Discussion Papers on Entrepreneurship, Growth and Public Policy


# 4504

# Bank Interest Margins and Business Start-Up Collateral: Testing for Convexity

by

**Andrew Burke**
**University of Warwick, UK and**
**Max Planck Institute for Research into Economic Systems**

**Aoife Hanley**
**University of Nottingham (CRIS), UK**

**Number of Pages: 26**

The *Papers on Entrepreneurship, Growth and Public Policy* are edited by the Group Entrepreneurship, Growth and Public Policy, MPI Jena.
For editorial correspondence, please contact: egppapers@mpiew-jena.mpg.de

ISSN 1613-8333


Max Planck Institute for
Research into Economic Systems
Group Entrepreneurship, Growth and
Public Policy
Kahlaische Str. 10
07745 Jena, Germany
Fax: ++49-3641-686710

# Bank Interest Margins and Business Start-Up Collateral: Testing for Convexity

Andrew Burke
University of Warwick, UK
& the Max Planck Institute, Germany

Aoife Hanley
University of Nottingham (CRIS), UK

## Abstract

The paper investigates the relationship between bank interest rate margins and collateral for loans issued to new ventures. The analysis finds a convex U-shaped relationship. The results indicate that while provision of collateral initially reduces bank exposure to risk (through security, more optimal levels of capital and lower moral hazard among entrepreneurs) that beyond a point the positive risk-wealth association gives rise to greater risk taking propensity among entrepreneurs and ultimately higher interest rates. This indicates that a lender's pricing policy may even somewhat help to level the competitive playing field between ventures launched by higher and moderately wealthy entrepreneurs.

*JEL classification*: G210; 3153, 3140, 3120

*Keywords*: asymmetric information, bank lending, credit constraints

**1. Introduction.**

Ever since the seminal paper by Evans and Jovanovic (1989) identified a relationship between self-employment choice and wealth, an immense empirical literature has emerged which investigates the role of collateral in the area of new venture credit constraints.[1] In terms of credit rationing, collateral can influence the amount of credit used by a new venture either by affecting the cost (interest margin), or the actual amount of credit offered to a new venture by a bank. Loan finance is the most widely used form of external finance for SMEs. The UK Federation Small Business reported in 2002 that 66 per cent of respondents relied on bank borrowing.[2] Therefore, a sound understanding of credit constraints is core to an understanding of the enterprise economy. However, while many empirical papers focus on how collateral affects the *amount* of finance offered to firms, few empirical studies have researched how it affects the *cost* of loan finance to these ventures. The aim of this paper is to fill some of this void. It is also motivated by a desire to shed some empirical light on the competing hypotheses on the relationship between interest rate margins and collateral arising in the theoretical literature. This literature is now so diverse that it can predict almost any relationship between interest margins and collateral. Thus, in the spirit of Parker (2002) who states that the "time is nigh to start pruning away those (models) that are inconsistent with the facts" [P.189-190], we seek to test the empirical validity of these models. The objective is to contribute to a greater understanding of the extent to which the ability to provide collateral affects the price new ventures pay for loan finance – and in turn, how it affects their performance.

[1] See Parker, (2002) and Cressy, (2003) for good overviews of this literature

[2] http://www.fsb.org.uk/policy/BRIEFS/finance/default.asp for results of the "Small Businesses' Finance and the Economy" survey, (December 1998)

We have access to a data set containing loans made to new ventures by a major UK bank. Most importantly, we have access to a measure of the actual money value of collateral provided on loans. Thus, unlike so many of the previous empirical papers (Cressy, 1996; Cressy and Toivanen, 2001; Berger and Udell, 1990) applying a discrete measure of whether collateral was provided or not, our measure affords us with an opportunity to test for non-linearity between interest margins and collateral. In fact, we produce a new finding, namely a convex U-shaped relationship between interest rate margins and collateral. The result indicates that the ability to provide collateral for loans is not always an advantage for new ventures. The key is how banks perceive risk to vary as the ability to provide collateral varies with wealth. We provide an overview of the theoretical literature in order to explain why bank risk exposure may be related to collateral in this convex manner. We argue that, at an empirical level, an eclectic interpretation of the literature seems most appropriate rather than encampment in the theoretical schools of information asymmetry.[3] The results are also consistent with a growing body of empirical evidence which shows that entrepreneurs' wealth is related to venture performance in a concave manner. It is also consistent with anecdotal evidence which shows venture capitalists such as *Sequoia Capital* explicitly trying to avoid financing ventures launched by the offspring of excessively wealthy individuals. In sum, the results depict a new venture loan market where high worth entrepreneurs who rarely face *access* to finance constraints nevertheless pay a higher *price* for loan finance than their moderately wealthy counterparts. The lowest wealth individuals pay a higher price for loan finance than moderately wealthy entrepreneurs.

The paper is structured in the following way. We first outline the relevant literature dealing with interest margins and collateral, dwelling particularly on models of wealth and risk aversion. This is

[3] One view argues that lenders banks know more about the risk prospects of a venture than the entrepreneurs themselves but another view argues that the knowledge bias lies with borrowers

followed by a section describing and analysing the data. Finally, we conclude with some comments regarding the implications of our findings.

## 2. Literature overview and context for empirical analysis.

One major anomaly for researchers working in the field of credit contracts is the lack of correspondence between the theory and evidence on the relationship between interest rate margins and collateral. Accordingly, while the screening model theories predict a trade-off between collateral (*C*) and interest margins (*r*), over-optimism models posit a positive relationship between the two.[4] As we will discuss when looking at the empirical evidence much, but not all, of the empirical evidence suggests a positive relationship between interest margins and collateral. An exception is the recent work by Cressy (1996) and Cressy and Toivanen (2001) which suggest a negative relationship. Accordingly, the literature is by no means unanimous regarding the format of the *r* and *C* relationship. Thus, in order to provide a context for our paper, we initially provide an overview of screening and overoptimism models and then relate these to the existing body of empirical literature. We then discuss other theoretical insights and models relating to wealth, collateral and endogenous risk. We note that these either directly or implicitly can predict a convex U-shaped relationship between interest margins and collateral. This prediction has not been tested in the empirical literature and is the purpose of this paper.

### *Screening models*

Some theories explore risk margins while remaining silent on possible interactions between margins and collateral. Stiglitz and Weiss (1981) provide one of the earliest, but better known, models of interest margins and risk. They argue that lenders opt to reject some credit applicants on account of adverse selection and incentive effects. These effects operate in the following way. For

a given level of collateral, an increase in the interest margin gives rise to adverse selection because only borrowers with riskier investments will be happy to accept credit at a higher interest rate. In the same way, higher margins create an incentive for applicants to play for higher stakes and thus increase their bankruptcy risk. On the other hand, if the lender chooses to fix the interest margin, increasing the amount of collateral demanded of the applicant can also depress bank profits. In this latter scenario, a call for higher collateral on credit induces potentially good borrowers to shop around for a loan with other lenders. These good borrowers, being well aware of their own creditworthiness are not prepared to submit to what they perceive as actuarially high collateral demands. Accordingly, adverse selection arises and only the *ex post* riskier applicants remain with the lender.[5]

Criticisms of Stiglitz and Weiss, on grounds of failing to reflect the potential simultaneity between collateral and interest margins, may have prompted later work (notably the screening models) to deal with collateral and risk premiums as being interlinked. For instance, Coco (2000) in his recent review of the Stiglitz and Weiss (S-W) and the de Meza and Webb (1987) models, argues that consideration of interest margins alone, leaves theorists open to the challenge that if interest margins, when used in isolation, fail to achieve a separation equilibrium, collateral can then be deployed in order to achieve separation between good and bad risks.

*"The S-W arguments therefore seem also vulnerable to the criticism that, if at a certain interest rate, that maximises the profit function of the bank because of adverse selection or incentive effects,*

[4] One exception to the general consensus of the screening models that interest margins and collateral describe an inverse relationship is the paper by Coco (1999) where a positive relationship is possible within a screening framework once partial screening is permitted.

[5] de Meza and Webb (1987) relax the Stiglitz-Weiss assumption of mean preserving returns and argue that riskier borrowers were likely to have a higher dispersion around the same average return. Unlike Stiglitz and Weiss, they find that bank returns are increasing in the interest rate because the worst entrepreneurs drop out first and accordingly, rationing cannot arise.

*there exists an excess demand for loans, it may be possible for the bank to increase collateral requirements in order to clear the market and avoid rationing"*. [Coco, P.195]

Parker (2002) similarly argues that credit rationing models frequently assume that the interest margin is the only credit instrument that the lender can use while failing to recognise the usefulness of higher collateral requirements in shaking off excess credit demand. The consensus from the screening models by Bester (1985, 1987) and Besanko and Thakor (1987) which consider collateral and interest margins simultaneously, is that the two contract components act as substitutes and therefore a negative relationship should be observed between them.[6] A set of incentive compatible contracts is formulated by a lender where collateral is used as a mechanism by which the entrepreneur's *ex ante* risk preference is revealed.

Bester (1985) shows that no credit rationing will occur in equilibrium if lenders compete by choosing collateral requirements and interest margins in a way designed to screen the risk levels of credit applicants. The ability of borrowers to self-select into their risk types depends on a key assumption of simultaneity. Bester argues that self-selection will work if;

*"banks decide upon the rate of interest and the collateral of their credit offers simultaneously rather than separately"* . [Bester, 1985; pp. 850 ]

Bester's main finding is that credit applicants with a low probability of bankruptcy are more willing to accept an increase in collateral requirements in return for a lower interest margin, than their higher risk counterparts. Other variants of the screening model contain other combinations of the credit instruments, loan size, interest margins, collateral and the threat of denying the credit. For

[6] The propensity to substitute higher collateral in return for lower interest margins is predicted to vary according to the borrower's hidden but *ex post* known risk type.

example, Besanko and Thakor's screening model includes credit granting, interest margins, collateral and loan amount. Wette (1983) includes collateral in her screening model, but in her case interest margins are fixed and hence invariant to increases in collateral.[7] Besanko and Thakor's (1987) model attaches importance to collateral as a screening instrument. Similar to Bester, low-risk borrowers should put up more collateral than their high-risk counterparts in return for lower interest margins. Although some high risk borrowers unjustifiably receive a loan, there is no credit rationing in the absence of wealth constraints.

*Over-optimism models*

The contemporaneous borrower 'over-optimism' theories, also describe the terms of the credit contract, but in this case a positive as opposed to a negative relationship is inferred. de Meza and Southey (1996) reverse the assumption of superior borrower information and instead argue that lenders possess relatively unbiased expectations of future firm growth through their ability to make accurate predictions based on past experience and their cumulative portfolio of loans. If even a portion of entrepreneurs are overly upbeat about their repayment prospects, high risk borrowers will be required to post additional collateral. The marginal cost of additional borrowing in de Meza and Southey is driven by the divergence between the borrower's and lender's evaluation of the projects success probability. If this differs, for example by 20 percent, then bank credit carries an interest rate 20 percent higher than the cost of internal finance. The authors conclude that although desired entrepreneurial investment exceeds the optimal level, as long as optimists are both willing and able to pay for excessive investment (through posted collateral wealth and interest rates), lenders are forced through competition with other lenders to serve these applicants. They conclude that all new ventures, irrespective of whether they are optimists or pessimists, should opt for the maximum use of self-finance or collateral in their funding.

[7] In Stiglitz and Weiss (1981), collateral was fixed and interest margins allowed to vary so collateral was invariant.

*Empirical findings in the literature*

As mentioned earlier, the negative relationship between margins and collateral in the screening models is largely unsupported by empirical research. Work by Leeth and Scott (1989) and Berger and Udell (1990) report that both project risk, as well as the risk premium on loans, is positively related with collateral provision. Note that in both cases, the issue is whether or not loans are secured, as opposed to the magnitude of collateral used. The latter is a richer collateral descriptor and the one applied in our analysis.

Berger and Udell's cross-section results denoting *ex ante* risk as the endogenously determined risk margin, where the risk margin is the difference between the loan rate and a risk free rate of the same duration, show that for floating rate loans, a higher premium is charged when the loan is secured. The implication from this result is that interest margin and collateral are positively related. The authors conclude that collateral does not appear to perform a signalling role, because otherwise it would induce a reduction in interest margins.

The extension of Berger and Udell's analysis captures *ex post* risk (charged-off credit when the firm defaults). These estimates show that the high rate of net charge-offs on fixed rate loans which are financial products most likely to have collateral cover, suggests that collateral cover is not sufficient to cover the lender's charge-off-loss.[8] Accordingly, average loan to value ratios and the time firms take to default on their repayments imply a net loss to the bank when default rates rise. An important general finding is that there is a positive relationship between interest margins and collateral. As observed earlier, this result echoes the finding in Leeth and Scott (1989), although in the latter paper the positive relationship is insignificant.

[8] Net charge-offs are comprised of loans charged off by the lender due to borrower insolvency minus bank liquidated collateral

On the basis of the above, one might be tempted to conclude that interest margins increase as the probability that a loan is secured by a lender rises i.e. that a positive *r* and *C* relationship exists. However conflicting empirical evidence which shows a *negative r* and *C* relationship, consistent with the screening models, is reported in Cressy (1996) and Cressy and Toivanen (2001). Cressy finds that collateral provision is associated with a lower interest margin. One explanation for Cressy's findings which lends support to the negative *r* and *C* relationship advanced in the screening models is the nature of his analysis sample and analysis methodology: Cressy uses a rich dataset of start-up firms. He also allows for the 'potentially complex web of interdependencies' between contract terms by employing a 2-stage design where margins are a function of security and security in turn a function of assets (proxied by the average value of the proprietors' house).

The disagreement between the screening models of contract terms (a positive *r* and *C* relationship posited) and the observed statistical regularities reported in analyses of banking data, suggests that we may need to invoke other factors, such as wealth, borrower realism and transactions costs in order to clarify the *r* and *C* relationship. For instance, one possible explanation for the lack in correspondence between the theoretical screening models and the empirical models, may be the possible correlation between collateral and unobserved endogenous risk. In other words, higher collateral may induce higher risk from causes not documented in the theoretical models. The next section therefore sets out to describe theories of borrower wealth in order to explain how these factors can also drive the shape of the *r* and *C* relationship.

*Insights relating to collateral, wealth and endogenous risk*

One important factor which underpins the ability of collateral to induce borrower effort or risk aversion is the underlying level of borrower wealth. The amount of borrower wealth which

underpins the amount of collateral provided at the time of granting a credit, is typically unobserved in reduced form regressions, such as those documented above.

We highlighted earlier how Bester (1985) concludes that screening models should no longer achieve a separating equilibrium between different risk types if wealth levels are so low that the borrower cannot post a collateral bond.[9]

*"perfect sorting in a credit market equilibrium may be impossible if some low risk firms face a binding constraint on the amount of collateral they can provide"* [ *Bester*, 1985, pp.854]

Stiglitz and Weiss point out that the very smallest applications for credit, can also be the riskiest if they proceed at a suboptimal scale. It follows that, individuals with no wealth to offer as collateral may also pose a comparatively high risk of failure if their project is under budgeted. At the other end of the wealth continuum, enormously wealthy entrepreneurs, all things equal, should place a comparatively low value on their collateral bond and accordingly, we expect that the role of collateral is considerably weakened (Stiglitz and Weiss, 1981). The wealthiest entrepreneurs are also those who engage in risk loving behaviour and it follows that borrower risk is expected to rise with increases in wealth[10]. Stiglitz and Weiss indeed demonstrate (Theorem 10, P.404), that there is decreasing absolute risk aversion with wealth increases, $dR / dW > 0$. If we assume that parallels exist between project risk and the margin charged to borrowers in excess of the risk free rate, we can infer something about the nature of the collateral, wealth and interest margin relationship.

[9] The criteria which lead to a breakdown in the screening models are comprehensively outlined in Parker (2002).

[10] In fact, Cressy (2000) uses a similar argument (endogenising risk and making it a function of wealth) to report an alternative interpretation of the Evans and Jovanovic (1989) finding that business start-ups are positively associated with entrepreneurial assets which Evans and Jovanovic took to imply that start-ups are credit constrained. By making the endogenous risk assumption, Cressy can explain the finding that wealth and business birth rates are correlated by demonstrating that increases in wealth, can induce individuals to play for higher stakes and thence find self-employment more attractive. Exogenous wealth increases can increase the risk in a lender's portfolio riskier as entrepreneurs show increasing willingness to gamble their resources on an uncertain outcome.

Indeed, it is possible to argue that these aspects of Stiglitz and Weiss (1981) can moot a U-shaped convex relationship between interest rate margins and collateral *if one does not control for loan amount*. If one does control for loan amount and hence risk associated with venture undercapitalisation, then one might expect a positive relationship between *r* and *C* based on S-W's discussion of more risk loving high wealth individuals who can provide more collateral.

However, the possibility of convexity even after controlling for loan amount is identified directly by Burke and Hanley (2003). Their model does not use Stiglitz and Weiss's (1981) arguments relating to sub-optimal financing in order to justify the initial downward sloping part of a convex relationship between interest margins and collateral. Burke and Hanley (2003) focus on the relationship between collateral and risk aversion. They begin by showing that for any given level of wealth, higher collateral induces borrowers to be more risk averse hence raising bank's expected profits for any given interest rate margin. On this basis, they argue that since banks do not share in the upside of risk that they may try to influence risk aversion by seeking collateral cover. However, they also highlight that a bank's ability to influence risk taking behaviour is limited at both the upper and lower tails of the wealth distribution. At the upper end of the wealth distribution collateral has a limited ability to encourage risk aversion when the loan amount is small relative to the borrower's wealth (due diminishing marginal utility of wealth). At the lower, but not lowest end of the wealth distribution, banks are able to encourage risk aversion among relatively low wealth individuals where collateral is large relative to their wealth. However, at the very extreme of the lower tail of the wealth distribution, a lender's ability to stimulate risk aversion is constrained by the fact that borrowers can only provide partial or no collateral cover. On this basis, Burke and Hanley show that the bank's expected profit function will be a concave function of borrower wealth. Furthermore, if banks tend to take as much collateral cover as they are able,

which is what one would expect from a profit maximisation perspective, then it follows that the amount of collateral cover will, among other factors, be related to borrowers' wealth.[11]

Burke and Hanley (2003) argue that banks will naturally try to compensate by charging higher interest rates to less risk averse borrowers. In other words, one would expect to observe a convex U-shaped relationship between interest rate margins and collateral cover. Put simply, at one extreme, little or no collateral cover implies more risk for banks (more exposure and low risk aversion as it involves little loss for borrowers who default) while at the other extreme, higher collateral cover is associated with high wealth individuals who are less risk averse. The best borrowers, from a lender's perspective, are located between these extremes - by entrepreneurs who can provide reasonable collateral cover. Such borrowers, relative to their wealth, have a lot to lose in the event of default. The extent of this U-shaped relationship could also be tempered by the extent to which banks refuse to lend to very low risk adverse borrowers. Not just to individuals who have little collateral to offer but also to high worth individuals - as for example, is the case in equity markets where some venture capital firms (such as *Sequoia Capital*) as a matter of policy try to avoid investing in companies founded by the children of extremely high wealth individuals. Burke and Hanley's model is also consistent with the empirical results of Burke, Fitzroy and Nolan (2000) and Taylor (2001) who both find that the performance of the self-employed is related to the wealth of the entrepreneur in a concave manner – a negative relationship appearing after the entrepreneur's wealth moves beyond a threshold point. However, the scope of these papers does not enable them to test to see if this concave venture performance function transforms into a convex cost of loan or equity capital relationship. The rest of this paper is devoted to testing for evidence

[11] We have evidence from Hanley (2002) that when businesses are at their most nascent stage, that collateral posted most likely takes the form of an entrepreneur's home because the entrepreneur has few other assets to offer that yield the same value on resale. Accordingly, collateral represents a good proxy for wealth during business formation, both due to the scarcity as well as the indivisibility of large, non-idiosyncratic assets such as the family home.

of a convex relationship between cost of loan finance and collateral. In order to provide context, we summarise our discussion of the literature in table 1.

*{table 1 near here}*

**3. The data and analysis**

Our data comprises 214 applications for finance from business start-ups to a major UK retail bank from the period January 1998 until December 1999. Although we cannot, for reasons of confidentiality, disclose the name of the bank that donated the data used in our analysis, we can cross-check to see whether lending practices at our bank depart from the UK average. Another UK study relating to the same time period by Binks and Ennew (1998) compares borrower perceptions across all major UK banks. Results from the UK Banks FPB Survey for 1998 indicate that our bank does not adopt an extreme rejection policy and therefore we are reassured that lending practices are broadly in line with general UK lending practice.

The data also contains information on whether or not the enterprises subsequently defaulted in any way on their credits with the lender. Importantly for our analysis, we have robust valuations for collateral provided to the bank. Discussions with the lender reveal that the valuations reflect prices that the lender would expect to fetch if the collateral were sold off by the bank. Collateral wealth is calculated as the summation of all wealth inputs submitted to the lender on application for a loan. These are real estate, life assurance and cash contributions to the project. Although, we are aware that cash contributions are not in a strict sense defined as a collateral bond, they nonetheless are wealth descriptors. Discussions with the lender and a perusal of the lending documents show that they are treated in the same way as other borrower inputs.

*{table 2 near here}*

Table 2 describes the data. The summary statistics underpin the risk inherent in lending to new ventures where approximately 13 percent of businesses defaulted within the first year of receiving credit. While there is not much variation in interest margins (standard deviation is only 1.3 percent), there is much heterogeneity in the level of collateral, as evidenced by its relatively high standard deviation. Over half of applications for finance involved some cash contribution from the entrepreneur and the majority of the loan commitments were to cover working capital.

**Analysis**

Recalling our research question which is motivated by the literature on wealth and risk aversion: we aim to estimate the effects of collateral wealth, *C*, on interest margins, *r*. Additionally, we need to allow for differential effects of collateral on interest margins at lower and higher levels of collateral wealth. Accordingly, a squared collateral term is called for in order to capture possible non-linearities.

[1]

Equation 1 expresses the interest margin as a function of collateral and allows for concavity if the coefficient of the squared term differs from that of its linear counterpart. The standard residual $\mu$ captures unexplained covariance. Other covariates are needed in order to reduce $\mu$ and isolate the pure effect of *C* on *r*. The most important covariate is the value of the loan amount, *amt*. Although we can argue that this amount, *amt*, is expected to be collinear with the value of collateral, recent work on collateral suggests that the link is more tenuous than thitherto believed (Hanley, 2002). The indivisible nature of collateral wealth, the possibility of residual claimants (e.g. the Revenue Commission) and the deadweight loss of collateral, means that the collateral / amount ratio is not actuarially defined. Therefore, we observe great heterogeneity in collateral to value ratios. Instead

the new consensus is that collateral serves as a motivational tool by inducing the credit applicant to work harder (Hanley, 2002; Cressy and Toivanen, 2001). It could be argued that larger loans increase the lender's exposure and accordingly the lender's risk. However, larger loans also carry lower per unit transaction costs. The overall correlation coefficient between *amt* and *r* is -0.32 (supporting the transaction cost perspective) and between *amt* and collateral wealth, *C*, is 0.44, both of which terms are significant (Appendix 3).[12]

In our data, we also include a size variable, *size*, which denotes the enterprise's projected sales turnover in the coming year, recalling that all firms are new ventures and many have not established a sales base yet. The variable, *ex_risk*, is an indicator variable taking the value of 1 if the lender found reason to downgrade the enterprise's risk status in the 6 months from December 1999. While researchers view interest margin as a measure of *ex ante* risk, this variable reasonably accurately captures the real 'revealed' quality of the enterprise. [13] Finally, we include a variable, *purp*, capturing the purpose of the loan, whether it is for working capital (higher risk) or will cover a capital investment. The estimation, including all covariates now becomes

[2]

Our response variable, *r*, is censored at zero because lenders will always ensure that positive rent is earned from making a loan. Standard regression analysis, while feasible, assumes that the data is uncensored and therefore the format of the response variable suggests a standard tobit

[12] While the correlation matrix gives an immediate impression of the direct bivariate relationships between variables, it does not illustrate the dynamic effects bringing about these reduced form relationships through the interaction of supply and demand schedules. It does however provide us with the opportunity to have a first stab at exploring some key overall effects.

[13] In an earlier version of this paper, we interacted this term with a variable similar to collateral and found it to be insignificant. If we assume that collateral is exogenous (due to indivisibility arguments), the raison d'etre for including this term disappears because the lender does not respond to risk *ex ante* by demanding more collateral (a fixed quantity) upfront. The insignificance of the amt – *ex_risk* bivariate correlation coefficient (Appendix 3) supports the view that the link between the two variables is insignificant.

methodology[14]. Greene (1997) warns against forcing standard regression onto censored data where four problems may arise; predicted values can fall outside the range of the outcome variable, regression coefficients can be biased, error terms can assume nonnormal distributions, and finally heteroscedasticity can be exacerbated. While the first two problems undermine one's ability to trust predicted values and the direction and size of estimated relations, the last two problems are more serious for our analysis because they undermine a researcher's ability to produce unbiased standard errors and to conduct tests of statistical significance.

*{table 3 near here}*

In Table 3, we perform the first estimation which tests for the effect of collateral wealth on interest margin, while controlling for other covariates. The negative effect of *C* on *r* is significant to the 1 percent level. Moving on to the size of the loan facility, the transaction cost effect appears to dominate because interest margins are significantly lower for larger facilities. The ability of the lender to ascertain the borrower's real 'revealed' quality is evident in the positive and significant coefficient for the variable, *ex_risk*. Here we observe that borrowers whose credit quality subsequently deteriorated were charged higher interest margins up front, perhaps in anticipation of this deterioration in credit rating. This finding supports the view that the information environment is symmetric or asymmetric, along the lines outlined in the over-optimism models above. The finding is in line with other research which concludes that riskier loans are more likely to be secured (Berger and Udell, 1990; 1995). Another way of expressing this result is that other variables not captured in our model (unobservable variable) such as the lender's assessment of the borrower's project proposal, which themselves are correlated with revealed borrower quality, have assisted the lender when deciding on the risk margin. Larger enterprises, in terms of projected sales turnover, possibly pose lower risk because they can gain scale economies and quickly capture

[14] We are grateful to an anonymous referee for this suggestion.

market share.[15] In the second estimation run, we include a squared term for collateral wealth. This term is positive and significant, showing that the *r* and *C* schedule is concave.

We now move on to show how increases in collateral wealth are predicted to affect the interest margin by observing the marginal effects for our estimations. By setting the values for amount borrowed and enterprise size in regression 2 (Table 3) at their mean values of £17.5K and £265.5K respectively, and setting all dummy variables to 0 we can now observe how interest margins change with increases in collateral wealth.[16] When no collateral wealth is submitted, we predict the interest margin to be 4.05 percent, the margin falling to a minimum level of 2.94 percent for collateral wealth of £500K (See Appendix 2). Thereafter, the margin rises with further increases in collateral wealth. This concave pattern traced by interest margins with increases in collateral wealth is shown in Figure 1.

*{figure 1 near here}*

Our lack of additional information on human capital variables such as entrepreneur education, age or previous employment admit the possibility outlined in Cressy (2000) in his criticism of the Evans and Jovanovic result of credit rationing that wealth or collateral are correlated with human capital variables, which in turn can drive interest margins or credit availability. The interesting aspect here is that if that if this interpretation holds then it suggests a hitherto not considered interpretation of Cressy (2000): namely that higher wealth resulting from higher human capital *causes* entrepreneurs to be more risk loving and perhaps careless, to an extent that banks need to compensate for this higher risk through higher interest rates. In other words, the relationship

[15] This could also be a sectoral effect, proxying capital intensive vis-à-vis labour intensive sectors. The sectoral information in the data is very limited, being used internally by the bank for market segmentation, with high levels of aggregation for particular customer groups. Furthermore, it does not map onto Standard Industrial Classification codes

[16] We set the *ex_risk* dummy equal to 1 to reflect the majority of borrowers who did not default on their borrowing.

between human capital and entrepreneurial performance may be time contingent, after some initial success the now wealthy high human capital individuals become risky loan propositions. In effect, higher risk from wealth, which is acquired via possession of above average human capital, trades off and neutralises reduced risk induced by above average human capital.

**4. Conclusion**

We set out to examine the empirical relationship between interest rate margins and collateral for loans to new ventures. We had access to a unique data set taken from one of the major UK banks which included information on the actual level of collateral provide by new ventures (and not a dummy variable indicating whether collateral was provided or not which has been the only information available in so many other previous studies) which enables us to test for convexity. The findings are novel and for the first time highlight a convex U-shaped relationship between interest rate margins and collateral. The results provide a new perspective which indicates that the ability to provide collateral (through personal wealth) does not necessarily translate monotonically into an advantage for new ventures. We find that initially the provision of collateral enables new ventures to get cheaper loan finance by providing banks with more security. However, even greater subsequent amounts of collateral which can be provided by more wealthy individuals can be associated with greater moral hazard - through less entrepreneurial effort (Burke, FitzRoy and Nolan, 2000), more risk loving behaviour (Stiglitz and Weiss, 1981 and Cressy, 2000) or a combination of both generally depicted as increased carelessness (Burke and Hanley, 2003). In order to compensate for these greater risks, lenders need to charge higher interest rates.

Thus, the ability to provide collateral has two competing effects on new venture performance with a positive impact gradually turning into a negative effect as an individual's wealth increases, thereby resulting in a convex U-shaped relationship. This interpretation is consistent with empirical studies

on new venture performance which find a concave relationship between new venture performance and wealth (e.g. Burke, FitzRoy and Nolan, 2000 and Taylor, 2001). In terms of the literature on interest margins and collateral, our U-shaped convex function also provides support for a key assumption of over-optimism models (e.g. de Meza and Southey, 1996) where it finds that lenders appear to charge ventures, who *ex-post* turn out to be more risky, higher interest rates (*ex-ante*) at the time the loan is offered. We note that our convex U-shaped function occurs even after controlling for this effect. Of course, the screening model predictions are also supported where these models can justify the downward portion of the convex U-shaped function. From an empirical perspective we do not think it is unrealistic to have (double) countervailing asymmetries of information, which is what these results imply. For example, banks may be better able to gauge the risk associated with market opportunities than entrepreneurs, but simultaneously be less able to gauge the risk associated with the human capital of an entrepreneur, than an entrepreneur herself.

Overall, the empirical results indicate that the new venture loan market contains aspects of the various theoretical schools of thought and most importantly, while entrepreneurs with 'big bucks' rarely face *access* to finance constraints, they do pay a higher *price* for loan finance than their moderately wealthy counterparts. In fact, the U-shaped convex relationship which we discover in this paper indicates that a lender's pricing policy may even help to somewhat level the competitive playing field between ventures launched by higher and moderately wealthy entrepreneurs.

**References**

Berger A. and G. Udell, 1990, 'Collateral, Loan Quality and Bank Risk', *Journal of Monetary Economics*, v25, pp. 21-42

Berger, A. N. and G.F. Udell, 1995, 'Relationship Lending and Lines of Credit in Small Firm Finance', *Journal of Business*, v68, n3, pp. 351-81

Besanko D. and A. Thakor, 1987, 'Competitive Equilibrium in the Credit Market under Asymmetric Information', *Journal of Economic Theory*, v42, n1, pp.167-182

Bester, H., 1985, 'Screening vs. Rationing in Credit Markets with Imperfect Information', *American Economic Review*, v75, n4, pp. 850-855

Bester, H., 1987, 'The Role of Collateral in Credit Markets with Imperfect Information', *European Economic Review*, v31, n4, pp. 887-99

Binks, M. and C. Ennew, 1998, 'Private Businesses and their Banks', Forum of Private Business Bank Survey, 1998, University of Nottingham Business School

Burke, A.E., F.R. FitzRoy, and M. Nolan, 2000, 'When Less is More: Distinguishing between Entrepreneurial Choice and Performance', *Oxford Bulletin of Economic and Statistics*, v62, n5, pp. 565-587

Burke, A. and A. Hanley, 2003, 'How Do Banks Pick Safer Ventures? A Theory Relating the Importance of Risk Aversion and Collateral to Interest Margins and Credit Rationing', *Journal of Entrepreneurial Finance and Business Ventures*, v8, n2, October 2003, pp. 13-24

Coco, G., 1999, 'Collateral, Heterogeneity in Risk Attitude and the Credit Market Equilibrium', *European Economic Review*, v43, n3, pp. 559-74

Coco, G., 2000, 'On the Use of Collateral', *Journal of Economic Surveys*, v14, n2, pp.191-214

Cressy, R. 1996, 'Commitment Lending under Asymmetric Information: Theory and Tests on UK Start-up Data', *Small Business Economics* , v8, n5, pp. 397-408

Cressy, R., 2000, 'Credit Rationing or Entrepreneurial Risk Aversion? An Alternative Explanation for the Evans and Jovanovic Finding', *Economics Letters*, v66, n2, pp. 235-240

Cressy, R. 2003, Credit Constraints on Small Businesses: Theory Versus Evidence, *International Journal of Entrepreneurship Education,* vol 1, no 4, pp. 515-538.

Cressy, R. and O. Toivanen, 2001, 'Is There Adverse Selection in the Credit Market?', *Venture Capital*, v3, n3, July-Sept. 2001, pp. 215-38

de Meza, D. and C. Southey, 1996, 'The Borrower's Curse: Optimism, Finance and Entrepreneurship', *Economic Journal*, v106, n435, pp. 375-86

de Meza, D. and D. Webb, 1987, 'Too Much Investment: A Problem of Asymmetric Information', *Quarterly Journal of Economics*, v102, pp.281-292

Evans, D. and B. Jovanovic, 1989, 'An Estimated Model of Entrepreneurial Choice under Liquidity Constraints', *Journal of Political Economy*, v97, n4, pp.519-535

Greene, W. H., 1997, *Econometric Analysis (3rd Ed.)*. New York: Prentice Hall.

Hanley, A., 2002, 'Do Binary Collateral Outcome Variables Proxy Collateral Levels? The Case of Collateral from Start-ups and Existing SMEs', *Small Business Economics*, v18, n4, pp.317-331.

Leeth, J. and J. Scott, 1989, 'The Incidence of Secured Debt: Evidence from the Small Business Community', *Journal of Financial and Quantitative Analysis*, v24, n3, pp. 379-94

Parker, S., 2002, 'Do Banks Ration Credit to New Enterprises? And Should Governments Intervene?', *Scottish Journal of Political Economy*, v49, n2, pp. 162-95

Stiglitz, J. and A. Weiss, 1981, 'Credit Rationing in Markets with Imperfect Information', *American Economic Review*, v71, n3, pp. 393-410

Taylor, M., 2001, 'Self-Employment and Windfall Gains in Britain: Evidence from Panel Data', *Economica*, v68, n272, pp. 539-565.

Wette, H., 1983, 'Collateral in Credit Rationing in Markets with Imperfect Information: Note', *The American Economic Review*, v 73, n3, pp.442-445

**Table 1: Theories and evidence of the relationship between *r* and *C***

| **Predicted relationship between *r* and *C*** | **Theories which support this correlation** | **Empirical evidence of a relationship between *r* and *C*** |
|---|---|---|
| **Negative** | **Screening models:**<br>Bester (1985)<br>Besanko and Thakor (1987) | Cressy (1996)<br><br>Cressy and Toivanen (2001) |
| **Positive** | **Over optimism models:**<br>de Meza and Southey (1996) | Leeth and Scott (1989)<br>Berger and Udell (1990) |
| **Convex U-shaped** | **Collateral, Wealth and Endogenous Risk:**<br><u>Not controlling for loan amount</u><br>Stiglitz and Weiss (1981)<br>Stiglitz and Weiss (1981) *plus* Cressy (2000)<br><u>Controlling for loan amount</u><br>Burke and Hanley (2003) | <br><br><br><br><br>This paper |

**Table 2: Summary Statistics**

| **Summary statistics** | mean | median | max | Min | std. dev | no. of obs. |
|---|---|---|---|---|---|---|
| Interest margin *(r)* | 3.9 | 3.5 | 7 | 1.5 | 1.3 | 214 |
| Collateral in 1,000s (*C*) | 94.8 | 1.811 | 1,011.6 | 0 | 174.5 | 214 |
| Borrowed amount in 1,000s ($\hat{amt}$) | 17.5 | 7 | 400.0 | 0.5 | 39.8 | 214 |
| Enterprise size in 1,000s *(size)* | 265.5 | 130 | 3,200 | 12 | 398.6 | 181 |
| *ex post* default *(ex_risk)* | defaulters | total | % defaulters | | | |
| | 28 | 214 | 13 | | | |
| facility for working capital *(purp)* | working capital | total | % work. capital | | | |
| | 177 | 214 | 83 | | | |

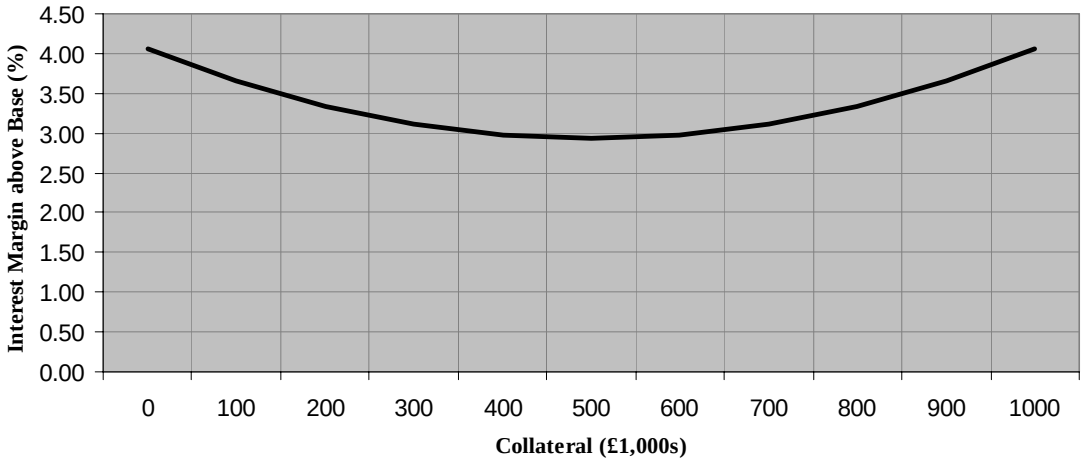
**Table 3: Collateral / Interest Margin Trade-off**

| | (1)<br>Interest margin (r) | (2)<br>Interest margin (r) |
|---|---|---|
| Total collateralisible wealth (*C*) | -0.001 | -0.004 |
| | (2.68)*** | (3.71)*** |
| Total collateralisible wealth squared (*C2*) | | $4.49e^{-06}$ |
| | | (2.80)*** |
| Amount borrowed (*amt*) | -0.008 | -0.007 |
| | (2.97)*** | (2.49)** |
| *Ex post* loan default (*ex_risk*) | 0.510 | 0.492 |
| | (2.08)** | (2.05)** |
| Working capital loan (*working1*) | 0.313 | 0.171 |
| | (1.31) | (0.71) |
| Enterprise Size: projected sales (*size*) | -0.001 | -0.001 |
| | (3.38)*** | (3.65)*** |
| Constant | 3.993 | 4.219 |
| | (16.76)*** | (17.09)*** |
| Observations | 181 | 181 |
| Pseudo $r^2$ | 0.08 | 0.10 |
| LR $\chi^2$ | 51.2 | 58.9 |

**Notes:**
Absolute value of t statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

*C:/&/instrument/revision/Figure1.xls*

**Figure 1 Interest Margin / Collateral Tradeoff**




**Notes:**
Simulation for regression (2), Table 2. Value for amount borrowed and size set at mean amounts £17.5K and £265.5K respectively
See **Appendix 2** for list of predicted values

## Appendix 1 List of Variables in Data

| Variable | Label | Description |
|---|---|---|
| *Ex post* risk | *ex_risk* | *Ex post* loan default (ex_risk) |
| Collateral: Wealth | *C* | Total collateralisible wealth (C) |
| Credit Amount | *amt* | Amount borrowed (amt) |
| Interest Margin | *r* | Interest margin (r) |
| Loan Purpose | *working1* | Working capital loan (working1). Otherwise, loan is for fixed capital investment |
| Enterprise Size | *size* | Enterprise Size: Projected Sales (size) |

## Appendix 2 Interest Margin Predictions (Figure 1)

| r (percent) | C (£1,000) |
|---|---|
| 4.05 | 0 |
| 3.65 | 100 |
| 3.34 | 200 |
| 3.11 | 300 |
| 2.98 | 400 |
| 2.94 | 500 |
| 2.98 | 600 |
| 3.12 | 700 |
| 3.34 | 800 |
| 3.66 | 900 |

## Appendix 3 Correlation Matrix

| | r | c | amt | ex_risk | purpose | size |
|---|---|---|---|---|---|---|
| r | 1 | | | | | |
| c | -0.3726* | 1 | | | | |
| amt | -0.3210* | 0.4458* | 1 | | | |
| ex_risk | 0.1006 | 0.0558 | -0.0405 | 1 | | |
| purpose | 0.1317 | -0.1282 | -0.1703 | -0.0425 | 1 | |
| size | -0.3364* | 0.3363* | 0.2194* | 0.0336 | 0.0628 | 1 |