Commitment Lending Under Asymmetric Information: Theory and Tests on U.K. Startup Data

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ABSTRACT. U.K. business startup data is used to examine the role of contract parameters in solving the bank's problem of lending under asymmetric information. Margins are found to be a direct function of the probability of failure and an inverse function of security (for given loan size) consistently with collateral being invoked to solve the Moral Hazard problem. Business survival is also found to be enhanced by owner equity inputs (for given debt) again consistent with a requirement for owner financial inputs to enhance (unobservable) effort. Security rises along with loan size and survival chances, a finding consistent with (a) a firm loan size effect (larger borrowers have lower marginal admin cost to the bank), and with (b) positive borrower self-selection (better borrowers offer collateral because they are less likely to experience forfeiture.) Observable business characteristics are found to play an important intermediary role in the solution to the moral hazard problem. More mature proprietors have more experience, business commitment, assets for borrowing and the willingness to use them for loan collateral. Their contract parameters reflect these facts.

1. Introduction

Whilst the theoretical literature on lending under asymmetric information has exhibited exponential growth in the last decade in the wake of seminal early papers[1] evidence on its empirical significance has been much slower to accumulate. A major implication of the theories has been to identify the importance of credit rationing as a response to Adverse Selection and the role of collateral and owner equity as tools for overcoming the Moral Hazard problem.[2] Several recent empirical studies have addressed the issue of debt rationing as a credit market imperfection (Evans and Jovanovic, 1989; Holtz-Eakin *et al.*, 1994a,b; Cressy, 1994). However, little has been done to determine the practical importance of Moral Hazard in structuring the terms of the loan contract and in the subsequent performance of contracting firms.

Loan commitments provide an important source of information for testing the importance of both Adverse Selection and Moral Hazard in the contracting process. Such contracts can be used by firms to ensure against a deterioration in their credit rating and hence withdrawal of spot loan facilities. Banks in turn can respond to the demand for loan commitments by potentially lazy or inept borrowers through the imposition of collateral requirements on the facility.

A small amount of empirical work has been done to test the theory of loan commitments (Ham and Melnik, 1987; Melnik and Plaut, 1986; Avery and Berger, 1991). However, the Moral Hazard and Adverse Selection problems are not always explicitly addressed and these studies have unfortunately laboured under huge informational lacunae. None of the published work has been able to allow for the potentially complex web of interdependencies existing between the various commitment contract terms and between relevant exogenous variables.[3] The present paper addresses this literature gap by using a new bank database on U.K. startups to test a set of eight hypotheses on the nature of loan commitment contracts. The data employed include the standard contract variables: loan amounts (Limits), margins,security, risk; and (uniquely) a wide range of proprietor-, firm- and industry-specific variables.

The use of startup data has the particular advantage of highlighting methods banks may use to overcome problems of lending under asymmetric

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information (AI). These businesses by their nature have little or no track record, and it can be argued they therefore represent a benchmark case against which AI theories can be tested. If AI factors do not play a role here, it is difficult to see where they can be relevant.

The structure of the paper is as follows. Section 2 introduces the concept of a loan commitment. Section 3 sets out the hypotheses to be tested. Section 4 introduces the database, defines the variables of the system and performs a univariate analysis of the data. Section 5 provides the econometric estimates and Section 6 evaluates the findings. A final section overviews the results.

2. Loan commitments

Loan Commitments are a specific form of lending used by businesses of all sizes but most importantly smaller businesses. In the U.K. in 1988 some 33% of business startups borrowed from their bank at inception and two thirds of this was on Overdraft (U.S. terminology: revolving credit), a form of loan commitment.

More formally, an *overdraft* is a U.K. lending facility which provides the *option* of borrowing by a person or business up to a maximum amount (the overdraft *Limit*) over a fixed period (usually less than one year) at a fixed margin over Base (the bank's cost of funds) agreed at the outset. An up-front Arrangement fee is usually paid to set up the facility (the *Loan Commitment Fee* in U.S. parlance). Interest paid on drawn-down funds is calculated on a daily basis at the Base rate plus the agreed margin as long as the borrower remains within the agreed limit.[4] If the borrower exceeds the overdraft limit at any point during the term of the overdraft another rate of interest may at the discretion of the bank manager apply to the "unauthorised" portion of borrowing for the period during which the limit is exceeded. This penal rate is a flat rate (i.e., is independent of Base rate) and is usually much higher than would be paid on authorised borrowing.[5]

Overdraft borrowing is the most common form of institutional finance used by the small business.[6] Several reasons have been advanced to explain this fact. Firstly, an overdraft provides flexibility by allowing the borrower in the light of subsequent product market conditions and interest rates to decide whether to borrow and if so at what level. Secondly, through the fixed margin, overdrafts allow the borrower some insurance against subsequent deterioration in his credit rating. It is significant that credit rationing can only take place under this form of contract by a variation in the level (limit) of the commitment since borrowing levels during the contract are (within agreed limits) at the discretion of the borrower. Finally, overdraft facilities, in combination with up-front fees and collateral can help overcome the moral hazard problem implicit in lending under asymmetric information.[7]

3. Overdraft lending hypotheses

In this section we outline the overdraft lending hypotheses derived from the finance literature to be tested below.

Hypothesis 1. Margins are positively related to risk represented by the debt-equity ratio (equivalently, margins are positively related to debt for a given level of equity) and to the unit administrative cost of lending.

Intuition. A familiar argument from the finance literature is that a higher debt-equity ratio is associated with higher failure rates, cet par. (Melnik and Plaut, 1986). This follows from the nature of the firm's gross revenue stream (the discounted sum of which represents the equity value of the firm) and the level of its debt. The latter represents a fixed payment and the higher this payment is, the higher the probability that revenue fall below it. However, risk is only one component in the bank's margin equation: the other is the unit administrative costs of lending also plays an economic role. Since the costs of setting up an overdraft are independent of the size of the facility, larger limits will have *lower* admin. costs per unit, reducing the margin for given risk for larger borrowers in equilibrium.

Hypothesis 2. Margins are an inverse function of security and a direct function of the probability of failure.

Intuition. Under asymmetric information collateral is typically used to overcome the Moral Hazard and Adverse Selection problems (Chan

and Thakor, 1987; Boot *et al.*, 1991, etc.). Under Moral Hazard, a higher margin will reduce effort and increase failure, whereas a higher level of collateral will increase effort and reduce failure. If collateral is used to the profit maximising level by the bank the expected return from its use must equal that from interest rate changes. Since security increases expected bank profits a higher security level must be accompanied by a lower interest rate to maintain zero profits for a fixed loan size.[8]

Under Adverse selection, borrower risks are initially indistinguishable. Collateral can then be used to reveal borrower types. However, the "Good" (low risk) borrower will then experience the "externality" of having to provide collateral, to deter the "Bad" borrower (who has more to lose) from dissembling. To keep bank profits in equilibrium for all contracts lower margins are associated with a lower failure rates.

Hypothesis 3. Margins are a direct function of the probability of failure and an inverse function of the loan amount (Besanko and Thakor, 1987).

Intuition. Under symmetric information larger loans will have lower margins to maintain the bank's competitive return at zero. Larger loans are offered to better borrowers – those with lower failure probabilities. Hence better borrowers get better margins. Under asymmetric information larger loans will have more collateral and be associated with lower margins (see Hypothesis 2 above). The negative relation of margins to loan size follows from the fact that larger loans are more likely to be secured (see Hypothesis 5 below for details).

Hypothesis 4. Survival is enhanced by equity inputs for a given level of debt (*Moral hazard*).

Intuition. Collateral has been shown to ameliorate the moral hazard problem (see Hypothesis 2 above and Chan and Thakor, 1987). Owner equity (wealth) plays the same role as collateral in that if the business fails equity is lost, thus creating an incentive for the entrepreneur to maintain effort. However, it is also easier to withdraw from the business than collateral, so its effectiveness as a tool for solving the moral hazard problem is less.

Hypothesis 5. Security increases with the size of the loan for *given* survival chances (*firm-loan size* effect) and increases with survival chances (*positive self-selection* effect).

Intuition. If security did not increase with the size of loan then the expected loss under failure would increase with loan size. (The probability of failure is assumed independent of loan size.) Whilst the extra loss could be compensated for by a rise in the interest rate, this would in turn reduce effort thereby worsening the moral hazard problem and bank profits. Hence it is optimal for the bank to require more collateral for larger loans. Likewise, security will increase with survival chances if the effect of an increased security requirement is to attract *better* quality borrowers, or if moral hazard is present. The former is a positive self-selection effect.[9]

Hypothesis 6. Proprietor assets are an increasing, concave function of age.

Intuition. The Life-cycle hypothesis of Modigliani suggests that older individuals will be more likely to save as their wage income increases faster than consumption over the initial phase of the life-cycle. Nearing retirement they consume unearnt income (and possibly capital) to maintain consumption levels in the face of declining wage income.

Hypothesis 7. Business survival is an increasing function of age.

Intuition. Age brings wage and business experience which may enhance survival chances; it also brings responsibilities which provide a moral and economic push to business continuation; finally it reduces expected transfer earnings into wage employment (the older self-employed have a lower re-employment probability than their younger colleagues), locking in the mature proprietor to his or her business career.

Hypothesis 8. Older and wealthier borrowers get lower margins.

Intuition. This follows from the assumption that older borrowers will have more assets (Hypothesis

6), are more likely to survive in business (Hypothesis 7), and that the bank, in attempting to reduce its expected losses will require the business owners to pledge assets in support of the loan.

4. Empirical specification

The data used is based on a questionnaire put to a nationwide random sample of some 2,000 startups opening business accounts for the first time at the National Westminster Bank of Great Britain in 1988.[10] Replies to some 35 questions were recorded. These questions included information on the backgrounds of the businesses and their proprietors, sources of finance used to start the business, current banking requirements and the status of the bank official conducting the interview.[11] In addition quarterly bank accounts data on the business is available recording initial and subsequent borrowing conditions (levels, interest rates, collateral required, etc.) of the businesses. Finally information on account cessations of the businesses up to six years later is available. Some 650 businesses borrowed from the bank to start in business, mostly on overdraft.

An Overdraft contract consists of values assigned to the following variables: Overdraft limit, interest margin, security level, duration of the facility and arrangement fee for the facility. In the present dataset Arrangement fees are a direct function of the Limit; hence they have no statistical role in the estimation.[12] Currently no data is available on duration of overdrafts and this feature of the contract has therefore to be ignored.

Two additional variables are modeled, namely, personal equity inputs of the entrepreneur and the survival probability of the business account. These are of relevance to the overdraft contract because both affect survival chances of the business (see below) and therefore both parties' returns to the contract.

Each variable used in the analysis is measured at the business account opening stage. This is also the date of startup for some 80% of the businesses considered.[13]

4.1. *The equation system*

The system estimated in the next section is defined by the following set of equations:

$$\text{PERFIN} = \beta_{10} + \beta_{11} \times \text{ODLIM} + \beta_{12} \times \text{MARG} + \beta_{13} \times \text{SEC} + \beta_{14} \times \text{PRES921} + \beta'_{15} z_1 \times \varepsilon_1 \quad (1)$$

$$\text{ODLIM} = \beta_{20} + \beta_{21} \times \text{PERFIN} + \beta_{22} \times \text{MARG} + \beta_{23} \times \text{SEC} + \beta_{24} \times \text{PRES921} + \beta'_{25} z_2 \times \varepsilon_2 \quad (2)$$

$$\text{MARG} = \beta_{30} + \beta_{31} \times \text{PERFIN} + \beta_{32} \times \text{ODLIM} + \beta_{33} \times \text{SEC} + \beta_{34} \times \text{PRES921} + \beta'_{35} z_3 \times \varepsilon_3 \quad (3)$$

$$\text{SEC} = \beta_{40} + \beta_{41} \times \text{PERFIN} + \beta_{42} \times \text{ODLIM} + \beta_{43} \times \text{MARG} + \beta_{44} \times \text{PRES921} + \beta'_{45} z_4 \times \varepsilon_4 \quad (4)$$

$$\text{PRES921} = \beta_{50} + \beta_{51} \times \text{PERFIN} + \beta_{52} \times \text{ODLIM} + \beta_{53} \times \text{MARG} + \beta_{54} \times \text{SEC} + \beta'_{55} z_5 \times \varepsilon_5 \quad (5)$$

where the first five variables in each equation are endogenous and the vector z_i for equation i is a set of exogenous variables specific to that equation. The βs are parameters of the system to be estimated.

4.1.1. *Endogenous variables*

PERFIN = 1 if the business used "personal money or savings" to start up; = 0 elsewhere.

ODLIM = the overdraft limit (£) set for the business.

MARG = the margin (%) over Base set for borrowing on overdraft.

SEC = 1 if the overdraft is secured; = 0 elsewhere.

PRES921 = 1 if the business account ceased in the period 88q2–92q1; = 0 elsewhere.

4.1.2. *Exogenous variables*

The following groups of variables z_i appear in the final system estimated. Full definitions are provided in Appendix I.

4.1.3. *Information (I)*[14]

Information used at startup includes sources such as friends and relatives, the firm's own bank, government and professionals (accountants and solicitors).

4.1.4. *Finance/assets (F)*

Finance used to start the business includes both finance from another bank and collateralisable assets.

4.1.5. *Human capital (H)*
Age, vocational qualifications, educational qualifications, work experience and motivation of the proprietors at startup.

4.1.6. *Lending branch size (B)*
A relative measure of the branch size at which lending occurs at startup stage.

4.1.7. *Size of firm (E)*
Measured by total number of part-time and full-time employees at startup.

4.1.8. *Industry (S)*
Industry dummies defined for 9 sectors.

4.2. *Univariate distributions*

Table I of Appendix II provides the sample statistics (means, standard deviations, maxima and minima) for all the variables in the system.

4.2.1. *Owner equity participation rates*
From Table I some 43% of overdraft users used personal savings/money of the proprietors (PERFIN) at startup.[15] These financial inputs are used both singly and in combination with other sources of finance.[16] Personal equity inputs are thus an important source of initial capitalisation and are used by almost half of the business startups that approached the bank for overdraft finance.[17]

4.2.2. *Overdraft limits*
The distribution of overdraft limits (ODLIM) is skewed to the right. The minimum limit is £50 and the maximum £150,000 with an average (median) overdraft limit of some £2,950. The amounts used are thus small. However this reflects the fact that some 88% of the businesses are Sole Traders or Partnerships with an average of between one and two employees.

4.2.3. *Overdraft margins*
The distribution of margins (MARG) over Base Rate set at startup[18] is roughly symmetrical, possibly bi-modal, with a minimum of 2.5% above Base and a maximum of 9% above Base. The average (median and mode) margin is 5%, though there is apparently another mode at 7%. This implies an average margin about 2% higher than reported for small firms in general. The spread of rates around the mean is also larger than commonly reported for small businesses. Both these results may however arise because the figures represent margins *set* rather than *paid*.[19]

Overdraft Limits may be either Manager Secured, Manager Unsecured, Head Office Limit or Under Report.[20] An overdraft limit is said to be *secured* if the bank can call upon tangible assets to recoup drawn down funds in the event of default. An example is a second mortgage on the business owner's house.[21]

In the present analysis we define a security variable SEC taking the value one if either Manager or Head Office Secured Limit has been imposed and zero elsewhere. The vast majority (some 80%) of startup overdraft borrowing is unsecured. This is mainly because the limits are too small for security to be worth "perfecting", i.e., for its value to be assessed by the bank.[22] Fees for the latter passed on to the business would make the cost of an initial loan prohibitive and discourage potentially profitable customers.

4.2.4. *Survival rates of accounts*
An account is said to *survive* to a particular quarter if it is still open at the originating Branch at the end of that quarter. Non-survival of accounts may take the form of non-trading, discontinuation of the business without bankruptcy, bankruptcy/insolvency, and to a much lesser extent takeover and account transfers.[23] Table I in Appendix II shows the survival rates of accounts in the period 88q2–89q4. Only some 43% of borrowers starting up in 1988q2 survive until 1992q1. In other words over half of the 1988 startups had ceased within approximately three-and-a-half years of their inception.[24]

5. Econometrics

In this section we present the results of single equation (bivariate) and the simultaneous equation (multivariate) estimation.

5.1. *Bivariate relationships*

Ordinary Least Squares regression and Logit Maximum Likelihood estimates of bivariate relationships are presented in Table II in Appendix II

below. The table shows how the endogenous variables relate to overdraft limits, security and age of proprietors respectively. In general the relationships indicated are quadratic rather than linear, though over the relevant range of the explanatory variable (e.g., the working age of the proprietors) they are increasing. The following facts emerge.

Firstly, survival (PRES921) is, consistently with Hypothesis 8, an inverse U-shaped function of age (H:AVAGE), being positively associated with age over the initial phase of life, as predicted.

Secondly (Table III in Appendix II), survival rates (PRES921) are independent of loan size (ODLIM). This seems inconsistent with theories of lending which suggest larger loans are made to better borrowers, but security is not held constant in this regression.

Thirdly, a clear *negative* relation between overdraft margin (MARG) and overdraft limit (ODLIM) emerges implying that bigger overdrafts get smaller margins above Base. As suggested in Hypothesis 1 above, this reflects the dominance of the falling fixed costs of lending over the (supposed) rising riskiness of such lending. Since, however, the previous result suggests that riskiness is independent of loan size, the inverse relation of margin to overdraft limit seems to be explained by falling average costs alone.

Fourthly, security (SEC) is more likely to be required on larger overdrafts (ODLIM), in conformity with Hypothesis 5 above. The rate of securitisation rises from 0.0% below £500 to above 95% for limits over £25,000. This result combined with the previous one suggests that security and margin may be negatively correlated.

Fifthly, consistently with Hypothesis 2, margins (MARG) are indeed a decreasing function of security posted (SEC): more secured loans get lower margins. This suggests that larger loans (being also more secured) may get lower margins.

Sixthly, personal equity involvement (PERFIN) is independent of the overdraft limit (ODLIM). The theory of lending under moral hazard would suggest a positive correlation between these variables. However, this argument assumes other bank instruments of effort-creation (e.g., posting of house equity as security) are held constant. In practice the latter may be the most effective instrument in the hands of the bank.

Seventhly, house equity (AVHEQ), a proxy for available security, is an increasing, concave function of owner age, consistently with the life-cycle Hypothesis 6 above.

Eighthly, security *posted* (SEC) is increasing in proprietor age (H:AVAGE): more mature proprietors are more likely to have secured loans. Results seven and eight combined with the higher survival rate of mature proprietors, suggest that more mature proprietors, having greater chances of survival are more willing and able to place collateral for their loans. It also suggests that a negative relation between margins and age (Hypothesis 8), since we know from point five above that margins are inversely related to security.

Finally, consistent with Hypothesis 4, survival is increasing in security (SEC): more secured loans are more likely to be repaid since the placing of security would seem to increase borrower effort in the business, as predicted by the theory of moral hazard.

5.2. *System estimation*

The five simultaneous equations presented in Section 4 are estimated with dependent variables personal equity involvement (PERFIN), overdraft limit (ODLIM), security required (SEC), interest margin charged (MARG) and the probability of survival from 1988q2 to 1992q1 (PRES921).[25] The dependent variable in each equation was initially assumed to be a function of all other endogenous variables plus some subset of the exogenous variables preselected by stepwise methods on a single-equation basis. The simultaneous system that emerged from the first stage was in fact exactly identified. At the second stage the system was estimated by Two-stage Least Squares (2SLS). Variable addition tests were then performed both across and within equations until the final model emerged. The sample size, after deletion of observations with missing variables, is 227 observations.

The estimated system can be solved to provide consistent Reduced Form estimates giving each endogenous variable as a function of all exogenous variables. Table III in Appendix II provides the 2SLS estimates of this system. Table IV in

Appendix II provides the Reduced Form coefficient signs from the solution to this system.

5.2.1. *Interpretation*

The Rbar-squared statistics of the 2SLS equations are around 0.5 except for the margin equation which is 0.15. All equations are significant at well below the 1% level. The form of the estimated system (Table III in Appendix II) is:

$$\text{PERFIN} = f_1\,(\text{AGE, INFORMATION, FINANCE, MOTIVATION}) \quad (6)$$

$$\text{ODLIM} = f_2\,(\text{ASSETS, INDUSTRY, SIZE, MANAGER GRADE}) \quad (7)$$

$$\text{MARG} = f_3\,(\overline{\text{SEC}} \mid \overline{\text{EDUCATION}}) \quad (8)$$

$$\text{SEC} = f_4\,(\underline{\text{PRES921, ODLIM}} \mid \text{ASSETS, } \overline{\text{EXPERIENCE}}\text{, INDUSTRY}) \quad (9)$$

$$\text{PRES921} = f_5\,(\text{PERFIN,} \mid \text{AGE, VOCQUAL, INDUSTRY}) \quad (10)$$

where the variable names refer to obvious groupings of the original set of variables,[26] and where the signs on the relationships are positive unless the variable has a bar over it.[27] Solving for the Structural Form of the recursive system in terms of the margin,[28] we can write it in the following four equivalent forms:

$$\text{MARG1} = \alpha_0 - \alpha_1\text{PERFIN} - \alpha_2\text{ODLIM} + \gamma_1' z_1 \quad \text{where } \alpha_1, \alpha_2 > 0 \quad (11)$$

$$\text{MARG1} = \beta_0 - \beta_1\text{SEC} + \gamma_2' z_2 \quad \text{where } \beta_1 > 0 \quad (12)$$

$$\text{MARG1} = \delta_0 - \delta_1\text{PRES921} - \delta_2\text{ODLIM} + \gamma_3' z_3 \quad \text{where } \delta_1, \delta_2 > 0 \quad (13)$$

$$\text{MARG1} = \eta_0 - \eta_1\,\text{AVAGE} - \eta_2 \times \text{INFORMATION} + \eta_3\,\text{VOCQUAL} - \eta_4 \times \text{ASSETS} + \gamma_5' z_5 \quad \text{where } \eta_1, \ldots, \eta_4 > 0 \quad (14)$$

z_i are vectors of exogenous variables and α_i, μ_i, δ_i, η_i are coefficients.

Equation (11) shows that entrepreneurs that put their own money into the startup get lower margins for a given overdraft, consistent with the bank using equity inputs as a solution to the Moral Hazard problem (Hypothesis 4).

Equation (12) shows that more secured loans of any size and failure rate have lower margins, again consistently with the role of security to solve the moral hazard problem (see Hypothesis 2 above).

Equation (13) shows that a higher "quality" borrower (measured by the survival probability) gets a lower margin for any fixed level of borrowing. This result is consistent with Hypothesis 3 and theories of lending under asymmetric information. The same equation shows that larger borrowers get lower margins.

Equation (14) shows that older borrowers and those with more assets get lower margins. This is consistent with Hypothesis 8 above, that older borrowers post more collateral and survive longer.

Equation 15 below (also solved from the Reduced Form) shows that older proprietors are indeed more likely to place security on their loans, cet par.[29]

$$\text{SEC} = \mu_0 - \mu_1 \times \text{PERFIN} + \mu_2 \times \text{AVAGE} + \mu_3 \times \text{VOCQUAL} + \gamma_6' z_6 \quad (15)$$

$$\text{PRES921} = \theta_0 + \theta_1 \times \text{PERFIN} + \theta_2 \times \text{AVAGE} + \theta_3 \times \text{VOCQUAL} + \gamma_7' z_7 \quad (16)$$

Equation (16), however, shows that survival is *not* in fact enhanced by security (SEC), although it is enhanced by owner equity inputs (PERFIN). This is strange in view of the likely advantage of security in dealing with the Moral Hazard problem.

We conclude with the general observation that there is a great deal of evidence from startup borrowing that contract features are designed to solve the Moral Hazard problem epitomised by suboptimal effort on the part of the borrower and much discussed in the literature.

5.2.2. *Reduced form of the system*

The following additional facts emerge from Table IV of Appendix II.

a) More mature proprietors put more equity into their businesses, survive longer and place more security on their loans. Therefore their lower margins reflect a correspondingly higher expected return to the bank.
b) More (appropriately) motivated entrepreneurs get lower margins as a result of greater survival chances and ability to provide more security.
c) Business assets reduce margins by providing the basis for security and larger, lower cost,

loans. Asset availability has a sectoral component, with Manufacturing, Motor and Agriculture having significant advantages over the Service sectors.

d) Borrowers who use other banks put less owner equity in their businesses, survive for shorter periods, and have less security to place with their own-bank; hence they are charged higher margins on their borrowing. The additional riskiness of such borrowers to the bank is reflected in their borrowing costs.[30]
e) Users of professional sources of information (accountants, solicitors etc) are more likely to put equity into their business, survive longer and place security on their loans. Hence they get lower margins.
f) Larger businesses, measured by employees, borrow more and have more security to place on loans. Therefore, for both cost and risk reasons they get lower margins.
g) Larger businesses (measured by employees) are managed by more senior bank personnel. Thus higher lending official status is associated with lower margins on lending both through the greater security associated with their lending and the larger loans they are able authorise.

6. Summary and conclusions

Using a new startup database the paper tested a set of propositions from the literature relating to the way bank lending contracts deal with the problems of asymmetric information, specifically Adverse Selection and Moral Hazard. The picture that emerged was as follows.

The bank has an incentive (other things equal) to lend to proprietors that are committed to their business and wish it to succeed. Maturity of proprietors was shown to be a key feature of this process. "Slacking", or Moral Hazard of the entrepreneur, was countered by the bank by requiring collateral on loans and equity inputs from the proprietors. Interestingly, older proprietors were more likely to have assets to pledge for collateral, and the bank made use of this fact in setting contract parameters.

However, although in the bivariate analysis we found that survival was correlated with security (suggesting its successful use as a tool for inducing effort), in the multivariate estimation this relationship disappeared. There, we found that the greater proprietor endowments of human capital (age and vocational qualifications) were bonded to favourable outcomes by *owner equity inputs*, which acted to obviate failure. Moreover, because of their superior survival rates, businesses run by such proprietors were offered lower margins for the same loan size, over businesses run by younger colleagues.

Finally, despite the literature's emphasis on *failure* in the pricing of loans, we found a significant *loan scale effect* in the bank's pricing formula. Smaller loans were *less* likely to be collateralised, due to the higher unit costs of administering such loans and were subject to higher margins. Thus smaller loans still reflect significant failure risk to the lender, but unlike in the case of large loans, this was not offset by collateral. Instead, the bank eliminated loan setup costs and raised the margin. Larger loans, by contrast, were found to be more secured, and to have lower admin costs per pound lent, and in consequence to record lower margins for given equity inputs, even though (surprisingly) they were no less risky than their smaller counterparts.

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Notes

[1] Most notably Stiglitz and Weiss (1981).

[2] See Cressy (1994) for references to the literature.

[3] Recent contributions to the empirical literature include: Ham and Melnik (1985) who use microdata to examine the demand for loan commitments in a sample of large American firms. The dependent variable was desired borrowing and this was regressed against sales, interest cost, reserves, and a collateral dummy. Melnik and Plaut (1986) use a sample of 92 American loan commitments to regress commitment size against risk premium, commitment duration, commitment fee, current ratio, collateral and a firm size dummy. Avery and

Berger (1991) use aggregate bank-level data to examine the determinants of the ratio of non-performing loans to total loans, the ratio of charge-off loans to total loans and the ratio of net income to total assets. These performance measures are to be explained by a set of loan commitment variables (ratio of used loans against commitments; ratio of unused commitments to total loans) and a set of control variables (e.g., ratio of loan types likely to be used for commitments; ratio of agricultural to total loans; ratio of demand deposits to total assets).

[4] Two qualifications need to be added here. Firstly, there is sometimes a Split level of the overdraft. Below the Split a lower margin is charged; above it a higher margin. Secondly, banks often operate *Minimum* rates which set lower bounds to the interest rate charged and are fixed at the outset.

[5] Since the advent of unauthorised borrowing is normally accompanied by letter of admonition from the bank manager at the client's cost, the effective rate of interest on marginal unauthorised borrowing is understated by the method of margin calculation used in below.

[6] For example in the case of startups, overdrafts constitute about 60% of initial lending to the businesses (Cressy, 1993).

[7] See for example, Boot *et al.* (1987), Berger *et al.* (1992), Melnik and Plaut (1986).

[8] Loan size here refers to the overdraft limit rather than drawn down funds.

[9] The literature finds that positive and negative self-selection are both possible.

[10] These questions relate to the nature of the business, the backgrounds and qualifications of the proprietors, the sources of finance used to start up and the initial banking requirements of the owners. A full analysis of the database is found in Cressy (1993).

[11] A full list of variables used in the model-building process of the paper is available in an unpublished Appendix to the paper.

[12] They may play a role via the "true" cost of funds since the latter will include all payments associated with the loan, not simply interest. See below.

[13] Other types of startup defined in the STE database are purchase of an existing business and upgrading of a business from part- to full-time or from Personal to Business account.

[14] A capital letter in brackets following the variable set is used in the Tables as a shorthand to categorise the variables.

[15] The total number of borrowing firms differs across tables due to missing values for some variables.

[16] Most businesses used only one or two sources of finance to start up. The most common combination used was personal and bank finance. No business used more than four sources. See Cressy (1993) for details.

[17] The data presented here are of course binary. However, the *quantitative* importance of personal finance is confirmed by a later sample in the same database.

[18] Strictly these are the First margins over Base since the overdraft may have a split level above which a different interest margin applies. The percentage of ODLIMs with a split however is very small at the startup stage and so the distinction has been ignored.

[19] The margin is paid only if the overdraft is actually drawn down. Some businesses hit by large margins may decide ex post not to use their facility. A future paper will explore this issue.

[20] A *Manager Unsecured* limit is one without security of any form. Small overdraft limits (e.g., up to £5k in 1988, the majority of this sample as can be seen from Table I in Appendix II) would be of this kind. *Head Office* secured limits are imposed when the manager cannot lend up to the amount proposed without higher authority. These limit types constitute only a few percent of the startup sample. *Under Report* means that the account has given cause for concern and is currently being investigated usually at Regional Office level. Thus the decision has been removed from the Branch Manager's control. Security review is part of that process.

[21] Note that a Personal Guarantee by the owner is *not* in general considered security for an overdraft.

[22] See Stanworth and Gray (1991), p. 65.

[23] Details of the breakdown of cessations are available in a forthcoming paper.

[24] This compares with U.K. VAT statistics presented in Ganguly (1985), Table 27, showing approximately the same percentage of VAT new registrations deregistering within two years. The period of analysis for the VAT data is 1974–82.

[25] The system was initially estimated as a single equation with ODLIM as the dependent variable. However tests indicate that MARG, SEC, PRES921 and PERFIN are not exogenous.

[26] E.g., MOTIVATION refers to FRBOSS ("to be one's own boss" as the main reason for startup), ASSETS refers to AVHEQ (average housing equity) or LC (Life cover taken out by the business owner), and VOCQUAL refers to FTRAD, EXPERIENCE refers to FWKFLD.

[27] Industry signs are not indicated.

[28] The system can of course be written in terms of any of the other endogenous variables. However, most of the Structural Form hypotheses relate to the margin equation.

[29] It also suggests a tradeoff between equity inputs and security in solving the Moral Hazard problem: the two devices are substitutes.

[30] The Chairman of Barclays bank in evidence to a recent U.K. Treasury Select Committee explained that some one half of their bad debts come from transferred accounts.

[31] See Appendix II for details.

[32] The figures in the second column next to the dependent (endogenous) variable in the first column are the goodness of fit statistics for the relevant 2SLS equation.

Appendix I: Exogenous variable definitions

Information (I)

FRNDINFO = 1 if information from friends and relatives was used to set up the business; = 0 elsewhere.

OWNBNKFO = 1 if information from the business's own bank was used (ditto).

SFSERINF = 1 if information from the Government Small Firms Service was used (ditto).

ACNTINFO = 1 if an accountant was used as a source of information (ditto).

SOLINFO = 1 if a solicitor was used as a source of information (ditto).

Finance (F)

OTHBNKF = 1 if finance from another bank was used to start the business.
AVHEQ = arithmetic mean house equity of the proprietors at startup stage.
LC = 1 if at least one of the proprietors took out Life Cover at startup.

Human capital (H)

AVAGE = arithmetic mean age of the proprietors at startup.
AVAGE2 = AVAGE **2.
FTRAD = fraction of the business' proprietors with a trade apprenticeship qualification at startup.
AVQUAL = average academic qualifications of the proprietors.[31]
FWKFLD = fraction of proprietors with work experience in the same field as the startup.
FRBOSS = fraction of proprietors whose main reason for starting the business was "to be their own boss".

Lending branch size (B)

GRADM = 1 if the bank official making the lending decision was a Branch manager.

Size of firm (E)

PT = number of part-time employees in the business at startup.
FT2 = square of number of full-time employees in the business at startup.

Industry (S)

AGRI = 1 if the business was in the Agricultural sector; = 0 elsewhere.
MOTOR = 1 if the business was located in the Motor industry.
PROD = 1 if the business was located in Production/ Manufacturing sector.

Appendix II: Sample statistics

TABLE I
Sample statistics

	Mean	Std. Dev.	Max.	Med.	Min.
PERFIN	0.440529	0.497548	1	0	0
ODLIM	8357.04	18625.48	150000	2500	19
MARG	5.154736	1.275979	9	5	1
PRES921	0.550661	0.498526	1	1	0
H:AVAGE	34.85668	10.0109	65	33.5	19
H:AVHEQ	62911.67	73157.23	425000	45000	0
H:AVQUAL	1.79486	0.830997	4	2	1
H:FTRAD	0.157122	0.346399	1	0	0
H:FWKFLD	0.706608	0.407064	1	1	0
H:N	1.480176	0.730683	5	2	1
H:PURCH	0.207048	0.406086	1	0	0
C:HOMPREM	0.519824	0.500711	1	1	0
S:MOTOR	0.061674	0.241094	1	0	0
S:AGRI	0.030837	0.173258	1	0	0
S:PROD	0.061674	0.241094	1	0	0
B:GRADM	0.361233	0.48142	1	0	0
I:NWBINFO	0.76652	0.42398	1	1	0
I:OTHBKNFO	0.057269	0.232869	1	0	0
I:FRNDINFO	0.215859	0.412326	1	0	0
I:AGYINFO	0.330396	0.471395	1	0	0
I:SFSERINF	0.088106	0.284075	1	0	0
I:ACNTINFO	0.23348	0.42398	1	0	0
I:SOLINFO	0.092511	0.290386	1	0	0
I:OTHINFO	0.088106	0.284075	1	0	0
E:FT	2.096916	2.332787	13	1	0

Sample size = 227.

Bivariate estimates

TABLE II
OLS and logit estimates of bivariate relationships

Variable	Parameter Estimate	PR > |Chi-sq|
1: PRES921	Model	0.0075
INTERCEPT	−3.2129	0.0469
AVAGE	0.1586	0.0761
AVAGE2	−0.00160	0.1720
2: PRES921	Model	0.4431
INTERCEPT	0.0839	0.6077
ODLIM	0.00002	0.2176
ODLIM2	1.88E-10	0.2919
3: MARG	Model	0.0001
INTERCEPT	7.654800	0.0001
ODLIM	−0.000196	0.0001
ODLIM2	1.3498695E-9	0.0001
4: SEC	Model	0.0001
INTERCEPT	−2.9178	0.0001
ODLIM	0.00031	0.0001
ODLIM2	−1.661E-9	0.0886
5: MARG	Model	0.0001
INTERCEPT	7.311371	0.0001
SEC	−2.674079	0.0001
6: PERFIN	Model	0.6434
INTERCEPT	0.2785	0.0898
ODLIM	−2.8E-6	0.8829
ODLIM2	−389E-13	0.8300
7: AVHEQ	Model	0.0001
INTERCEPT	−177008	0.0001
AVAGE	11557	0.0001
AVAGE2	−124.329947	0.0001
8: SEC	Model	0.0001
INTERCEPT	−10.7621	0.0001
AVAGE	0.4957	0.0005
AVAGE2	−0.00592	0.0013
9: PRES921	Model	0.0400
INTERCEPT	0.0471	0.7590
SEC	0.6461	0.0436

System estimates

TABLE III
2SLS Estimates of the equation system in Section 5

Variable	Coeff. est. Pr > |t|
1. PERFIN	*0.4906 = Rbar sq*[32]
	0.0001 = Pr > F
I:FRNDINFO	0.162578
	0.0197
I:SFSERINF	0.238556
	0.0203
I:ACNTINFO	0.175490
	0.0127
I:SOLINFO	0.265406
	0.0131
I:OTHINFO	0.271468
	0.0088
F:OTHBNKF	−0.332208
	0.0598
H:AVAGE	0.007730
	0.0001
H:FRBOSS	0.106108
	0.1117
2: ODLIM	*0.5053*
	0.0001
B:GRADM	7150.146618
	0.0001
S:PROD	8015.305465
	0.0297
F:AVHEQ	0.032022
	0.0026
E:PT	720.041597
	0.0036
E:FT2	292.494466
	0.0001
3: MARG	*0.1597*
	0.0001
INTERCEPT	6.067726
	0.0001
H:AVQUAL	−0.167333
	0.0474
SEC	−2.309804
	0.0001
4: SEC	*0.4351*
	0.0001
S:MOTOR	0.258883
	0.0058
H:AVHEQ	0.000000689
	0.0493
H:FWKFLD	−0.133484
	0.0136
F:LC	0.226247
	0.0008
PRES921	0.308034
	0.0011
ODLIM	0.000011026
	0.0011
5: PRES921	*0.5071*
	0.0001
S:AGRI	0.411179
	0.0179
H:FTRAD	0.166646
	0.0626
H:AVAGE	0.008940
	0.0001
F:PERFIN	0.329134
	0.0330

TABLE IV
Coefficient signs in reduced form of the system

Concept	Variable	MARG	ODLIM	PERFIN	PRES921	SEC
Information	FRNDINFO	–	0	+	+	+
	SFSERINF	–	0	+	+	+
	ACNTINFO	–	0	+	+	+
	SOLINFO	–	0	+	+	+
	OTHINFO	–	0	+	+	+
Other sources of debt	OTHBNKF	+	0	–	–	–
Motivation	FRBOSS	–	0	+	+	+
Lending manager	GRADM	–	+	0	0	+
Sector	PROD	–	+	0	0	+
	AGRI	–	0	0	+	+
	MOTOR	–	0	0	0	+
Assets	LC	–	0	0	0	+
	AVHEQ	–	+	0	0	+
Business size	PT	–	+	0	0	+
	FT2	–	+	0	0	+
Human capital	AVAGE	–	0	+	+	+
	AVQUAL	–	0	0	0	0
	FTRAD	–	0	0	+	+
	FWKFLD	+	0	0	0	–
	INTERCEPT	+	0	0	0	0

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