 2, the interest rate is a negative function of loan size, though this is only marginally significant. One should note that CT found, with this same data, and treating loan size as endogenous, that the interest rate is an increasing function of loan size. There are differences in the instruments used, and in that now we instrument SUC in addition to loan size and collateral. This time, we cannot reject the Null that loan size is exogenous to the interest rate (as suggested by our theoretical model). The value of the Bound et al. test suggests that the result is genuine, and not due to weak instruments. We therefore report in Column 3 the results of an estimation where loan size is treated as exogenous. Now the coefficient of loan size is positive and significant, in line with the CT results.

Bank's cost of funds carries a positive coefficient of .154, although this is significant at the 13% level only when we treat loan size as endogenous. When loan size is treated as exogenous, the coefficient of bank's cost of funds is significant at the 10% level with a slightly higher value of .198. Recall that 1/p times one minus the coefficient on bank's cost of funds is a measure of the market power of the bank. Employing the point estimate from the equation where loan size is exogenous, and the expected success rate in the sample, our estimate of bank market power is .794 on a scale from 0 to one, 0 representing a monopoly.

One can make at least two kinds of comparisons to theoretical models. Firstly, one could denote by 0 the price cost margin that a monopolist achieves in some theoretical model, and calculate the number of firms needed to achieve the level of competition suggested by our point estimate. Thus, to achieve a value .794, a linear demand homogenous goods Cournot oligopoly should have (should act as competitively as if there were) 1.5 firms. Alternatively, one could start from the observation that in our model, the monopoly bank captures (almost) all the surplus. One could therefore compare the industry surplus (total firm profits) to social surplus generated by a given market structure in some theoretical model. In the linear demand Cournot, a monopoly captures 2/3 of the social surplus, whereas our estimate suggests that the bank captures 79%.

Turning to other variables, we find that the interest rate is a decreasing function of both effort (success) and collateral, as predicted by our model. Duration affects the interest rate in a nonlinear fashion, confirming the findings of CT. We conclude that both the interest rate equation and the loan size equation suggest that our model is a reasonable description of the data, and proceed to discuss the success (effort) and collateral equations.

The success equation, reported in Column 4, is important both as a test of the endogeneity of effort, and as a test of the (a)symmetry of information. Recall that if effort is exogenous, success should not be a function of any of the other endogenous variables; that if effort is endogenous and information symmetric, it should be a function of loan size only (of the endogenous variables); and that if effort is endogenous and there is asymmetric information (moral hazard), it should be a positive function of collateral. Our specification passes the over-identification and instrument validity tests. We find that success is not a function of loan size, and that we cannot reject the Null that loan size is exogenous (treating it as exogenous did not change the results, and we therefore only report the results from the estimation where loan size is treated as endogenous). Interest rate obtains a coefficient of 5.150, which is significant at the 13% level only. Therefore neither loan size nor the interest rate coefficients yield support to the hypothesis that effort is endogenous. The collateral variable, in contrast, obtains a positive coefficient that is significant at the 5% level. This results turned out to be very robust to various experiments both with regard to instruments used (in the reported equation, collateral is instrumented by the purpose of loan dummies vector), and to exogenous variables included into the 2nd stage regression. The result leads us to reject both the Null of exogenous effort, and the Null of symmetric information (conditional on endogenous effort), and suggests that the data can be characterized by moral hazard. Note that as almost 40% of loans are uncollateralized, this results implies that these loans have no collateral because the cost of providing (more than the minimum amount of) effort is too costly.

In the last column we report the results of the collateral estimation. This can be used for verification of the moral hazard result of the success equation. If there is moral hazard, collateral is a positive function of loan size, whereas otherwise it is not a function of any of the other endogenous variables. We find a positive, statistically significant coefficient for loan size, whereas the other two endogenous explanatory variables (success, interest rate) carry imprecisely measured coefficients. We interpret this as further evidence in favor of moral hazard. We fail to reject the Null of exogeneity for both success and the interest rate. The insignificant coefficient of SUCC means that, in line with CT, we cannot reject the Null of symmetric information against the alternative of adverse selection (of course, the Null of symmetric information was rejected in favor of moral hazard in the success estimation).

VII. CONCLUSIONS

Our objective in this paper was to build upon earlier theoretical and empirical work in uncovering how loan contract terms are determined. We sought to generalize an existing model so as to allow for different potential features of real life loan contracts and contracting situations. In particular, we allowed the contract to have several dimensions (up to four: loan size, interest rate, collateral and effort); and the environment to vary in three ways (the degree of competition, the symmetry of information, and the endogeneity of effort). This theoretical approach produced eight versions of our basic model, each capable of a priori explaining the stylized facts of credit markets. We then showed that one can build a general econometric model that encompasses the different versions of the theoretical model, and devised a testing strategy that starts from an empirical verification of the model, and continues with tests of the different key assumptions that influence the determinants of loan contracts. Our theoretical model shows how the empirical predictions of adverse selection and moral hazard differ, and thereby allows us to test for the existence of one or the other. Most previous empirical work on the (a)symmetry of information has tested reduced form equations that do not allow the researcher to identify whether the form of asymmetric information (if any) is adverse selection or moral hazard.

Our theoretical model showed that earlier results that suggest that monopoly power of the bank may lead to pooling contracts and credit rationing are sensitive to the specification of the model. In particular, making loan size endogenous and cost of collateral nonlinear results in the possibility of separating contracts and no credit rationing. Our model displays however the same feature as that of Besanko and

Thakor (1987) in that a monopoly bank facing adverse selection may not resort to collateral as a signaling device and that there may be credit rationing in equilibrium. A corollary of this is that the test used in our earlier paper to distinguish symmetric information from adverse selection is not sensitive to the level of market power possessed by the bank as long as we observe separating contracts.

We implemented this testing strategy using a data set explored in earlier work (Toivanen and Cressy, 1998) and were careful to maintain comparability of our results with those reported earlier. Our empirical results showed that the model explains the data well and that thus our theoretical model seems to be an adequate description of real world loan contracting; we were also able to show that the bank in question possesses quite considerable market power in the market for small and medium sized enterprise loans. Most importantly, in terms of contributing to the research program of under what conditions are real world contracts designed, our results rejected the hypotheses of symmetric information, exogenous effort and adverse selection in favor of the hypotheses of endogenous effort and moral hazard.

Our results are important not only because they ex post justify the large research effort of the last two decades that has been directed towards theoretical modeling of (loan) contracts under asymmetric information (more specifically, moral hazard: adverse selection was not found); but also because they (hopefully) can be used as a starting point for further theoretical work. At the same time one should keep in mind that although robust as such, our results are still comparable to one experiment in natural sciences as we have used data from one bank operating in a particular country, and our data is limited by the relatively short time period it covers. More econometric work is called for before the profession can with any confidence claim to know what kind of an environment is faced by agents designing real world (loan) contracts.

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Table 1
Determinants of Loan Characteristics

	Exogenous Effort				Endogenou		
	Symmetric Information		Asymmetric Information		Symmetric Information		
	Competition	Monopoly	Competition	Monopoly	Competition	Monopoly	
Loan Size	$R'(L^*) = \frac{r}{p}$						
Interest Rate	$a^* = \frac{r}{p} + \frac{1}{p}\frac{K}{L^*} - \frac{1-p}{p}\frac{(bC^* - d)}{L^*}$	$a^* = \frac{R(L^*)}{L^*} - \frac{1-p}{p}\frac{f(C^*)}{L^*}$	$a^* = \frac{r}{p} + \frac{1}{p}\frac{K}{L^*} - \frac{1-p}{p}\frac{(bC^* - d)}{L^*}$	$a^* = \frac{R(L^*)}{L^*} - \frac{1-p}{p}\frac{f(C^*)}{L^*}$	$a^* = \frac{r}{p^*} + \frac{1}{p^*}\frac{K}{L^*} - \frac{1-p^*}{p^*}\frac{(bC^* - d)}{L^*}$	$a^* = \frac{R(L^*)}{L^*} - \frac{1-p^*}{p^*}\frac{f(C^*)}{L^*}$	a^* $-$
Collateral	$f'(C^*) = b$	$f'(C^*) = b$	*Bad:* $f'(C^*) = b$ *Good:* $f(\hat{C}_G) = f(C^*_B) + \frac{p_B}{1-p_B}\{[R(\hat{L}_G) - a_G \hat{L}_G] - [R(L_B^*) - a_B^* L_B^*]\}$	*Separating contracts:* $C^*_G \geq C^*_B$ *Pooling contracts:* $C^*_G = C^*_B$	$f'(C^*) = b$	$f'(C^*) = b$	
Effort	exogenous				$p'\left[R(L^*) + f(C^*) - C^*\right] - V = 0$		

NOTES: Each of the cells contains the equation that either determines the equilibrium value of the variable in question, or the equation that is use reported in the Propositions and in Table 2. For the adverse selection, monopoly bank case the loan size and interest rate equations are not strictly contracts are pooling or separating contracts. See Appendix A for details.

Table 2

DESCRIPTIVE STATISTICS

Variable	Whole Sample mean (standard deviation)
Loan size (£000)	18.785
	(22.406)
Interest rate (%)	15.964
	(2.086)
Bank's cost of funds (%)	13.020
	(2.308)
Interest rate margin (%-points)	2.944
	(1.556)
Default (%)	8.064
	(24.491)
Collateral (%)	61.596
	(46.581)
Duration (months)	90.640
	(51.633)

2767 loans, 43 Industry dummies, 6 Purpose of loan dummies. Numbers are weighted using industry dummies as weights (proportions of industries in the whole sample)

TABLE 3
INDUSTRY LEVEL DESCRIPTIVE STATISTICS

SIC codes	number of firms in the industry	proportion of firms in the industry (%)	interest rate margin (%-points)	loan size (£000)	interest rate (%)	collateral (as proportion of all loans to the industry)	success (as proportion of all loans to the industry)
1000-1100	43	1.590	3.181	13.463	16.381	0.605	0.977
			(0.537)	(12.937)	(2.105)	(0.495)	(0.153)
1100-1200	30	1.109	2.236	14.539	16.213	0.767	0.967
			(1.603)	(8.587)	(2.173)	(0.430)	(0.183)
2000-2100	7	0.259	4.257	13.928	16.064	0.286	1.000
			(0.970)	(16.291)	(2.346)	(0.488)	(0.000)
3000-3100	4	0.148	3.365	5.320	16.413	0.500	1.000
			(2.138)	(0.874)	(2.105)	(0.577)	(0.000)
5600-5700	24	0.887	2.840	32.092	15.146	0.750	0.917
			(1.456)	(33.944)	(2.250)	(0.442)	(0.282)
5700-5800	9	0.333	3.902	9.249	17.089	0.556	0.889
			(1.515)	(5.064)	(2.391)	(0.527)	(0.333)
5900-6000	42	1.553	3.104	28.841	15.332	0.691	0.952
			(1.445)	(44.790)	(2.502)	(0.468)	(0.216)
21000-21100	2	0.074	2.500	25.931	16.000	1.000	1.000
			(1.414)	(10.616)	(0.707)	(0.000)	(0.000)
22000-22100	5	0.185	3.608	32.055	16.260	0.400	0.800
			(1.097)	(57.285)	(2.123)	(0.548)	(0.447)
24300-24400	4	0.148	4.745	4.449	18.875	0.000	1.000
			(0.441)	(1.305)	(0.433)	(0.000)	(0.000)
24700-24800	9	0.333	2.830	12.909	16.404	0.667	1.000
			(1.871)	(11.628)	(1.095)	(0.500)	(0.000)
25000-25100	3	0.111	1.167	29.162	15.500	0.334	1.000
			(1.155)	(6.731)	(0.000)	(0.577)	(0.000)
31000-31100	10	0.370	3.480	28.082	15.770	0.600	1.000
			(1.632)	(34.151)	(1.850)	(0.516)	(0.000)
32000-32100	27	0.998	3.243	18.265	15.994	0.482	0.926
			(1.582)	(17.422)	(2.413)	(0.509)	(0.267)
33000-33100	6	0.222	3.548	31.094	14.958	0.667	1.000
			(0.896)	(45.890)	(3.287)	(0.516)	(0.000)
34000-34100	22	0.813	2.802	16.745	16.200	0.591	0.955
			(1.725)	(13.220)	(2.015)	(0.503)	(0.213)
35000-35100	9	0.333	2.424	37.713	14.789	1.000	1.000
			(1.796)	(34.372)	(2.193)	(0.000)	(0.000)
36100-36200	4	0.148	2.130	21.554	13.950	0.750	1.000
			(1.853)	(11.095)	(1.836)	(0.500)	(0.000)
37000-37100	44	1.627	2.368	17.197	16.135	0.750	0.955
			(1.595)	(14.790)	(2.079)	(0.438)	(0.211)
41000-41100	29	1.072	2.330	22.193	16.286	0.655	0.897
			(1.400)	(26.849)	(1.892)	(0.484)	(0.310)
42500-42600	3	0.111	2.500	5.915	17.500	0.333	1.000
			(1.732)	(3.856)	(1.732)	(0.577)	(0.000)
43000-43100	19	0.702	2.744	23.789	16.261	0.684	0.790
			(1.780)	(20.326)	(1.887)	(0.478)	(0.419)

TABLE 3 (CONTINUED)

SIC codes	number of firms in the industry	proportion of firms in the industry (%)	interest rate margin (%-points)	loan size (1000£)	interest rate (%)	collateral	success
45000-45100	27	0.998	2.953	14.993	15.726	0.778	0.926
			(1.862)	(9.775)	(2.283)	(0.424)	(0.267)
46000-46100	3	0.111	1.517	25.016	16.500	0.667	1.000
			(1.718)	(14.462)	(1.732)	(0.577)	(0.000)
47000-47100	103	3.808	3.040	20.221	16.364	0.592	0.942
			(1.470)	(27.597)	(2.155)	(0.494)	(0.235)
50000-50100	231	8.540	3.418	13.447	16.854	0.494	0.922
			(1.493)	(22.187)	(2.201)	(0.501)	(0.269)
50200-50300	6	0.222	2.127	18.688	15.900	0.833	0.833
			(1.716)	(9.989)	(2.070)	(0.408)	(0.408)
61100-61200	10	0.370	2.422	16.127	16.105	0.800	0.900
			(1.509)	(13.569)	(1.848)	(0.422)	(0.316)
63000-63100	10	0.370	3.462	14.354	17.875	0.400	0.900
			(1.809)	(10.934)	(1.366)	(0.516)	(0.316)
64000-64100	278	10.277	2.738	21.124	15.887	0.716	0.957
			(1.596)	(23.583)	(2.087)	(0.452)	(0.204)
64100-64200	208	7.689	2.932	21.863	15.874	0.740	0.942
			(1.690)	(26.623)	(2.148)	(0.440)	(0.234)
65100-65200	47	1.738	2.885	17.229	15.948	0.745	0.957
			(1.543)	(15.394)	(2.094)	(0.441)	(0.204)
65200-65300	25	0.924	2.544	22.913	15.572	0.920	0.920
			(1.413)	(23.786)	(2.027)	(0.277)	(0.277)
66000-66100	237	8.762	2.712	26.865	15.595	0.709	0.949
			(1.632)	(27.783)	(2.142)	(0.455)	(0.220)
70000-70100	118	4.362	3.168	17.944	16.842	0.542	0.899
			(1.506)	(28.105)	(1.994)	(0.500)	(0.304)
77100-77200	5	0.185	3.480	13.503	15.860	0.600	1.000
			(1.903)	(12.755)	(2.582)	(0.548)	(0.000)
79000-79100	20	0.739	3.005	19.957	14.813	0.900	0.900
			(1.834)	(13.631)	(2.162)	(0.308)	(0.308)
81500-81600	4	0.148	3.943	54.025	14.638	0.750	1.000
			(0.541)	(69.909)	(2.712)	(0.500)	(0.000)
83200-83300	19	0.702	3.384	18.464	15.913	0.526	0.895
			(1.461)	(16.498)	(2.342)	(0.513)	(0.315)
83500-83600	10	0.370	2.461	14.250	15.835	0.700	1.000
			(1.250)	(9.615)	(2.091)	(0.483)	(0.000)
83600-83700	12	0.444	2.568	14.665	15.967	1.667	1.000
			(1.624)	(9.919)	(2.493)	(1.492)	(0.000)
84000-84100	10	0.370	3.332	9.564	16.370	1.400	1.000
			(1.882)	(4.770)	(1.937)	(0.516)	(0.000)
85000-85100	68	2.514	2.247	32.451	14.693	0.927	0.956
			(1.677)	(35.453)	(2.064)	(0.263)	(0.207)
95200-95300	48	1.774	2.728	22.229	15.953	0.148	0.979
			(1.518)	(29.032)	(2.014)	(0.505)	(0.147)
96000-96100	851	31.460	3.179	15.325	16.641	0.539	0.903
			(1.590)	(19.514)	(2.125)	(0.499)	(0.297)

Reported numbers are mean and (standard deviation)

Table 4
ESTIMATION RESULTS

	Loan size	Interest rate	Interest rate	Success	Collateral
Const.	65.394	1.047***	1.070***	-3.563	-2.705
	(89.895)	(.052)	(.065)	(3.734)	:(6.183)
AM	-	-.0003*	.043*** [a]	.0006	0.011**
		(.0002)	(.018)	(.0043)	(.004)
INTRATE	-	-	-	5.150	3.588
				(3.488)	(5.922)
BRATE	-106.010	.154	.198*	-	-
	(75.503)	(.102)	(.123)		
SUC	51.855***	-.028***	-.044***	-	.398
	(9.294)	(.008)	(.010)		(.497)
COLL	-	-.040***	-.055***	.391**	-
		(.006)	(.003)	(.174)	
DUR	1.705***	.120*** [a]	-.133*** [a]	-.0026	.008***
	(.679)	(.366)	(.047)	(.0008)***	(.003)
DUR2	-.001***	-.312*** [b]	-.285*** [b]	.0069***	-.195*** [a]
	(.0002)	(.121)	(.153)	(.0027)	(.075)
P1B	4.631	-	-	-	-
	(20.705)				
P2B	157.26**	-	-	-	-
	(68.489)				
P3B	-95.938	-	-	-	-
	(119.870)				
P4B	172.48	-	-	-	-
	(161.81)				
P5B	-4.922**	-	-	-	-
	(1.767)				
P6B	175.80**	-	-	-	-
	(84.494)				
DURB	-1.188**	-	-	-	-
	(.581)				
Nobs.	2767	2767	2767	2767	2767
Industry dummies	Yes	Yes	Yes	Yes	Yes
Purpose of loan dummies	Yes	No	No	No	Yes
Quarter dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	Yes	Yes	Yes
GDP	No	Yes	Yes	Yes	Yes
E_{AM}	-	.9929	-	.8020	.0676
$E_{INTRATE}$	-	-	-	.0399	.1293
E_{SUC}	.0000	.0029	.0029	-	.4187
E_{SEC}	-	.0000	.0000	.0386	-
B_{AM}	-	.0557	-	.0000	.0003
$B_{INTRATE}$	-	-	-	.0000	.0050
B_{SUC}	.0000	.0000	.0000	-	.0000
B_{SEC}	-	.0000	.0000	.0925	-
OI	1.000	.5292	1.000	.3026	.1689

Notes: reported numbers are coefficient and heteroskedasticity robust (standard error).
PiB, i=1,…,6 are purpose of loan dummy-bank's cost of fund interactions. DURB is the interaction between duration of the loan and bank's cost of funds.
E_i = Hausman test of endogeneity of variable i. Reported number is p-value.
B_i = Bound et al. test of instrument validity for variable i. Reported number is p-value.
OI = Hausman overidentification test. Reported number is p-value.
*** = significant at the 1% level
** = significant at the 5% level
* = significant at the 10% level
[a] = coefficients and standard errors multiplied by 1000.
[b] = coefficients and standard errors multiplied by 10 000.

FOOTNOTES:

[1] We assume that they have either zero wealth or assets tied to idiosyncratically valued and/or illiquid assets. Adding the possibility that the entrepreneur invests some of her wealth into the project does not materially change the results.

[2] Our assumptions allow for the possibility that an entrepreneur i) in case of bankrupCTy incurs costs on and above the loss of collateral (e.g. the loss of reputation) and ii) pledges collateral that is worth more to her than to the bank, a case which casual observations seem to support. See CT (footnote 14) for more discussion.

[3] Snow and Crocker (1986) and Bond and Crocker (1990) analyze theoretically the welfare effects of exogenous and endogenous categorization respectively in an insurance market model.

[4] Strictly speaking, a participation constraint for the entrepreneur should be added to (3). We will assume throughout that the participation constraints are satisfied under the assumptions of competitive loan markets, and the constraint is hence superfluous in (3). If the constraint was binding under the assumptions of competitive loan markets and symmetric information, analyzing the cases of asymmetric information and a monopoly bank would not be necessary anymore as either the participation constraint would be violated under these assumptions, or the results would be identical to those obtained under the current assumptions. The participation constraints will play an important role when analyzing the monopoly bank case.

[5] Unless otherwise stated, the proofs of the Propositions are given in Appendix A.

[6] We assume that there is no cross-subsidization.

[7] This can only be done because the incentive compatibility constraint ensures truth-telling by the Bad borrower.

[8] CT reject in their empirical Section the Null hypothesis of pooling contracts. Hence their result of no adverse selection is not caused by their assumption of a competitive loan market. We will execute the same test in this paper.

[9] This necessitates us to make choices as to which instruments are purported to instrument each endogenous variable.

[10] See CT for a more in depth discussion of the data.

[11] This is in contrast to CT, who executed the same test and failed to reject the Null of exogeneity. The reasons for the difference are twofold. Firstly, we employ a more powerful instrument for SUCC; secondly, the equations differ slightly in what exogenous variables are included.