Do Binary Collateral Outcome Variables Proxy Collateral Levels? The Case of Collateral from Start-ups and Existing SMEs

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ABSTRACT. This paper is designed to test whether the factors which affect the decision to collateralise business loans affect the level of collateralisation in the same manner. If the level of collateralisation does matter, the provision of collateral becomes more than a goodwill gesture to placate banks and more a device to ameliorate the risk of lending. We use a thitherto unseen dataset from a U.K. retail bank comprising 4,618 transfers and start-ups (TS group) who applied for business loans and overdrafts between January 1998 and January 2000. The control sample comprised 9,596 existing businesses from the same period. Our unique dataset permits an analysis of this kind for the first time because it contains a continuous variable for collateral unlike previous studies. Existing businesses exhibit a higher frequency (binary outcome) and level (tobit outcome) of collateral than the businesses who are start-ups or have transferred from another bank only when distortions within the data are not controlled for. These distortions negate the value of binary collateral variables. Factors such as business type and loan purpose are useful at explaining the likelihood of a borrower having his loan collateralised and the level of collateralisation for borrowers who provided collateral or not.

1. Introduction

There has been empirical work into the decisioning process of whether a bank decides to take collateral or not (Berger and Udell, 1993; Cressy and Toivanen, 1997). Unfortunately there has been no empirical analysis to date of the level of collateral taken. This gap in the literature has meant that while analyses have modelled and demonstrated empirically the decision to take collateral or not, there has been no corresponding empirical analysis which demonstrates whether the same factors affecting the decision to take collateral or not also affect the level of collateral taken.

It could be argued that the level of collateral should not matter as much as the decision to collateralise the loan or not. The basis for this argument is that any provision of collateral is merely a signalling gesture by the business to the bank. If the business put "its money where it's mouth is" the bank would be induced to lend.[1]

Although this may seem a simplistic argument, anecdotal evidence from interviews with German and Irish bankers from different types of bank suggests that collateral while important for owner managed business, is less important than the viability of the business plan and the credibility of the business principals (Hanley, 1997). The decision to take collateral or not is a function inter alia of the loan purpose where bankers match asset type to collateral type and relegate collateral to second place behind the viability of the business and the business plan. It is natural that bankers would want to portray themselves in the best possible light and therefore understate the significance they attach to collateral and overstate their ability to correctly assess good projects.

We argue that deciding upon a level of collateral as opposed to deciding whether to take collateral or not cannot be clean cut or scientific. The very indivisible nature of collateral suggests that banks cannot easily match the level of collateral to the level of borrowing. Since a unit of collateral is typically understood to be indivisible, it follows that this unit of collateral must be spread over a number of loans or overdrafts. Real-life datasets do not typically exhibit neat, clean separations between collateral units. They involve

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spreading the security over an amalgam of borrowing. This feature of collateral being undivisible highlights the need to examine aggregate borrowing rather than loans or overdrafts in isolation. Collateral may furthermore be under- or overvalued and realise less value on disposal than its value as a going concern (sunk cost). Given the comparative "messiness" of looking at collateral levels rather than the binary decision of whether collateral is taken or not, it might be expected that the same factors driving the decision to take collateral might be not significant in explaining the level of collateral taken.

It is necessary to compare the significance and effects of factors that influence the decision to lend or not as well as their corresponding influence on the level of collateral taken. Firstly, if the factors exert a similar influence on both the binary (decision to take collateral or not) as well as the continuous (level of collateral) response variable, an empiricist can use the decision to take collateral or not as a proxy for the level of collateral taken. Given the difficulty in valuing collateral and assigning its value over individual loans as well as the problem in obtaining estimates of collateral value, using the binary outcome variable of whether collateral is taken or not represents a simplification of the collateralisation process and eases data constraints in this area. This in turn could facilitate further research into the area of signalling and information asymmetry which to date has been hampered by a lack of data.

The aim of our paper is twofold. Our primary aim is to investigate whether a binary "*yes_no*" type variable allows the same conclusions be drawn about the role of the independent variables as a variable measuring collateral level. If the analysis using the binary response variable parallels the analysis on collateral level, there is a rationale for proxying collateral level using a simple binary variable. Such a proxy would be very useful for further research where there is comparative difficulty quantifying the amount of collateral on loans.

Secondly, we examine over two adjacent time periods whether there is a disparity in the way start-up businesses are treated in terms of collateral requirements *vis a vis* existing businesses. This latter focus of our analysis is the first to our knowledge to use two time periods. This additional constraint of using two time periods acts as a control on the validity of our results.

The outline of this paper is as follows: The first section "Background" outlines the most recent related analyses on collateral. The second section "Data Description" deals with a description of our data and elaboration of the models used in this analysis. The next section "Descriptive Statistics" looks briefly at the data before embarking on the more in-depth analysis. The section following this "Econometric Models", describes the models used in our analysis. The section entitled "Econometric Results" as the name suggests, outlines the results of the logistic regression and tobit analysis. The final section "Discussion" sums up the implications of our analysis.

2. Background

This section outlines other related research which has sought to explore the issue of collateral tying it in with our research question.

The two most recent analyses that deal with the provision of collateral both use collateral dummies as dependent variables (Berger and Udell, 1993; Cressy and Toivanen, 1997).

The analysis by Berger and Udell (1993) models the decision to require collateral from a business as a function of the financial characteristics of the business, its corporate governance, the industry within which it operates and relationship characteristics such as the number of years it has been a bank customer. Their logistic regression is defined as[2]

$$\textit{Decision to take collateral} = \alpha \pm \beta_1 lev + \beta_2 arturn \pm \beta_3 age \pm \beta_6 relate + e$$

Where "*lev*" is defined as the ratio between the amount borrowed and total business assets, "*arturn*" refers to the turnover of accounts receivable in days, "*age*" a relationship variable, refers to the number of years the current entrepreneurs have owned the business. Finally "*relate*", another relationship factor, denotes the length of years the borrowers have had a borrowing relationship with the current lender.

Cressy and Toivanen (1997) model the hypothesised relationships between their variables before embarking on their empirical analysis. They define

the level of collateral "*C*" within their signalling model as;

Level of Collateral C = f(*Ind, purp, succ, dur*)

Where "*succ*" is the ex post risk type of the entrepreneur and indicates whether she defaulted on her loan or not. "*purp*" is the loan purpose which represents the purchase of stock, plant, a business, vehicles, improvements to property, working capital and other. "*Ind*" represents the industrial sector of the business and "*dur*" the duration of the loan. Unfortunately the authors do not have an estimate for the level of collateral, "*C*", in their dataset and use instead a dummy similar to that used by Berger and Udell as a proxy.

Unlike both studies outlined above, our analysis does not set out to establish the relationship between the decision to take collateral and the ultimate risk type of the entrepreneur. Therefore, our analysis does not explore theories of information symmetry and asymmetry. Furthermore, unlike the above analyses we aim to examine the sensitivity of the coefficients of the explanatory variables selected to the definition of collateral chosen. Ultimately, we seek to infer whether the binary decision to take collateral or not represents a useful proxy for the magnitude of collateral since only binary variables have been used in the literature to date.

3. Data description

This is the first known analysis to our knowledge containing both a value for collateral (continuous variable called "*allcoll*") and a variable indicating whether collateral was taken by the bank to secure borrowing (binary variable called "*yes_no*"). The variable "*allcoll*" is calculated by adding the values of land and buildings, guarantees, life policies and cash the owner injects into the project. In all instances, the value of collateral is estimated at its liquidation price by the bank. The percentage markdown for land and buildings is 30 percent, guarantees is 100 percent and life policies a percentage markdown that is based on the time to run.[3]

As such the dataset allows us to infer whether using dummy variables for collateral influences coefficient signs and significance levels in a way which differs from the conclusions arrived at when using continuous variables. The choice of variables would have repercussions in theory testing exercises where the sign of the collateral coefficient has implications for the information regime that prevails.

A secondary focus of our analysis is on the "*Transfer-Start-up*" TS group and the "*Existing Businesses*" EB groups that are described by the variable "*type*". The TS group, as the name suggests, contains businesses which have transferred their business from another lender or are *ab initio* start-ups. They have been grouped together because neither transfers nor start-ups have a track record with the lender and are hence unknown quantities as far as the lender is concerned. On the other hand, the EB group comprises existing businesses which have a track record with the bank. Since "*type*" is a dummy variable taking on values of 1 if the loan is to an existing business and zero if not, all values of the coefficient given for "*type*" refer to the relationship between membership of the EB group and the response variable with the TS group representing the base category. The definition of borrowing used in this analysis is aggregate borrowing and is calculated by summing all term loans and overdraft limits applied for and secured during a 6 month time window in 1999. It is necessary to use an aggregate borrowing measure to allow us use an aggregate collateral measure. This approach is used due to the indivisibilities of collateral.

The secondary aim is to establish whether the TS group is placed at a disadvantage compared to the EB group on the basis of the perceived ex ante risk of the TS group. The TS group is perceived to be riskier due to start-ups being younger businesses. Leeth and Scott (1989) for example, used age as a negative proxy for riskiness. Both start-ups and transfers have also by definition a shorter business relationship with the bank, a further basis for riskiness.

Our data come from a unique dataset provided by a major U.K. retail bank. There were 4,335 businesses in the sample that applied for finance from this bank during the first 6 months of 1999. Of these 1,553 belonged to the TS group with the remaining 2,782 belonging to the EB group. The number of applicants in our database for the second 6 months is over twice that for the first period with a total of 9,879 businesses. Of these

3,065 were from the TS group and the remaining 6,814 from the EB group.

The reason why we use business applicants for two time periods is to assess whether the relationship between collateral as the response variable and the explanatory variables used is consistent over the two time periods and for the two different sets of business applicants. The constraint was that all applicants had applied for either a loan or overdraft within either of the 6 month periods. It was possible that applicants who applied within the first 6 months could also apply in the second period and so the two periods do not represent a mutually exclusive set of applicants.[4]

Several further constraints were placed on the data and these are outlined as follows. Our screened dataset contained only borrowers who had borrowed at least £1,000 in either overdraft or term loan form. This was to exclude very small amounts of borrowing that would not necessitate collateral. In a further screening of the data the ratio of collateral to aggregate borrowing was calculated. If these collateral ratios exceeded 20 as a minority of the observations did, applicants whose collateral ratios exhibited these anomalies were excluded from the dataset. There was a concern that duplication by bank personnel inputting the data had occurred in the right tail of the collateral ratio distribution and a value of 20 represented a generous cut-off point allowing for "excessive" ratios while excluding the extreme ratios for cautionary reasons.

Apart from errors made when entering the data, a further reason for excessive collateral ratios is that if collateral has not been decommissioned it remains on the system and does not reflect the current borrowing situation having already served its purpose. Moreover, collateral can be assigned in anticipation of future borrowing in which case it does not reflect the current borrowing situation since it reflects future intentions. Since collateral in the form of real estate is often non-divisible, it is plausible that such anomalies arise. In order to check for errors arising when collateral data would not be decommissioned but would remain on the system for subsequent loans, a modification of our regressions in the next section looks at the response variable within "acceptable" collateral to loan ranges i.e. collateral as a proportion of borrowed amount does not exceed 200 percent. This gives a collateral to loan ratio of 2. This modification is only performed for the response variable when it is continuous. This is because we assume that analyses using dichotomous outcome variables would not have this collateral to loan information on hand since collateral to loan ratios contain collateral level in its continuous variable format in the numerator.

4. Descriptive statistics

The purpose of this section is to shed some light on some distributions within the data in order to show the breakdown between the existing business EB group and TS transfer/start-up group across several dimensions.

Figures 1 and 2 show the distribution of collateral across the existing business EB and transfer-start-up TS groups for borrowing of over £1,000. It can be seen that the TS group fares better than the EB group in terms of being less well represented in the fourth quartile representing the highest 25 percent of observations by collateral amount. This counter intuitive result showing that existing businesses offer more rather than less collateral, will be examined more closely in the regressions that follow. The pattern whereby the EB group has a comparatively higher presence than its TS group counterparts in the fourth quartile holds for the first period (January until June 1999) and also for the second period (July until December 1999). The differences seen in these distributions are significant to the 1 percent level as seen in the corresponding cross-tabs (Table I).

It can easily be argued that it does not matter if businesses in the EB group appear to have given more collateral because they receive higher loans anyway. In other words, collateral per unit would fall because the EB group are receiving comparatively higher finance than their TS counterparts. Table II shows that this is not the case. In the first period only 43.1 percent of the TS group were borrowing over the median level compared with 54.5 percent of the EB group. However, by the second period this pattern was reversed with 54 percent of the TS group borrowing over the median level compared with 49.1 percent of the EB group.[5]

So far we have looked at cross-tabs which describe the difference between borrowers from

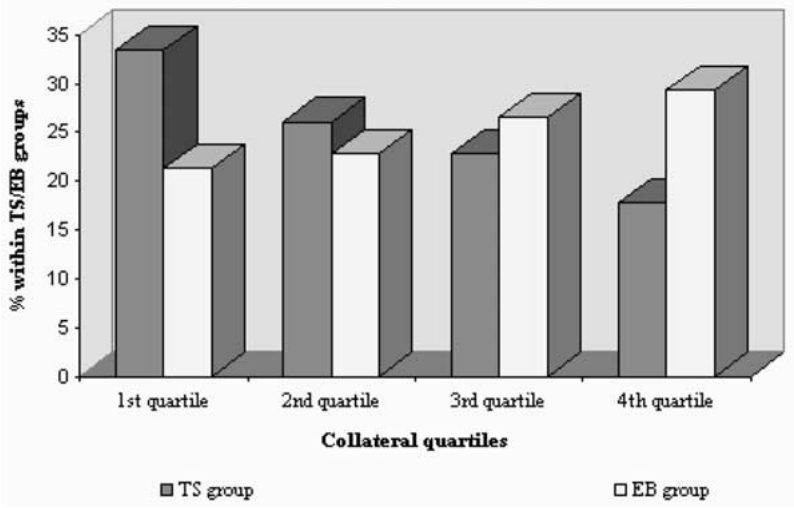

Figure 1. Composition of collateral (allcoll) for first period.

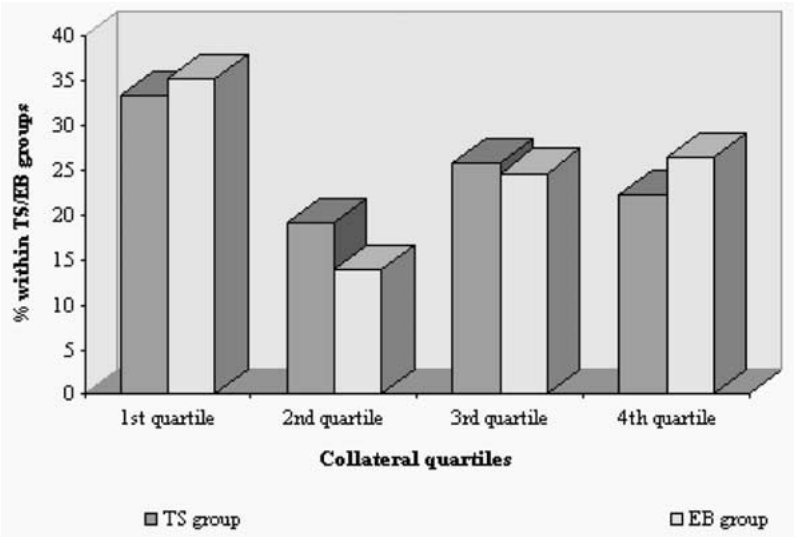

Figure 2. Composition of collateral (allcoll) for 2nd period.

the EB and TS groups in terms of their relative borrowing and collateral levels. However, the issue of borrowing and collateral amount is best expressed as the ratio between collateral and borrowing i.e. collateral to loan value. The question now is whether businesses from the TS group are in general higher geared than their counterparts in the EB group? Since collateral to loan ratios are typically non-normally distributed, they are best logged to ensure higher normality.[6] We examined the corresponding Q-Q plots to ensure that the logged distributions were indeed more multivariate normally distributed than the untransformed collateral ratios before dichotomising the logged collateral to borrowing ratios around their median for both periods. When the relative frequencies of the transformed collateral to loan ratios are compared across the SME borrower type groups, it is suprising that the pattern is inconsistent across the periods (Table III). Borrowers from the EB group have a higher likelihood of showing collateral to loan values above the median value in the first period but this pattern is reversed in the second period where borrowers from the TS group

TABLE I
Collateral by business type

January–June 1999	Collateral quartiles		TS group	EB group
	1st quartile	$C \leq 12{,}050$	33.4	21.3
	2nd quartile	$12{,}050 < C \leq 34{,}000$	26.1	22.8
	3rd quartile	$34{,}000 < C \leq 80{,}000$	22.8	26.5
	4th quartile	$80{,}000 < C$	17.8	29.3
			100	100
		Value	df	Asymp sig. (2-sided)
	Pearson chi-square	116.779	3	0.00
July–December 1999	Collateral quartiles		TS group	EB group
	1st quartile	$C \leq 10{,}100$	33.3	35.1
	2nd quartile	$10{,}100 < C \leq 30{,}000$	19	13.9
	3rd quartile	$30{,}000 < C \leq 70{,}000$	25.7	24.6
	4th quartile	$70{,}000 < C$	22.1	26.3
			100	100
		Value	df	Asymp sig. (2-sided)
	Pearson chi-square	51.947	3	0.00

TABLE II
Amount borrowed by business type

	January–June 1999			July–December 1999		
	Borrowing ≤ median	Borrowing > median	Total	Borrowing ≤ median	Borrowing > median	Total
TS group	56.9	43.1	100	46	54	100
EB group	45.5	54.5	100	50.9	49.1	100
	Value	df	Asymp. Sig. (2-sided)	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	37.793	1	0.000	15.198	1	0.000

are more likely to exhibit collateral to loan values which are above the median value. We conclude on the basis of this lack of consistency across periods that diffferences between our two a priori risk categories are perhaps blurred due to similarity between borrowers in both groups. Rather than comparing small start-ups with large existing businesses, all SME borrowers in our database are small, unquoted companies according to the bank's definition of small. They may represent a more homogenous group of "small risky businesses" than their different bank relationship status suggests.

It could also be argued that businesses from the EB group may have by definition higher assets with which to leverage higher borrowing or signal their creditworthiness. Unfortunately, our dataset does not permit a direct comparison between asset values for both small business groups. However, we have asset values for a subset of the TS and these are compared against their corresponding level of borrowing. The bottom line is to establish a link between assets and amount borrowed although this information pertains to the TS group alone (Table IV). It can be seen from Table IV that higher borrowing is associated with higher levels of assets and that this association is statistically significant. Borrowers from the TS group borrowing more than £100,000 are most likely to have at least £175,000 worth of business assets where

TABLE III
Logged collateral to loan ratios by business type

	January–June 1999			July–December 1999		
	Logged gearing ratio ≤ median	Logged gearing ratio > median	Total	Logged gearing ratio ≤ median	Logged gearing ratio > median	Total
TS group	53.3	46.7	100	43.3	56.7	100
EB group	48.3	51.7	100	53.6	46.4	100
	Value	df	Asymp. Sig. (2-sided)	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	7.501	1	0.006	67.310	1	0.000

69 percent of the highest level borrowers are located in the highest asset category.

Econometric models

We specify two different approaches to investigate the relationship between the collateral response variable and the independent variables. The first approach employs a logit specification and the second approach uses a tobit specification.

The comparative difficulty with which either of the small business categories of the variable "*type*" (*type* = 1 denoting an existing business and a start-up otherwise) obtains finance on favourable terms is proxied by two versions of the response variable. The first response variable is the dummy "*yes_no*" for collateral. The response variable collateral value is dichotomised into the binary outcomes "*bank takes collateral*" and "*bank does not take collateral*". This variable "*yes_no*" takes the value of 1 when the bank takes collateral and 0 otherwise. The binary logistic regression model uses the same definition of collateral i.e. dichotomous outcome variable as used by Berger and Udell (1993) and by Cressy and Toivanen (1998). It serves as a benchmark against which to compare the outcomes of the subsequent Tobit analysis which uses a continuous variable for collateral.

The format of the binary logit model is;

$$\text{“}yes\_no\text{”} = \mathbf{Z}_i\beta' + e$$

where **Z** is a vector of variables which are summarised in Appendix 1 along with the expected signs on the coefficients. These variables are further discussed in more detail below.

We cannot confidently predict the sign of the coefficient "*type*" because arguments for both a positive and for a negative sign can be made. We might expect a negative sign for the following reasons. First, according to the capital gearing approach described by Binks and Ennew (1997), banks use collateral as a way of attenuating the risk on their loans where risk is difficult to guage ex ante. This was indirectly corroborated by Cressy and Toivanen (1998) who find that collateral increases in ex ante risk. In our sample, the bank has more information about the EB firms than about members of the TS group and we would expect the EB group to offer less collateral. In addition, empirical work by Berger and Udell (1993) found that businesses having longer relationships with a bank and longer business experi-

TABLE IV
Amount borrowed by business and assets (TS group only)

	Business owned assets	Assets ≤ £60,500	£60,501–£175,000	Assets ≥ £175,001	Total
Amount borrowed	Borrowed ≤ £40,000	53	22	25	100
	£40,001-£100,000	19	61	19	100
	Borrowed ≤ £100,001	10	21	69	100
		Value	df	Asymp sig. (2-sided)	
Pearson chi-square		36.35	4	0.00	

ence had a lower likelihood of giving collateral. But Berger and Udell did not control for the size of the loan and so when loan size is not controlled for it appears that businesses with a longer relationship with the bank (the EB group) might exhibit reduced collateral requirements because of reduced information asymmetry. However, counteracting this tendancy of reduced collateral from the EB group, businesses with longer relationships might also be expected to have requested larger loans. The EB firms may be expected to request larger loans than the TS firms because they are expected a priori to be larger. This suggests that the effect of membership of the EB group on collateral is ambiguous.

Finally, empirical evidence from the U.S. study by Hancock and Wilcox (1998) suggests a positive relationship between membership of the EB group and offering collateral. They find that small firms have lower rather than higher collateral to loan ratios due to a shortage of appropriate assets to offer as collateral. Therefore, the coefficient for "*type*" should be positive all things equal, if the firms from the TS group are similar to the small firms in the U.S. analysis. So overall, in view of the lack of consensus in the literature, the sign of the "*type*" coefficient cannot be conjectured ex ante.

The coefficients of other variables whose signs can be hypothesised are whether an asset was purchased "*assetpu*", whether the borrowing covered working capital "*working*" and whether the loan was for the purpose of business capital "*purchca*". Whether collateral is taken on a loan or not is expected to be positively related to the loan being used to finance an asset "*assetpu*" and decreasing in working capital loans "*working*". This most liquid type of borrowing does not involve the purchase of tangible assets that could be used to secure the borrowing. It is also to be expected that loans for working capital are less collateralised than loans for business capital according to the golden rule that banks collateralise like assets with like collateral (Hanley, 1997). Optimally highly liquid collateral such as a lien on a deposit account is used to collateralise working capital as it is a highly liquid form of collateral. However, the bank in our sample does not resort to using liens on deposit accounts.

The conjectured signs for the coefficients of "*debtres*" and "*busprem*" are unknown. These variables have never to our knowledge been used before in an analysis of this type.

The variable "*busprem*" denotes whether the business was run from the owner's house (*busprem* = 0) or whether the entrepreneur had a separate location (*busprem* = 1) from which to run the business. This variable was intended to capture entrepreneurs who, perhaps from unemployment push factors, have set up business from their own homes. Alternatively it captures service-based start-ups which possess high knowledge to capital ratios. Such businesses would have little to offer in the way of tangible capital. Small businesses operating out of their own business premises should have an additional asset to offer as collateral compared to those who do not.

The variable "*debtres*" indicates whether the business is rescheduling its debt. It is conjectured in the literature that the rescheduling of debt shows that the business is suffering financial distress as it cannot meet its current repayments and requires the bank to extend the period over which the payments are made (Wruck, 1990). However, it is not known whether the bank demands additional collateral when businesses reschedule their loans because a financially distressed business may have below average levels of collateral in which case there would be a negative sign on the coefficient of "*debtres*".

The analysis moves in a second stage to the estimation of a linear regression using Tobit techniques. The response variable to be used in the first set of linear regressions is the variable "*allcoll*" which stands for the aggregate value of collateral.[7]

In order to explore the relationship between collateral level and the explanatory variables which have already been used in the logistic regression, a problem arises. The distribution of the collateral is truncated at 0 because there is no such thing as negative collateral. In order to circumvent this problem, a Tobit specification is used instead of normal OLS. This Tobit uses the latent variable y_i^* which can theoretically take on negative values. But these negative values are not observed, there are none. Thus $y_i^* = 0$ due to nonobservability. The format the Tobit takes is;

$$-y_i^* = \mathbf{x}_i\beta' + u_i \qquad u_i \sim \text{IN}(0, \sigma^2)$$

The observed values are related to the latent variable y_i^* as follows;

$y_i = y_i^*$ if $y_i^* \geq 0$

$y_i = 0$ otherwise

The format of the Tobit model is;

"*allcoll*" = $\mathbf{Z}_i\beta' + e$

where **Z** represents the same vector of independent variables as used in the logit model (See Appendix 1).

In the following section, we present the results of the models that are outlined above.

6. Econometric results

We first present and interpret the results from the logit before moving on to the results from the tobits. Looking at the logit for all collateral to loan ranges, the Existing Business group (EB group) rather than the businesses from the Transfer and Start-up (TS group) are more likely to have provided collateral in both periods. This likelihood is indicated by odds ratios of 1.18 and 1.21 for the first and second periods respectively for the coefficient of the variable "*type*" ("*type*" = 1 for EB) (Table V). This suggests that banks may be more lenient on businesses lacking appropriate assets to offer as collateral. This seems to corroborate the results of Hancock and Wilcox (1998) where smaller businesses exhibit lower gearing ratios. Those businesses which have been in existence for a while (EB group) are expected to have accumulated assets which in turn can be used to collateralise loans. This finding also corroborates the summary statistics presented in the "Descriptive Section". However, the relationship between a higher likelihood of giving collateral and the EB group could be spurious if collateral is not decommissioned after its first use and remains on the data system. Such redundancy would be particularly pronounced for the EB group, which is likely to be already borrowing in periods subsequent to the period in which it commenced its relationship with the bank. There is a

TABLE V
Variables affecting dichotomous collateral outcome "yes_no" (borrowing ≥ £1,000)

Variable	DF (1)	Std. estimate (2)	Std. error (3)	Wald chi-square (4)	Pr > Chi-square (5)	Odds ratio (6)
January until June 1999						
INTERCPT	1	–	0.19	0.00	1.00	–
TOTAL	1	0.24	7.92	49.01	0.00	1.00
TYPE	1	0.04	0.09	3.44	0.06	1.18
ASSETPU	1	0.35	0.10	178.01	0.00	3.63
BUSPREM	1	0.05	0.16	4.18	0.04	1.40
WORKING	1	–0.11	0.09	21.51	0.00	0.65
PURCHCA	1	0.10	0.19	16.35	0.00	2.17
DEBTRES	1	–0.05	0.11	4.82	0.03	0.78
		Intercept and covariates			Chi square for covariates	
– 2 Log L		3592.72			466.642 with 7 DF (p = 0.0001)	
July until December 1999						
INTERCPT	1	–	0.13	2.91	0.09	–
TOTAL	1	0.30	5.79	139.71	0.00	1.00
TYPE	1	0.05	0.06	10.17	0.00	1.21
ASSETPU	1	0.38	0.07	385.71	0.00	4.10
BUSPREM	1	0.00	0.11	0.04	0.85	0.98
WORKING	1	–0.21	0.06	141.30	0.00	0.47
PURCHCA	1	0.05	0.15	11.02	0.00	1.64
DEBTRES	1	–0.01	0.09	0.42	0.52	0.94
		Intercept and covariates			Chi square for covariates	
– 2 Log L		8883.07			1703.203 with 7 DF (p = 0.0001)	

higher risk of such redundancy with maturing bank-business relationships not captured in the binary collateral outcome variable.

The variable "*total*" denoting total amount borrowed is significant and positive in both periods, demonstrating that the likelihood of collateral being given is directly related to the amount borrowed.

As expected, the coefficient for the variable "*working*" in both periods is negative. Such loans are not likely to be collateralised because no hard asset is being purchased which could in turn be used to collateralise the working capital loan. A similar reasoning applies to the positive sign on the coefficient for "*assetpu*" in both periods. The bank can collateralise the loan using the newly purchased asset as collateral. The coefficient for the variable "*purchca*" is also positive in both periods.

Although the fact that a business has rescheduled its debts ("*debtres*" = 1) appears to reduce the likelihood of a business providing collateral, this variable is not significant at the 95 percent level for the second period. Finally, the fact that a business operates from its own premises ("*busprem*" = 1) conjectured to be positively related to the likelihood of being collateralised, is not significant for the second period and moves in a different direction in both periods with only the first period the expected positive relationship.

We now move on to the Tobit analysis using the level of collateral as the response variable (Tables VI and VII). Table VI shows the results when the dependent variable is the value of collateral. Table VII shows the results for the same dependent variable when the sample is restricted to only those cases where the collateral to loan ratio was 2 or less.

The interesting feature of the tobits is the difference in the significance level of the variable "*type*" when controlling for collateral distortions than when these distortions are not controlled for. Table VI shows that the variable "*type*" is significant where businesses from the EB group are more likely to provide collateral than their counterparts in the TS group. However, column 5 of Table VII shows that "*type*" is no longer significant when collateral to loan value ratios in excess of 2 are excluded and the tobits rerun. This pattern of non-significance for the variable "*type*" is repeated for both periods when controlling for collateral to loan levels greater than 2.

These disparities between the significance levels of the "*type*" business dummy when controlling for the collateral to loan regime or otherwise, underline the hazard of looking at collateral which has not been decommissioned over subsequent lending periods. When all collateral to loan ranges are investigated in Table VI, the variable "*type*" is significant in both periods appearing to corroborate the findings of the logits above and supporting the view that the binary variable represents a good proxy for collateral level. However, this is not the case when looking at the level of "*allcoll*" within the arbitrarily "safe zone" where the collateral to loan ratio reaches a maximum of 2.[8] Here the variable "*type*" becomes redundant and does not obtain any statistical significance in either period 1 or period 2.

This final result cautions against applying collateral data where distortions may exist and demonstrates how these distortions can lead an analyst to make inferences based on spurious relationships. This problem is most likely to arise in comparisons between new borrowers and existing borrowers where the latter group has had time to accumulate collateral over subsequent borrowing periods and hence mismatches between collateral level and borrowing are more likely to occur.

A final test of the validity of collateral level "*allcoll*" under different collateral to loan regimes is performed in column 6 of Table VII. Column 6 of Table VII demonstrates that if loan to value ratios in excess of 2 are capped at the threshold value of 2 and the tobits again rerun, that the significance levels of "*type*" increases. On this occasion, it achieves significance in the second period at the 1 percent level but nonetheless fails to be significant for the first period. Therefore, even capping values of collateral suspected to be distorted at the threshold level is not sufficient to restore the significance level of the business dummy "*type*" in both periods.

However, apart from this disparity between the results when looking at the relationship between business type and collateral level for all collateral to loan levels or a subset of collateral to loan levels, there is less disparity among the other variables. Working capital is consistently negatively related to collateral level as hypothesised while

TABLE VI

Variables affecting "allcoll" in period 1 (borrowing ≥ £1,000)
(all collateral to loan ranges)

Noncensored values = 2738 Left censored values = 896

Variable	DF (1)	Estimate (2)	Std Err (3)	Chi square (4)	Pr > Chi (5)
INTERCEPT	1	–41283.50	10056.38	16.85	0.00
TOTAL	1	0.86	0.03	1093.20	0.00
TYPE	1	20267.74	4649.37	19.00	0.00
ASSETPU	1	40229.93	4972.16	65.46	0.00
BUSPREM	1	17768.29	8274.46	4.61	0.03
WORKING	1	–15516.80	4960.27	9.79	0.00
PURCHCA	1	–1888.44	9458.29	0.04	0.84
DEBTRES	1	–8234.13	6507.50	1.60	0.21
SCALE	1	120752.7		1684.303 Normal scale parameter	

Variables affecting 'allcoll' in period 2 (borrowing ≥ £1,000)
(all collateral to loan ranges)

Noncensored values = 3457 Left censored values = 2797

Variable	DF (1)	Estimate (2)	Std Err (3)	Chi square (4)	Pr > Chi (5)
INTERCEPT	1	–237.17	3021.73	0.01	0.94
TOTAL	1	0.10	0.01	69.16	0.00
TYPE	1	2907.51	1304.91	4.96	0.03
ASSETPU	1	24402.69	1565.34	243.03	0.00
BUSPREM	1	–229.00	2438.11	0.01	0.93
WORKING	1	–14148.50	1486.01	90.65	0.00
PURCHCA	1	10089.35	3314.49	9.27	0.00
DEBTRES	1	2833.88	2197.58	1.66	0.20
SCALE	1	42703.58		562.7266 Normal scale parameter	

the purchasing of assets is positively related to collateral levels. These results point to the practice of using assets purchased to back lending. Less consistent are the signs and significance levels of "*busprem*" and "*debtres*". The former is only significant in the first period (all collateral to loan levels) with the hypothesised sign and the latter is not significant in any of the periods or under any of the collateral to loan regimes.[9] The amount of the loan "*total*" is positively related to the level of collateral and is significant in all periods and under all collateral to loan regimes. The results of the tobit in this instance agree with the results obtained in the logit.

The variable "*purchca*" is both positive and significant for both collateral to loan regimes (second period only). A possible interpretation for its lack of significance in the first period is that business capital is not always useful as an asset and the bank does not use capital such as machinery as collateral. Hence, other more suitable collateral would have to be used.

7. Discussion

The main conclusion of our analysis is that two different specifications i.e. a binary logit and tobit analysis yield similar results when exploring the factors which affect the incidence and level of collateralisation on business loans respectively only at a superficial level. The dummy variable "*yes_no*" indicating whether collateral was taken or not and which has been used by all empirical studies so far, performed in much the same way

TABLE VII

Variables affecting "allcoll" in period 1 (borrowing ≥ £1,000)
(collateral to loan = (allcoll/total) ≤ 2))

Noncensored values = 1728 Left censored values = 896

Variable	DF (1)	Estimate (2)	Std Err (3)	Chi-Sqre (4)	Pr > Chi (5)	Pr>Chi All data (6)
INTERCPT	1	–45498.90	7593.63	35.90	0.00	0.00
TOTAL	1	0.76	0.02	1824.21	0.00	0.00
TYPE	1	–2959.28	3509.16	0.71	0.40	0.15
ASSETPU	1	35121.95	3904.69	80.91	0.00	0.00
BUSPREM	1	8109.21	6229.41	1.69	0.19	0.22
WORKING	1	–18185.50	3808.86	22.80	0.00	0.00
PURCHCA	1	11439.13	7039.55	2.64	0.10	0.89
DEBTRES	1	6851.38	4912.72	1.94	0.16	0.83
SCALE	1	76675.91		1352.836 Normal scale parameter		

Variables affecting "allcoll" in period 2 (borrowing ≥ £1,000)
(collateral to loan = (allcoll/total) ≤ 2))

Noncensored values = 2528 Left censored values = 2797

Variable	DF (1)	Estimate (2)	Std Err (3)	Chi-Sqre (4)	Pr > Chi (5)	Pr>Chi All data (6)
INTERCPT	1	–11717.80	2898.42	16.34	0.00	0.00
TOTAL	1	0.22	0.00	2240.05	0.00	0.00
TYPE	1	–838.16	1265.44	0.44	0.51	0.00
ASSETPU	1	26207.40	1525.04	295.31	0.00	0.00
BUSPREM	1	–304.22	2349.70	0.02	0.90	0.65
WORKING	1	–15555.30	1458.54	113.74	0.00	0.00
PURCHCA	1	13341.98	3063.79	18.96	0.00	0.47
DEBTRES	1	543.95	2128.48	0.07	0.80	0.57
SCALE	1	37110.97		556.5983 Normal scale parameter		

as the response variable denoting value of collateral "*allcoll*". However, binary collateral variables lack the incisiveness of collateral level variables because they do not allow the researcher to go beyond the anomalies arising in collateral databases. Given the complexity of collateral data and its possible usage as a goodwill token rather than a scientifically derived "price to risk" mechanism, sensible analyses of collateral must avoid coming to premature conclusions on the properties of collateral unless prior cognizance is taken of its anomalies. These anomalies would comprise indivisibilities in addition to mismatches between borrowing values and collateral for subsequent periods if collateral were not decommissioned.

There are other problems with using binary collateral variables. Firstly, they confine the econometrics to techniques which deal with binary variables i.e. logits for non-parametric techniques or studies of relative frequencies such as cross-tabs based on the χ^2 distribution. A more important consideration deals with the limited set of conclusions that can be drawn with dichotomous outcome variables. They do not allow the researcher to deal with concepts of more or less but confine the analysis to studies of relative frequencies. The simple "*yes_no*" dichotomy does not permit a differentiation between businesses whose collateral terms are light from those who have had to pay comparatively heavier terms. There is a long continuum of businesses that are charged collateral in varying degrees of magnitude.

We would argue that there is less disparity in

the collateral terms charged business start-ups and existing businesses than thitherto believed. However, this conclusion must remain tentative given that other mechanisms may be at work. For example, the bank may compensate for its level-handedness in the area of collateral by discriminating between businesses in other areas such as interest rates or by rationing credit. The latter hypothesis could not be adequately tested give the lack of assets data for existing businesses which would allow a fuller exploration of the supply dynamics of the lending relationship. A further possible explanation for the blurring of collateral terms between the TS and EB groups could be due to similarity in the attributes of borrowers in both groups given that they are all small businesses.

Total borrowing as described by the variable "*total*" represents an end effect and we cannot observe whether the TS group were offered all the finance they sought or whether they were credit constrained. Alternatively, without being able to observe the total assets of the business, we cannot conclude whether collateral offered by the TS group represented proportionally more of their total assets than for the EB group.

The most robust explanatory variables across time appear to be the working capital and asset purchase dummies. These always retained the predicted signs and significance levels.

We conclude that the dichotomous variable indicating whether collateral was taken or not does not represent an adequate proxy for the level of collateral because it cannot deal with anomalies within the collateral data which could otherwise be attenuated by using appropriate collateral to loan levels.

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Appendix 1. List of variables used

Label	Variable description	Hypothesised sign of coefficient
allcoll	Sum(*land_dv, lpol_dv, guar_dv, non_borr*)	
assetpu	$x = 1$ if asset purchased, 0 otherwise	Positive. The asset is conjectured to be used as collateral until loan redemption
b40_amt	Overdraft amount	
bln_amt	Loan amount	
busprem	$x = 1$ if owner has business premises, 0 otherwise	Positive. The business has additional asset i.e. business premises apart from the family home which can be used as collateral
debtres	$x = 1$ if owner has rescheduled debt, 0 otherwise	
guar_dv	Value of personal guarantees (reduced by markdown)	
land_dv	Value of land and buildings (reduced by markdown)	
lpol_dv	Value of life policy (reduced by markdown if any)	
non_borr	Equity contributed by owner	
purchca	$x = 1$ for capital purchased, 0 otherwise	Positive (as for "*assetpu*")
total	Sum(*b40_amt, bln_amt*)	Positive. The larger the loan the higher the collateral requirement

Appendix 1 (Continued).

Label	Variable description	Hypothesised sign of coefficient
type	$x = 1$ for EB group, 0 otherwise	Negative (on balance) – quality of EB group easier to ascertain ex ante (lower risk) and collateral increasing in ex ante risk (Cressy and Toivanen, 1998) – collateral per loan unit i.e. collateral to loan ratio, decreasing in firm size as postulated by the Capital Gearing approach (Binks and Ennew, 1997) + Smaller firms have lower gearing ratios (Hancock and Wilcox, 1998)
working	$x = 1$ for working capital, 0 otherwise	Negative. Loans for working capital should be less collateralised as 'soft' collateral such as liens on accounts and accounts receivable normally used for collateralising working capital is not used by this bank (Hanley, 1997).
yes_no	$x = 1$ for collateral required, 0 otherwise	

Notes

[1] The meaning of the term "signalling" in this most superficial sense implies the automatic provision of any amount of collateral and does not imply the ratio of the collateral to the loan.

[2] For the sake of brevity only the variables significant to at least 10 percent are included as explanatory variables here.

[3] Keasey and Watson (1996) refer to this markdown value of collateral as the "carcass" values arguing that;

> . . . a relatively illiquid market in second hand plant and equipment would suggest that the value of a business asset for the purposes of collateral is often considered to be much lower than its cost as a new asset', p. 20.

[4] Because of the proximity of the time periods, it is doubtful that the profile of the applicant type will have changed very much as the population of applicants is likely to have remained stationary (Hanley, 2000).

[5] The lack of an appreciable difference between the two perhaps points to the homegeneity of my sample given that all my firms are small irrespective of their borrowing status. This may explain the blurring of distinction between the EB and TS group regarding borrowing amount.

[6] Altman and Saunders (1997) and Goss et al. (1995) also encountered the same difficulty with non-normally distributed gearing ratios.

[7] It is possible to replace collateral level "*allcoll*" as the dependent variable with the ratio between collateral and aggregate borrowing. However this alternative approach makes it impossible to isolate the pure relationship between collateral level and the other explanatory variables and is inconsistent with our aim of comparing the effects of the explanatory variables on collateral as the response variable.

[8] We did not use collateral to loan as an explanatory variable because of endogeneity problems. Since its numerator is the same value as the response variable "*allcoll*" and its denominator another explanatory variable "*total*", we deemed it safer to control for its effects without increasing distortion by including it as an additional explanatory variable.

[9] This inconsistency in the signs and significance levels of "*busprem*" and "*debtres*" is not likely to have been induced by a lack of population stationarity due to the proximity of the two time periods but a lack of robustness in the variables themselves or conceivably a change in the way the bank assesses loans. This lack of robustness could arise for a number of reasons including inappropriate treatment of missing values by data inputters in the case of "*busprem*" or different treatment of borrowers by loan officers for "*debtres*". Since the relationship between borrower and lender is not controlled for, this latter scenario is likely where leniency towards troubled borrowers differs among loan officers depending on the strength of the individual borrower/business relationship. Troubled borrowers who are "participative" according to the defininition by Binks and Ennew (1997) and cooperate with their banks, may be treated less severely on reschedulement of their loans.

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