Lending Relationships and the Collateral Channel

Gareth Anderson[*†] Saleem Bahaj[†] Matthieu Chavaz[†]
Angus Foulis[†] Gabor Pinter[†]

October 24, 2018

Abstract

This paper shows that lending relationships insulate corporate investment from fluctuations in collateral values. We construct a novel database covering the banking relationships of private and public UK firms and their individual directors. The sensitivity of corporate investment to changes in real estate collateral values is halved when the relationship between a bank and a firm or its board of directors increases by 11 years. The importance of long bank-firm relationships diminishes when directors have personal mortgage relationships with their firm's lender. Our findings support theories where collateral and private information are substitutes in mitigating credit frictions over the cycle.

JEL Codes: E22; E32; G32.

[*]International Monetary Fund

[†]Bank of England. Contact author: matthieu.chavaz@bankofengland.co.uk. We thank Sumit Agarwal, Allen Berger, Steve Bond, Hans Degryse, Olivier De Jonghe, Raj Iyer, Farzad Saidi, Rhiannon Sowerbutts, Hirofumi Uchida, Greg Udell, as well as participants at Bank of England, Chicago Financial Institutions conference, CREDIT Venice 2018 conference, Econometric Society winter meeting, and Royal Economic Society meetings for useful comments. The views expressed in this paper are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management, nor those of the Bank of England, the MPC, the FPC or the PRC.

1 Introduction

Corporate investment is known to respond strongly to cyclical swings in firms' collateral values. This *collateral channel* is a key source of business cycle amplification.[1]

At first sight, this evidence is consistent with a range of models where collateral is an important determinant of firms' borrowing capacity (Bernanke, Gertler, and Gilchrist, 1996). In these theories, however, collateral is mainly relevant for investment due to information asymmetries between firms and their creditors.[2] This suggests that corporate investment over the cycle should not depend mechanically on collateral price fluctuations, but also on the interaction of these fluctuations with information issues.

This paper tests this idea by assembling a dataset that contains both information on firms' investment and collateral holdings, as well as proxies for the degree of information asymmetries between firms and their lenders. We use both a well-known proxy - the length of relationships between lenders and firms - and novel ones - the length of the corporate and mortgage relationship between lenders and the *individuals* running these firms.

Our key question is: do longer lending relationships amplify or moderate the collateral channel? Existing theories provide two competing hypotheses. Strong relationships can mitigate the collateral channel if they reduce information asymmetries and thus lenders' demand for collateral (Holmstrom and Tirole, 1997; Boot, 2000). But strong relationships can also amplify this channel if private information allows lenders to better monitor the value

[1] See Gan (2007); Chaney, Sraer, and Thesmar (2012); Liu, Wang, and Zha (2013); Cvijanovic (2014); Kleiner (2015); Ersahin and Irani (2015); Bahaj, Foulis, and Pinter (2018).

[2] Information asymmetries can arise from different issues depending on models, such as moral hazard (Holmstrom and Tirole, 1997), adverse selection (Stiglitz and Weiss, 1981), or a bankruptcy cost arising from the need to verify debtors' cash flows (Townsend, 1979). But a common prediction across these theories is that a firm's external finance premium and thus investment level depends on the value of its collateral (Bernanke, Gertler, and Gilchrist, 1996).

of collateral (Rajan and Winton, 1995), or if private information allows borrowers to obtain more credit for a given collateral value (Kiyotaki and Moore, 1997). Testing these ideas is key at a time where the relationship lending model is increasingly disrupted by technology and other forces.

Our results provide support for the first hypothesis: longer lending relationships between a firm (or its board or directors) and its bank insulate corporate investment from the collateral channel during both boom and bust periods.

These results are novel in three respects. First, lending relationships are known to support firms' investment during downturns. But the role of collateral in that context, and the implications of this mechanism for firms' investment flexibility outside of crises are unclear.[3]

Second, our results shed new light on the inconclusive evidence for the excess sensitivity of small and young firms to aggregate shocks.[4] These papers often use size or age to proxy for the information frictions that also motivate our study. By contrast, our data allow us to separate the role of information asymmetries from that of size and age. A corollary of our findings is that small and young firms are not inherently more exposed to aggregate fluctuations; the former can circumvent cyclical financial constraints by maintaining strong lending relationships, and the latter by possibly borrowing from a bank that knows the firm's directors in their private mortgagor capacity.

[3] Jimenez, Ongena, Peydro, and Saurina (2012); Sette and Gobbi (2015); DeYoung, Gron, Torna, and Winton (2015); Bolton, Freixas, and Gambacorta (2016); Banerjee, Gambacorta, and Sette (2017); Beck, Degryse, De Haas, and Van Horen (2018). The use of collateral is known to be correlated with information issues in cross-sections of firms (Jimenez, Salas, and Saurina, 2006; Berger, Frame, and Ioannidou, 2011; Degryse, Karapetyan, and Karmakar, 2017); yet the implications of this link for firms' investment have attracted less attention. The findings of this literature are inconclusive. For instance, Berger and Udell (1995) find that firms with long relationships post less collateral, while Ono and Uesugi (2009) and Cerqueiro, Ongena, and Roszbach (2016) find that bank monitoring increases with corporate collateral usage and value.

[4] See Moscarini and Postel-Vinay (2012); Kudlyak and Sanchez (2017) and Crouzet, Mehrotra, et al. (2017) for aggregate shocks. See Adelino, Schoar, and Severino (2015) and Adelino, Ma, and Robinson (2017) for house price shocks.

Finally, we are the first to show that firms' financial constraints are affected by personal mortgage relationships between a firm's lender and its individual directors. This adds to recent evidence that these constraints are influenced by interpersonal relationships between executives and banks, as well as by changes in the value of firm directors' houses.[5]

Our constructed panel dataset covers UK firms between 2002 and 2013 and has several useful features. First, our sample covers both private and publicly listed firms, allowing us to test whether the impact of lending relationships on the collateral channel varies across firm types: as one would expect, we find that lending relationships only dampen the collateral channel for private firms, where information asymmetries are likely to be greater. Second, we are able to match information on a firm's creditors with regulatory banking data, allowing us to not only measure the length of lending relationships but also control for how bank characteristics affect the collateral channel. Third, the dataset also contains detailed information on *company directors,* which we match with administrative data on household mortgage data. This matched dataset allows us to explore the importance of relationships between banks and the individuals running the firms, both in their professional capacity, and through their personal mortgages.

Our main test examines how the length of a firm's lending relationship affects the sensitivity of its investment to changes in the value of its real estate collateral. We focus on the firm's real estate collateral; real estate serves as security for 80% of bank loans to UK firms, providing a clear source of collateral to focus upon (Bahaj, Foulis, and Pinter, 2018). Moreover, there is significant regional variation in the real estate price dynamics in the UK over this period. Our strategy to identify changes in collateral values exogenous to individ-

[5] Karolyi (2018); Bahaj, Foulis, and Pinter (2018).

ual firms follows Benmelech and Bergman (2009) and Chaney, Sraer, and Thesmar (2012). Specifically, we measure firms' exposure to collateral values by interacting the value of a firm's real estate at the start of the sample with yearly changes in regional real estate prices across 204 local authorities in England, Wales, and Scotland, that are plausibly exogenous to the behaviour of an individual firm. As a robustness check we instrument for regional real estate prices by interacting aggregate mortgage rates with geographical constraints on housing supply, similar to the approach followed in the US using the measures of Saiz (2010).

We then interact this collateral measure with relationship length to test the conflicting hypotheses outlined above. Consistent with Chaney, Sraer, and Thesmar (2012), we find that increasing collateral values are associated with higher corporate investment: a £1 increase in the value of corporate collateral increases investment by around £0.04 on average. However, this effect is materially reduced for firms with longer lending relationships: this sensitivity falls from £0.048 for a firm at the 25th percentile of relationship length (4 years) to £0.025 for a firm at the 75th percentile of relationship length (15 years). More generally, a doubling of the relationship length reduces the strength of the collateral channel by £0.02.

This finding is consistent with lending relationships insulating corporate investment from the effect of collateral values on borrowing constraints, as predicted by models where collateral and private information are substitutes (Holmstrom and Tirole, 1997; Boot, 2000). It suggests that lending relationships can serve as "insurance" against collateral value changes, with more muted investment dynamics during booms being compensated by greater borrowing flexibility in busts.

However, our main result could also be consistent with alternative mechanisms. In particular, a key challenge is that, while the collateral price fluctuations we rely on for identification should be plausibly exogenous to individual firms, relationship length might be correlated with a range of factors that might also affect the sensitivity of corporate investment to house prices. We explore three such mechanisms.

First, relationship length results partly from a choice by firms, and might thus be correlated with a number of firm characteristics. In turn, firm characteristics such as size (Adelino, Schoar, and Severino, 2015), age (Adelino, Ma, and Robinson, 2017) or credit rating (Boot, Thakor, and Udell, 1991) could affect the responsiveness of investment to collateral values. We find that controlling for these factors and their interaction with collateral values does not change our results; the effect of lending relationships that we document thus seems independent from these mechanisms.

Second, relationship length is also bound to partly reflect a choice by banks, and thus could be correlated with endogenous bank characteristics relevant for a given bank's ability or inclination to lend over time. For instance, house price fluctuations could alter banks' balance sheet strength and lending capacity (Gan, 2007; Flannery and Lin, 2016). Alternatively, house price changes might result in part from changes in bank credit supply (Favara and Imbs, 2015); therefore our results could reflect a change in bank lending standards, not one in collateral values. Since our dataset reports the identity of both firms and their lenders, we can mitigate these channels in a mechanical way by introducing bank-year or bank-region-year fixed effects. This does not change our results, suggesting that changes in banks' borrowing capacity or lending standards are unlikely to explain our findings. Controlling for the interaction of collateral values and lender characteristics does not affect our conclusions either. This insensitivity might partly reflect the fact that 94.1% of single-bank relationships in our sample are with the "big-five" UK banks, and that these banks have similar domestic scale, branch presence and business models. The concentration and homogeneity of the UK domestically-oriented banking system also means that endogenous sorting between banks and firms is less likely to be a concern than, for instance, in the US (Schwert, 2018).

Finally, real estate price changes could affect corporate investment through local demand-side channels, such as local investment opportunities (Giroud and Mueller, 2016) or agglomeration effects (Dougal, Parsons, and Titman, 2015). That these channels should affect firms differently depending on their relationship length is perhaps less clear at first sight. At a stretch, however, firms expecting low collateral values to coincide with high demand for their products or services in the future might be more likely to maintain long-term relationships. Our regressions mitigate such demand-side channels by including region-year fixed effects. We also show that our key result remains similar when concentrating on manufacturing firms, which are likely to export their products out of their headquarter region. In doing so, we eliminate firms in the non-tradable sector whose demand is likely to be more affected by local economic conditions (Mian and Sufi, 2014; Adelino, Schoar, and Severino, 2015). Finally, our results remain similar when controlling for the interaction of relationship length and a measure of local house prices that does not account for firms' collateral holdings; this contradicts the idea that our main finding is explained by house-price driven demand effects.

In addition to these tests, we document two results consistent with our interpretation, and harder to explain based on alternative mechanisms. First, we run the baseline regression using short-term and long-term corporate borrowing as the dependent variable. We find that lending relationships only mitigate the response of long-term borrowing to changes in collateral values; this is consistent with the idea that long-term debt confronts lenders with more acute information frictions than short-term debt (Flannery, 1986). Second, we show that lending relationships only significantly mitigate the collateral channel for private firms. This is consistent with the notion that publicly listed firms either circumvent bank lending and collateral constraints by borrowing from capital markets or face smaller informational constraints (Brav, 2009).

Finally, we utilise the information reported on company directors in our dataset to further explore the mechanism. Directors control firms' management and strategic decisions and private information about the skills and conduct of individuals within firms might thus provide lenders with a better view of a firm's riskiness (Karolyi, 2018). Lenders can learn about the individuals running companies in two different ways. First, lenders can learn about directors in their *professional* capacity. Consistent with this idea, we find that long relationships between a bank and a firm's current set of directors mitigates the sensitivity of corporate investment to collateral value changes in a similar way to long relationships with the firm itself. In fact, the effect of relationships with directors can dominate the effect of relationships with firms in some specifications.

Second, lenders can also learn about directors through their *personal* borrowing behaviour. To explore this idea we match the corporate data to a database of all UK mortgages to identify which lender provides the mortgage on a given director's home. We find that the collateral channel is not as sensitive to the length of a firm's banking relationship when the director has their personal residential mortgage with the same bank as the firm. One interpretation for this result is that the information obtained by observing a director's personal mortgage behaviour might substitute for that obtained through a long relationship. with this director's firm.

Overall, our results highlight significant distributional effects of real estate price fluctuations across firms. To put our findings into a macroeconomic context, consider the following. In 2013, the total value of corporate collateral was about 17% of UK GDP and business investment was 9% of GDP (£302bn and £149bn respectively).[6] For a firm at the 25th percentile of relationship length in our sample (4 years), the sensitivity of investment to a £1 increase in collateral is £0.048. If all firms in the economy behaved this way, a back-of-the-envelope calculation implies that a 1% increase in real estate prices increases investment by 0.10%.[7] In contrast, if all firms in the economy behaved as if their relationship length was in line with the 75th percentile in our sample (15 years), this elasticity would fall in half to 0.05%, significantly dampening the collateral channel.

2 Testable Hypotheses and Empirical Strategy

Financial intermediation theory offers conflicting predictions about the interaction between lending relationships and the collateral channel.[8]

A first strand of theories suggests that relationships and collateral play a similar role in overcoming adverse selection and moral hazard issues in debt contracts. Relationships mitigate the adverse selection problem to the extent that they provide lenders with private information about a borrower's default risk (Boot, 2000); relationships also reduce moral hazard by reducing monitoring costs after a loan is granted. Similarly, collateral helps lenders to

[6]Here, collateral is defined as the value of owner occupied real estate owned by non-financial corporations, and business investment is investment of private non-financial corporations.

[7]To see this, a 1% increase in real estate prices increases the value of corporate collateral by £3.02bn. Using the 0.048 estimated sensitivity generates a £145mn increase in investment, or 0.10%.

[8]Collateral and banking relationships can affect corporate investment under three conditions. Firstly, firms' cash inflows should not suffice to cover profitable investment opportunities, thereby giving the firm a reason to seek external finance (Froot, Scharfstein, and Stein, 1993). Secondly, the firm should face frictions in accessing external finance. Thirdly, collateral and/or banking relationships should act to reduce these frictions (Holmstrom and Tirole, 1997).

screen otherwise similar prospective borrowers *ex ante* (Bester, 1985; Besanko and Thakor, 1987), and monitor borrowers *ex post* (Boot, Thakor, and Udell, 1991).

If they are a substitute for collateral, stronger banking relationships might dampen the link between firm collateral and firm investment. For example, lenders can require less (more) collateral from firms they are able to monitor more (less) intensively (Holmstrom and Tirole, 1997; Manove, Padilla, and Pagano, 2001). Alternatively, lenders might be willing to abstract from crisis-time drops in the collateral value of firms with which they have ongoing, profitable relationships (Sette and Gobbi, 2015; Bolton, Freixas, and Gambacorta, 2016; Jiangli, Unal, and Yom, 2008). In return for this bad-time "insurance" lenders may be less willing to extend more credit when collateral values rise during booms.

Another hypothesis is that collateral and banking relationships are complements, in which case stronger relationships could amplify the link between collateral and investment. For instance, collateral could increase lenders' incentive to monitor borrowers (Rajan and Winton, 1995), or the cost of doing so. Alternatively, collateral might help to reduce lenders' inclination to extract rents from ("hold up") firms with which they have long-standing relationships (Sharpe, 1990; Rajan, 1992; Xu, Wang, and Rixtel, 2015).

2.1 Empirical Strategy

Given these conflicting theories, this paper tests how lending relationships affect the response of corporate investment to changes in real-estate collateral values. The baseline empirical specification is:

$$\begin{aligned} Investment_{i,t} &= \alpha_i + \chi_{j,t} + \mu_{b,t} + \phi \cdot Firm\, Controls_{i,t} \\ &+ \beta \cdot Collateral_{i,t} + \kappa \cdot Relationship\, Length_{i,t} \\ &+ \delta \cdot Collateral_{i,t} \times Relationship\, Length_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{2.1}$$

where:

$Investment_{i,t}$	is a proxy for the investment activity by firm i, located in region j and with relationships with a combination of banks indexed by b at time t
α_i	is a firm fixed effect
$\chi_{j,t}$	is a region-time fixed effect
$\mu_{b,t}$	is a bank combination-time fixed effect
$Firm\, Controls_{i,t}$	are various controls for firm i
$Collateral_{i,t}$	measures the value of real estate corporate collateral
$R'ship\, Length_{i,t}$	measures the average length of relationship between firm i and its bank(s) b

In Equation 2.1, the coefficient β measures the direct strength of the corporate collateral channel. The coefficient of interest δ measures the impact of *Relationship Length* on the collateral channel. A negative δ would imply that the collateral channel is weaker for firms that have longer relationships with their banks.

Identifying our key parameter requires plausibly exogenous variation in $Collateral_{i,t}$ or $Relationship\ Length_{i,t}$; we chose the former approach because of clues from existing research. Specifically, following Benmelech and Bergman (2009), we do not measure $Collateral_{i,t}$ using a firm's actual real-estate collateral holding. We do so because firms can chose the *quantity* of collateral they want to hold. In contrast, the *value* of this collateral is determined in part by local changes in real-estate prices that are beyond the control of an individual firm. We thus construct a proxy that exploits plausibly exogenous regional differences in the evolution of real estate prices. Within regions, we exploit differences in firm's initial holdings of collateral. Our measure is:

$$Collateral_{i,t} = Land\,and\,Buildings_{i,2002}\frac{Land\,Prices_{j,t}}{Land\,Price_{j,2002}} \times \frac{1}{Turnover_{i,t-1}}, \tag{2.2}$$

where *Land and Buildings*$_{i,2002}$ is the book value of land owned by the firm at the start of the sample (2002), and *Land Prices*$_{j,t}$ is the real estate price index for the region where a firm has its registered office; we scale our measure using the firm's lagged turnover.[9]

The fixed effects included in Equation 2.1 address three distinct issues with this identification. Firm fixed effects (α_i) capture unobserved, time-invariant characteristics that could determine both *Land and Buildings*$_{i,2002}$ and investment; region-time fixed effects ($\chi_{j,t}$) control for unobserved regional conditions that could affect both *Land Prices*$_{j,t}$ and investment through demand-side channels; finally, bank-combination-time fixed effects ($\mu_{b,t}$) control for the potential impact of real estate prices on banks' balance sheets and credit supply capacity (Gan, 2007).[10] In addition, our firm-level controls include known determinants of investment

[9] Following Chaney, Sraer, and Thesmar (2012), we could have used fixed assets instead of turnover as the scaling variable. However, unlike theirs our dataset is not limited to listed and relatively large companies, but includes a large number of small companies with potentially small amounts of fixed assets. Using turnover as scaling variable is therefore better suited to our sample, and avoids placing too much weight on smaller companies with small holdings of fixed assets. We select 2002 as our base year to preserve a sufficient number of observations. Therefore, a firm must have existed since 2002 to be included our sample. In comparison, Chaney, Sraer, and Thesmar (2012) consider only Compustat firms in existence since 1993.

[10] Fixed effects are based on the combination of banks a firm has a relationship with. For example, a firm which banks with "Bank A" and "Bank B" will have the same bank combination fixed effect as another firm which banks with "Bank A" and "Bank B". The fixed effect will differ from that of one bank firms which

such as firms' profit margin and cash ratio, and known correlates of collateral such as firm age and credit rating.

While this empirical strategy makes variations in $Collateral_{i,t}$ credibly exogenous to individual firms, the key identification challenge we face is that a number of omitted variables might determine both $Relationship\ Length_{i,t}$ *and* the response of a firm's investment to a given change in collateral values. Below, we discuss a number of potential channels, and we use a combination of additional controls, fixed effects, sub-sample analyses and instrumental-variable regressions to address them.

3 Data, Sample, and Summary Statistics

3.1 Data Sources

Corporates Our main source of information on UK companies is the Financial Analysis Made Easy (FAME) dataset, provided by Bureau van Dijk. FAME compiles the financial statements filed annually by all incorporated UK companies registered at Companies House. This registration is mandatory under UK company law. The dataset thus covers all UK firms except unincorporated businesses such as partnerships or sole proprietorships.

FAME reports data on a firm's balance sheet and income statements, directors' identities and addresses, lender identity for all secured borrowings, as well as the postcode of each firm's trading addresses, date of incorporation, and industrial sectors (four-digit SIC code). This allows us to identify the region(s) and sector within which a firm operates.

One limitation of FAME is that only large companies are required to report full balance

bank with just "Bank A" or just "Bank B" and from multi-bank firms which bank with, for example, "Bank A" and "Bank C".

sheet and profit and loss accounts (Evans and Ritchie, 2009). However, we show below that this does not distort the sample coverage in a systematic way. Furthermore, FAME is a live database; information on key variables such as company structure and director information is thus only accurate at the time the database is accessed. To mitigate this issue, we have used discs of the FAME database over time and have archived the database at six-monthly intervals over the January 2005 to August 2015 period to capture information when it is first reported. Using this database, we can start our panel in 2002.[11]

Banks We retrieve accounting data for banks from the Bank of England's Historical Banking Regulatory Database (HBRD). The HBRD reports financial statements and confidential regulatory information for all authorised UK banks and building societies (de Ramon, Francis, and Milonas, 2017). We use the consolidated (group) level version of the data.

Real Estate Prices To proxy for collateral values, we use monthly regional repeat-sales real estate price data reported by the Land Registries for 204 regions in England, Wales, and Scotland. We match this data to individual companies using the firm's registered office postcode reported in FAME. The variation in the evolution of real estate prices over our sample is substantial; the total change in real estate price between the start and end of our sample ranges from 21% (Swindon) to 276% (Kensington and Chelsea).

3.2 Construction of Variables

Table 1 reports the detailed definitions of the variables.

[11] See Bahaj, Foulis, and Pinter (2018) for more details. Financial statements collected in FAME might not be audited for firms with turnover below £1 million (Brav, 2009) - around 55% of observations in our sample. The fact that our estimate for the collateral channel is similar to the one found for US listed firms by Chaney, Sraer, and Thesmar (2012) suggests that this issue is unlikely to bias the results in a systematic way. Further, our results are robust to excluding firms with turnover below £1 million.

Corporate Investment and Controls Our preferred measure of investment is :

$$Investment_{i,t} = \frac{\triangle Fixed\, Assets_{i,t} + Depreciation_{i,t}}{Turnover_{i,t-1}}.$$

We compute the following firm controls: $Cash_{i,t}$ ($\frac{BankDeposits_{i,t} - Overdrafts_{i,t}}{Turnover_{i,t-1}}$), $Profit_{i,t}$ ($\frac{OperatingProfit_{i,t}}{Turnover_{i,t-1}}$), $Age_{i,t}$ (log number of months since incorporation), $Size_{i,t}$ (log total assets), and $Credit\, Score_{i,t}$. To measure credit ratings, we use the "Quiscore" reported in the FAME dataset. The Quiscore is produced by CRIF Decision Solutions Limited and is designed to reflect the likelihood that the company will fail in the following 12 months. Each firm is assigned a value between 0 and 100, with a larger value indicating a lower probability of failure.[12] To avoid outliers, $Investment_{i,t}$, $Cash_{i,t}$, and $Profit_{i,t}$ are winsorised at the 1st and 99th percentile.

Lending Relationships UK companies are required to report mortgages on their assets (hereafter "corporate mortgages") to Companies House within 21 days of their creation date. In particular, firms must provide the identify of the corporate mortgage's holder - typically a bank. We use this information to identify bank-firm relationships. We use a textual algorithm to match registered corporate mortgages to UK banks and building societies. The dataset reports the corporate mortgage creation date and whether the corporate mortgage is outstanding. For firms which have an outstanding corporate mortgage with a bank, we use the corporate mortgage creation date to measure:

$$Relationship\, Length_{i,t} = log\,(1 + Months_{i,t}), \tag{3.1}$$

[12]The scores can be categorised into five bands: 0-20 ("high risk"), 21-40 ("caution"), 41-60 ("normal"), 61-80 ("stable") and 81-100 ("secure"). The Quiscore is produced using a proprietary model which considers a range of factors including the financial performance of the firm, the economic conditions the firm faces and the firm's compliance with audit procedures (see Bo, Lensink, and Murinde (2008) for more details).

where $Months_{i,t}$ is the number of months at time t since a corporate mortgage was first created between firm i and bank(s) b.[13] For firms with outstanding corporate mortgages with more than one bank at a given point in time, we average $Relationship\,Length_{i,t}$ for all of a firm's outstanding banking relationships. In Section 5, we discuss alternative measures based on the duration of the relationship between the bank and the firm's group of directors, as well as that of the mortgage relationship between a bank and a director.[14]

Bank Controls In selected specifications, we control for the following bank characteristics: $Bank\,Size_{b,t}$ (log total assets), $Bank\,Losses_{b,t}$ $(\frac{NetCharge-Offs_{b,t}}{TotalAssets_{b,t}})$ and $Bank\,Leverage_{b,t}$ $(\frac{Tier1Capital_{b,t}}{TotalAssets_{b,t}})$.

3.3 Sample and Summary Statistics

Our sample includes all private and public UK companies which report to Companies House between 2002 and 2013. Following Chaney, Sraer, and Thesmar (2012) and Kleiner (2015), we exclude firms in idiosyncratic sectors.[15] To avoid double counting, we exclude companies that have a parent with an ownership stake exceeding 50%. We further drop firms without any outstanding banking relationships, or which do not report our key variables. This screening excludes a substantial number of observations from the original FAME data (Panel A in Table 2). While *Total Assets* and *Fixed Assets* are reported in 96% and 85% of observations,

[13]The archiving of FAME discs at a six-monthly frequency does not affect the accuracy of our relationship length measure. Since firms must report the date on which corporate mortgages are created, we can accurately calculate the length of the relationship as the difference between the corporate mortgage creation date and the statement date of their accounts.

[14]The literature has used proxies for relationship intensity other than duration, such as the number of past interactions or their size (Bharath, Dahiya, Saunders, and Srinivasan, 2009). Our data does not allow us to consider these alternatives.

[15]The UK 2003 SIC codes we exclude are: mining (1010-1450), utilities (4011-4100), construction (4511-4550), finance and insurance (6511-6720), real estate (7011-7032), and public administration (7511-7530).

respectively, *Land and Buildings* and *Turnover* are reported in 59% and 18% of observations only. Around 15% of firms report a banking relationship.

Our final sample contains 115,284 firm-year observations covering 27,572 firms (Panel B in Table 2). Almost 90% of these observations have outstanding relationships with just one bank (henceforth "single-bank firms"). Just over 10% of the observations have outstanding relationships with more than one bank ("multiple-bank firms"), a large majority of which have two relationships. The sample is representative of the UK economy despite these screenings. Table 3 shows the distribution of employment across our selected industries in (i) the overall FAME dataset, (ii) our final dataset, and (iii) aggregate UK employment statistics from the Office for National Statistics (ONS). Overall, the distribution of employment across industries in our final sample is similar to that of the other two datasets.[16]

Table 4 reports summary statistics for our final sample, for three different groups of firms sorted by their average lending relationship length.

4 Lending Relationships and the Collateral Channel

4.1 Baseline Results

Collateral Channel We begin by assessing the strength of the collateral channel - that is, the relationship between the value of a firm's collateral and its investment. Column 1 of Table 5 reports the results of a regression where we only control for $Collateral_{i,t}$ and our preferred set of fixed effects. The results suggest that a £1 increase in the value of collateral

[16] Relative to the aggregate data, the share of employment in education and health and social care is very small in our sample, since we focus on employment within UK companies. The share of employment in manufacturing is notably higher in our sample relative to the aggregate data.

increases investment by around £0.04. This finding is comparable to the evidence that US public firms increase investment by around \$0.06 in response to a \$1 increase in the value of collateral (Chaney, Sraer, and Thesmar, 2012).

In column 2, we add our preferred set of firm controls: $\textit{Relationship Length}_{i,t}$, $Cash_{i,t}$, $Profit_{i,t}$, $Age_{i,t}$, $\textit{Credit Rating}_{i,t}$, and $\textit{Total Assets}_{i,t}$, as well as the interactions of $Age_{i,2002}$, $Profit_{i,2002}$ and $\textit{Total Assets}_{i,2002}$ with $\textit{Land Prices}_{i,t}$. The interactions help control for omitted factors that govern how a firm responds to land prices beyond collateral values. These additional controls leave the estimate of the collateral channel unchanged.

Lending Relationships and the Collateral Channel In column 3 of Table 5, we test our preferred specification by including the interaction of $Collateral_{i,t}$ with $\textit{Relationship Length}_{i,t}$. For ease of comparison with columns 1 and 2, we measure $\textit{Relationship Length}_{i,t}$ in deviation from its sample average. Therefore the coefficient on $Collateral_{i,t}$ (β in Equation 2.1) estimated in this specification captures the magnitude of the collateral channel for a firm with $\textit{Relationship Length}_{i,t}$ equal to the sample mean.

The estimated coefficient on $Collateral_{i,t} \times \textit{Relationship Length}_{i,t}$ suggests that longer banking relationships are associated with a significantly weaker collateral channel. Specifically, the estimated coefficient (δ in Equation 2.1) suggests that a doubling in relationship length reduces the strength of the collateral channel by half (around £0.02).[17] To provide some context to these results, a firm with a relationship length equal to the 75th percentile (15.4 years) increases investment by around 50% less than a firm in the 25th percentile (4.2 years) in response to a similar collateral value change. This result suggests that longer relationships insulate firms from the impact of fluctuations in collateral values on their in-

[17] *Relationship Length* is measured in natural logarithms, as described in Equation 3.1.

vestment behaviour.

Private vs. Public Firms Our preferred interpretation of the key result above is that collateral and private information perform a similar role of mitigating contracting frictions over the cycle (Holmstrom and Tirole, 1997). Therefore, longer lending relationships can compensate for lower collateral values, and vice-versa. If this interpretation is correct, the mechanism whereby lending relationships insulate investment from collateral value changes should be stronger for firms for which private information is more relevant. To test this notion, we compare public and private firms. Since publicly listed firms are required to disclose more information, they are typically less susceptible to information asymmetries associated with bank lending contracts. In addition, public firms can more readily access market-based funding, and can thus circumvent frictions in access to bank finance (Michaely and Roberts, 2011).

In columns 4-5 of Table 5, we report the results of the baseline regression run separately for private and public firms. Consistent with our prior, the interaction of relationship length and collateral is only statistically significant for private firms. This reinforces our preferred interpretation of the key result: since private information matters less for transparent firms, long relationships play a less obvious role in insulating investment from the collateral channel for public firms. In contrast, the heterogeneity between public and private firms would be harder to explain by alternative mechanisms such as the effect of house prices on the demand for firms' products. We further investigate such demand-side explanations below.

Corporate Borrowing Our preferred interpretation of the key result is that long lending relationships insulate firms from the effect of collateral values on their ability or willingness to borrow from banks. If this interpretation holds, the interaction of lending relationships should not only affect firm investment (as our baseline regression shows) but also their borrowing.

To test this idea, we re-estimate our baseline model using the change in long-term and short-term debt as dependent variables. We separate these two types of borrowing because long-term loans cannot be renegotiated regularly and hence are typically thought to confront lenders with more acute information issues (Flannery, 1986).

The results are consistent with this prior. The coefficient for $Collateral_{i,t}$ suggests that firms lower (increase) their long-term and short-term borrowing when the value of their collateral declines (rises) (columns 6-7 in Table 5). In turn, the parameter estimate for $Collateral_{i,t} \times Relationship\ Length_{i,t}$ shows that longer relationships insulate long-term borrowing from this effect (column 7). However, consistent with the idea that short-term debt presents smaller information issues, this effect is not significant for short-term borrowing (column 6). This finding reinforces our interpretation. In contrast, it seems harder to explain by alternative mechanisms such as changes in the demand for firm products.

Crisis vs. Normal Times Several studies have found that lending relationships insulated corporate investment during the recent financial crisis.[18] Our key result is distinct from these findings because it focuses on the specific role of fluctuations in collateral values, as opposed to that of economic downturns. However, one important question is whether our main finding is driven by crisis-time effects only, or whether it operates throughout the cycle. To find out, we repeat the main regression for (i) the 2007-2010 period and (ii) all other years. We do so

[18] Jimenez, Ongena, Peydro, and Saurina (2012); Sette and Gobbi (2015); DeYoung, Gron, Torna, and Winton (2015); Bolton, Freixas, and Gambacorta (2016); Banerjee, Gambacorta, and Sette (2017); Beck, Degryse, De Haas, and Van Horen (2018).

because in the aggregate, UK house prices fell during the crisis period, and increased during other years.

The results indicate that our key finding is visible during both the crisis (column 8) and non-crisis (column 9) periods. In other words, longer relationships do not only insulate corporate investment from house price falls during aggregate downturns: they also limit the propensity for firms to boost investment during times of rising collateral prices. This symmetry is consistent with the theories that motivate our study and suggest that both positive and negative shocks to the balance sheets of firms subject to information frictions can give rise to a "financial accelerator" (Bernanke, Gertler, and Gilchrist, 1996). This effect points to lending relationships as a form of insurance, whereby firms are protected from negative shocks in exchange for more muted investment dynamics in "good" times.

4.2 Identification Issues

Our identification exploits plausibly exogenous variations in collateral values across regions and time. We then test how these fluctuations impact investment depending on a firm's lending relationship length at this time, as captured by the parameter on $\textit{Collateral}_{i,t} \times \textit{Relationship Length}_{i,t}$ (Section 2.1).

The key challenge we face is that a number of omitted variables might influence both $\textit{Relationship Length}_{i,t}$ *and* the sensitivity of a firm's investment to collateral value changes. We now discuss three such channels, before further strengthening the exogeneity of fluctuations in collateral values with an instrumental variable approach.

4.2.1 Firm Characteristics

Relationship $Length_{i,t}$ might correlate with a number of firm characteristics that could affect a firm's ability or willingness to invest over time, for instance its age, size, or credit rating. These characteristics are controlled for in our baseline set-up, but their interactions with $Collateral_{i,t}$ and *Relationship* $Length_{i,t}$ are not.

If these factors drive our results, adding these interactions should make our key parameter $Collateral_{i,t}$ × *Relationship* $Length_{i,t}$ insignificant. We test this idea in Table 6 (column 1 reproduces our baseline specification for ease of comparison). The results in columns 2 to 4 indicate that adding interactions between $Collateral_{i,t}$, *Relationship* $Length_{i,t}$ and firm size, age, and credit rating do not affect our key conclusion.

4.2.2 Relationship Breaks

Banks may break relationships with firms based on factors that might be imperfectly controlled for in our regressions, for instance firms' expected benefits or investment opportunities; in turn, these factors might also govern the response of a firm's investment to collateral values. To check if relationship breaks explain the results, we lag *Relationship* $Length_{i,t}$ by two years. The results in column 2 of Table 7 are qualitatively unchanged from the baseline specification.

4.2.3 Bank Lending Capacity and Standards

Relationship $Length_{i,t}$ might also be correlated with characteristics of banks or of the bank-firm pair (Schwert, 2018), and these characteristics might also affect corporate investment. This endogeneity of the firm-bank matching is arguably less problematic in our context than in the US given the concentration and homogeneity of the UK market for corporate lending. In our sample, 94.1% of single-bank lending relationships are with one of "Big-5" banks. Still, one concern is that changes in house prices might coincide with changes in banks' lending capacity (Flannery and Lin, 2016), and with changes in their lending standards (Favara and Imbs, 2015).

We test these ideas in two main ways. First, we separately add interactions between $\textit{Collateral}_{i,t}$ and $\textit{Relationship Length}_{i,t}$ and controls for the bank's: size, leverage, and non-performing loans.[19] The results in columns 5 to 7 of Table 6 show that none of these additional controls change our main result. This suggests that our results are unlikely to be explained by changes in a bank's UK-wide lending capacity or standards over time.

However, this need not be the case if banks' lending capacity or underwriting standards changes differently across regions depending on local changes in real estate prices. In addition, regional disparities in house price developments might result in part from changes in *regional-specific* bank lending standards (Favara and Imbs, 2015). To test whether this explains our results, we run our baseline regression using bank-region-year fixed effects. These dummies capture shocks common to firms in a same region, time period, and lender, thus evacuating changes in a bank's credit supply in different region and periods. The results in column 3 of Table 7 are qualitatively unchanged from the baseline specification.

4.2.4 Local Demand

Firm investment could be affected by house prices regardless of whether firms own commercial property, for instance because higher real estate prices might increase the demand for a firm's

[19] Following the approach taken to measure $\textit{Relationship Length}_{i,t}$ for multiple-bank firms, we average $\textit{Bank Size}_{b,t}$, $\textit{Bank Leverage}_{b,t}$ and $\textit{Bank Losses}_{b,t}$ across all the relationships of a given bank and year. We also demean all of the variables which we interact with $\textit{Collateral}_{i,t}$.

products or services. In our baseline regression, this channel is controlled for through region-time fixed effects. So, if anything, local demand-side factors can only explain our results if house price fluctuations affect corporate investment in a way that is systematically correlated with *Relationship* $Length_{i,t}$.

First, in column 8 of Table 6, we directly test for this possibility by controlling for the interaction between *Land* $Prices_{j,t}$ and *Relationship* $Length_{i,t}$. This leaves key coefficients unchanged. Second, we re-estimate our baseline model using only firms which operate in the manufacturing sector. Since these firms are likely to produce tradable goods, they are likely to be relatively insensitive to local demand conditions (Adelino, Schoar, and Severino, 2015). The key results remain unchanged (column 4 in Table 7).

4.2.5 Instrumental Variable Approach

Next, we seek to instrument real estate prices with a variable plausibly uncorrelated with the unobserved error term $\varepsilon_{i,t}$. In addition to providing further reassurance against the omitted variable concerns above, this approach mitigates a possible reverse causality issue whereby investment behaviour by large companies in a region affects real estate prices in that region.[20] It does so by exploiting variation in house prices which is credibly exogenous to firm behaviour and local economic activity.

We adapt the approach of Saiz (2010) to our sample; specifically, we instrument for real estate prices in region j by interacting a measure of mortgage demand with a measure of geographic constraints on the supply of housing in region j. Our preferred measure of mortgage demand is the change in the interest rate on the most common UK mortgage

[20] Arguably the problem of reverse causality is likely to be less severe for our sample, which is dominated by relatively small firms, compared to studies focused on larger firms.

product - a two-year 75% Loan-To-Value loan - as collected by the Bank of England. We use a measure of local housing supply constraints constructed by Hilber and Vermeulen (2016), which considers the share of developable land that was developed by 1990. For regions with a more inelastic supply of housing, a given shift in demand should have a larger impact on real estate prices.

We estimate the following equation at monthly frequency between January 1995 and January 2016:

$$Land\,Prices_{j,t} = \chi_j + \mu_t + b \times Housing\,Constraints_{j,1990} \times Mortgage\,Rate_t + \epsilon_{j,t}, \quad (4.1)$$

where:

χ_j	is a region fixed effect
μ_t	is a month fixed effect
$Hous.\,Constr._{j,1990}$	is the share of developable land in region j in 1990
$Mortgage\,Rate$	is the UK average rate on a 2-year 75%-LTV mortgage during month t
$\epsilon_{j,t}$	is an unobserved error term.

As expected the result in column 1 in Panel A of Table 8 suggests that a given increase in mortgage rates is associated with stronger house prices fall in regions where constraints on housing supply are tighter. We then use the estimate for the parameter b in Equation 4.1 to compute a measure of predicted land prices in a given region-month. We then interact this proxy with a firm's initial collateral holding to produce a *Predicted Collateral* measure, following the measurement of our baseline variable (Equation 2.2). Finally, we use this measure and its interaction with *Relationship Length* to instrument for *Collateral* and *Collateral* × *Relationship Length*, respectively.

The results of the first-stage and second-stage IV regressions are shown in columns 1-2 and 3 of Panel B of Table 8, respectively. The estimated coefficient on the interaction of $Collateral_{i,t}$ with $Relationship\ Length_{i,t}$ is significant and quantitatively similar to that obtained in the OLS regression. As shown at the bottom of the Table, we obtain a Kleibergen-Paap statistic of 25.05; this suggests that our instruments are not weak.

4.3 Robustness

Variable Definitions We now perturb our key measures. First, because we fix the value of $Land\ and\ Buildings_{i,2002}$ in 2002, firms must be active in 2002 to be included in our sample. To check whether this biases our results, we fix *Land and Buildings* at $t-5$ instead, and iterate this measure forward using changes in the regional real estate prices between time $t-5$ and t to calculate $Collateral_{i,t}$. The results, presented in column 5 of Table 7 show that our key finding remains qualitatively unchanged.

Second, we re-estimate $Collateral_{i,t}$ using Commercial Real Estate (CRE) prices from the Investment Property Databank. Unlike the local authority-level residential house prices used in our baseline measure, CRE prices are only available for major UK cities. Despite the smaller sample, the results in column 6 of Table 7 remain comparable to our baseline findings.

Finally, we consider different definitions of our dependent variable. Column 7 excludes depreciation from our measure of $Investment_{i,t}$, and column 8 uses investment in tangibles only. The interaction of collateral and relationship length is significant using both of these alternative measures.

Sample of Firms Our measure of *Collateral* uses house prices in the region where a firm has its registered office. In Column 1 of Table 9, we exclude firms with multiple trading addresses; our results are unchanged. Next, we exclude firms likely to be internationally active, and for which we might thus mismeasure investment, collateral holdings, and lending relationships.[21] Our key result is unchanged (column 2 of Table 9). Finally, to assess the possibility of biases in unaudited data, we exclude all firms that might have audited accounts - those with annual turnover below £1 million. The results reported in column 3 remain similar.

5 Relationships with Firm Directors

In line with previous literature (Petersen and Rajan, 1994), our focus thus far has been on the length of the relationship between a firm and its bank. However, interpersonal relationships between a bank and a firm's director(s) might also help to mitigate information issues. And as discussed in the introduction, lenders can learn about the individuals running firms in both a professional or personal capacity.

Our dataset has two key features in this context. First, FAME reports detailed information on the directors of a company - that is, the individual(s) who have a statutory obligation to run and contribute to the success of the company. FAME contains information on the identity of directors, including their full name and date of birth; their address and full postcode; and their appointment history at the firm, including date of appointment and resignation, allowing us to measure the length of time they have served at the firm. Second,

[21] We identify UK-focused firms as those whose total turnover equals their UK turnover. Since some firms do not report this variable, we are unable to identify all UK focused firms using this approach.

we utilise the Financial Conduct Authority's (FCA) administrative Product Sales Database (PSD) which contains information on the universe of residential mortgage originations in the UK, including the identity of the originating bank.[22] As the PSD also includes the full postcode of the property and the date of birth of the mortgage recipient, we are able to match the two datasets to determine which bank each director has their home mortgage with.

5.1 Relationship with Board of Directors

First, we measure the length of the relationship between banks and the firm's current director(s). In the UK, each company must have at least one director. Directors' legal responsibilities involve "running the company and making sure company accounts and reports are properly prepared."[23] An extensive literature shows that directors play a key role for firms' business decisions and financial reporting. This is either because they monitor managers, or because they bring expertise and business connections to the firm (Fama and Jensen, 1983; Monks and Minow, 1996; Anderson, Mansi, and Reeb, 2004). A long-term relationship with the individual(s) running a firm could thus provide lenders with additional or even superior private information on the firm's riskiness, relative to a situation where the bank has known the firm for a long time but not its current directors (Karolyi, 2018).

To test this idea, we construct two variables using information on how long directors have served with the firm and the length of the firm-bank relationship. First, *Board Majority* is the length of the overlapping period during which the firm was in a relationship

[22]PSD includes regulated mortgage contracts only, and therefore excludes other regulated home finance products such as home purchase plans and home reversions, and unregulated products such as second lien lending and buy-to-let mortgages.

[23]www.gov.uk/limited-company-formation/appoint-directors-and-company-secretaries.

with its current lender *and* more than 50% of the firm's current directors were appointed. Second, *Board Longest* is the length of the overlapping period during which the firm was in a relationship with its current lender *and* the firm's longest-serving current director was appointed. We then add these variables to our baseline empirical model; Table 10 reports the results.[24]

In columns 1 and 3, we substitute the baseline *Relationship Length* measure with the two board relationship length proxies. The findings show that longer relationships with directors mitigate the collateral channel. The parameter estimates are similar to those we obtain in the baseline regression. Thus, relationships with directors seem to insulate corporate investment from collateral value changes to a similar degree as relationships with the firm itself. In columns 2 and 4, we include both the baseline and board relationship measures. For one of our two measures, we find that only *Board Relationship Length* × *Collateral* is significant. At face value, this is consistent with the notion that knowing about the individuals running a firm might be more important than knowing about the firm itself.

5.2 Personal Mortgage Relationships

We then consider the interplay between bank-firm (or bank-board) relationships and directors' personal mortgage relationships. Personal mortgage relationships are relevant to our key question because they might provide the bank with information about an individual running a firm and its personal repayment behaviour, and this information might help this

[24]Formally, *Board Majority* = log(1+min(*Relationship Length*,*Majority Board Appointed*)) and *Board Longest* = log(1+min(*Relationship Length*,*Longest-Serving Director Appointed*)), where *Relationship Length* is the length of lending relationship between the firm and the bank, in months; *Majority Board Appointed* is the number of months served by the firm's current director with the median tenure, and *Longest-Serving Director Appointed* is the number of months served by the firm's longest-serving current director.

bank to assess her firm's risk.[25]

A priori, it is unclear how personal mortgage relationships and firm relationships should interact. On the one hand, the information a bank can gain from observing repayment on a mortgage might appear more credible and easier to assess relative to the information coming from the accounts of a firm, given that a mortgage puts the director's personal property at risk (Voordeckers and Steijvers, 2006; Brick and Palia, 2007). Good information about a firm's directors in their private capacity might thus compensate for a lack of information on the firm itself. But instead, personal and corporate relationships could also provide different, complementary information to creditors. In this case, a common personal relationship might reinforce the effect of a lengthy corporate relationship.

We create three variables to confront these ideas: (i) *Common Personal Relationship Dummy* - 1 for firms with common bank-firm and bank-director relationships, and 0 otherwise; (ii) *%(Common Personal Relationships)* - the share of a firm's current directors with an ongoing mortgage relationship with the firm's bank; and (iii) *Length Common Personal Relationships* - the mean log of 1+number of common personal relationship months for firms with common bank-firm and bank-director relationships, and 0 for other firms.

Our main interest is in the interaction between these variables and *Collateral* × *Relationship Length*. This coefficient should be be positive if the additional information stemming from the director-bank relationship mitigates the role of the firm's lending relationship in insulating corporate investment from the collateral channel.

The results reported in Table 11 show that the interaction of *Collateral* × *Relationship*

[25]Owner-directors can also use their own house as collateral for their firm - particularly for SME loans (Avery, Bostic, and Samolyk, 1998; Voordeckers and Steijvers, 2006; Ono and Uesugi, 2009). But it is less clear that this channel should only operate if the mortgage is with the bank that also lends to the director's firm - the main focus of our tests.

Length and the three proxies for personal mortgage relationships are positive and statistically significant. This holds true both when measuring *Relationship Length* using the baseline (columns 1-3) and board (columns 4-6) relationship length measures. Our key mechanism whereby corporate lending relationships insulate investment from fluctuations in collateral values is thus weaker for firms whose directors also maintain personal relationships with their firm's banks.

This effect is economically substantial. For instance, the parameter estimate for $\textit{Relationship Length}_{i,t} \times \textit{Collateral}_{i,t}$ in Column 1 is similar to the one we obtained in the baseline regression; this estimate indicates that for a firm without a common personal mortgage relationship, a shorter lending relationship is associated with a substantially stronger collateral channel. In contrast, the parameter for the interaction of this term with $\textit{Common Personal Relationship Dummy}_{i,t}$ has a roughly similar magnitude but the opposite sign. This suggests that for a firm with a common personal mortgage relationship, the effect of a shorter lending relationship between the firm and the bank on the strength of the collateral channel is close to zero.

This result is consistent with the idea that personal information about the individual in charge of a firm might compensate for a relative lack of information on the firm per se. A possible implication of this is that a firm with a short lending relationship might still be better insulated from the collateral channel if its directors are known to the firm's lender in their personal mortgagor capacity.

6 Conclusion

This paper shows that the collateral channel diminishes in strength when firms and their executives maintain long-term relationships with a bank. Concretely, UK firms' investment is less responsive to changes in the value of their real estate collateral when their ongoing lending relationships are longer. This finding is consistent with seminal theories arguing that collateral and private information are two complementary ways to mitigate similar contracting frictions (Holmstrom and Tirole, 1997); it contradicts alternative models presenting collateral and private information as complements (Rajan, 1992).

The notion of self-reinforcing swings in asset prices and economic activity has led to calls for macroprudential policies aimed at curbing cycles in real estate prices, such as loan-to-value limits and counter-cyclical buffers. Our results suggest that the transmission of these interventions to corporate investment is likely to depend on the intensity of firms' lending relationships. Understanding how the nature of corporate borrowing might evolve in a context of sweeping technological and structural changes in banking and financial markets could help to inform policies aimed at taming future credit cycles.

References

Adelino, M., S. Ma, and D. Robinson (2017): "Firm Age, Investment Opportunities, and Job Creation," *Journal of Finance*, 72(3), 999–1038.

Adelino, M., A. Schoar, and F. Severino (2015): "House Prices, Collateral, and Self-Employment," *Journal of Financial Economics*, 117(2), 288–306.

Anderson, R. C., S. A. Mansi, and D. M. Reeb (2004): "Board characteristics, accounting report integrity, and the cost of debt," *Journal of accounting and economics*, 37(3), 315–342.

Avery, R. B., R. W. Bostic, and K. A. Samolyk (1998): "The role of personal wealth in small business finance," *Journal of Banking & Finance*, 22(6-8), 1019–1061.

Bahaj, S., A. Foulis, and G. Pinter (2018): "Home Values and Firm Behaviour," Discussion Papers 1607, Centre for Macroeconomics (CFM).

Banerjee, R., L. Gambacorta, and E. Sette (2017): "The real effects of relationship lending," *Unpublished*.

Beck, T., H. Degryse, R. De Haas, and N. Van Horen (2018): "When arm's length is too far: Relationship banking over the credit cycle," *Journal of Financial Economics*, 127(1), 174–196.

Benmelech, E., and N. K. Bergman (2009): "Collateral pricing," *Journal of financial Economics*, 91(3), 339–360.

Berger, A., and G. Udell (1995): "Relationship Lending and Lines of Credit in Small Firm Finance," *The Journal of Business*, 68(3), 351–81.

Berger, A. N., W. Frame, and V. Ioannidou (2011): "Tests of ex ante versus ex post theories of collateral using private and public information," *Journal of Financial Economics*, 100(1), 85–97.

Bernanke, B., M. Gertler, and S. Gilchrist (1996): "The Financial Accelerator and the Flight to Quality," *The Review of Economics and Statistics*, pp. 1–15.

Besanko, D., and A. Thakor (1987): "Collateral and Rationing: Sorting Equilibria in Monopolistic and Competitive Credit Markets," *International Economic Review*, 28(3), 671–89.

Bester, H. (1985): "Screening vs. Rationing in Credit Markets with Imperfect Information," *American Economic Review*, 75(4), 850–55.

Bharath, S. T., S. Dahiya, A. Saunders, and A. Srinivasan (2009): "Lending relationships and loan contract terms," *The Review of Financial Studies*, 24(4), 1141–1203.

Bo, H., R. Lensink, and V. Murinde (2008): "Credit Ratings and Corporate Investment: UK Evidence," *SOAS Centre for Financial and Management Studies, Discussion Paper*, Discussion Paper 95.

Bolton, P., X. Freixas, and L. Gambacorta (2016): "Relationship and Transaction Lending in a Crisis*," *Review of Financial Studies*.

Boot, A. (2000): "Relationship Banking: What Do We Know?," *Journal of Financial Intermediation*, 9(1), 7–25.

Boot, A. W. A., A. V. Thakor, and G. F. Udell (1991): "Secured Lending and Default Risk: Equilibrium Analysis, Policy Implications and Empirical Results," *Economic Journal*, 101(406), 458–72.

Brav, O. (2009): "Access to capital, capital structure, and the funding of the firm," *The Journal of Finance*, 64(1), 263–308.

Brick, I. E., and D. Palia (2007): "Evidence of jointness in the terms of relationship lending," *Journal of Financial Intermediation*, 16(3), 452–476.

Cerqueiro, G., S. Ongena, and K. Roszbach (2016): "Collateral damage? On collateral, corporate financing and performance," Working Paper Series 1918, European Central Bank.

Chaney, T., D. Sraer, and D. Thesmar (2012): "The Collateral Channel: How Real Estate Shocks Affect Corporate Investment," *American Economic Review*, 102(6), 2381–2409.

Crouzet, N., N. R. Mehrotra, et al. (2017): "Small and Large Firms Over the Business Cycle," *Unpublished*.

Cvijanovic, D. (2014): "Real Estate Prices and Firm Capital Structure," *Review of Financial Studies*, 27(9), 2690–2735.

de Ramon, S., W. Francis, and K. Milonas (2017): "An overview of the UK banking sector since the Basel accord: insights from a new regulatory database," *Unpublished*.

Degryse, H., A. Karapetyan, and S. Karmakar (2017): "To Ask or Not To Ask? Collateral versus Screening in Lending Relationships," *Unpublished*.

DeYoung, R., A. Gron, G. Torna, and A. Winton (2015): "Risk overhang and loan portfolio decisions: small business loan supply before and during the financial crisis," *The Journal of Finance*, 70(6), 2451–2488.

Dougal, C., C. A. Parsons, and S. Titman (2015): "Urban Vibrancy and Corporate Growth," *The Journal of Finance*, 70(1), 163–210.

Ersahin, N., and R. M. Irani (2015): "Collateral Values and Corporate Employment," Working Papers 15-30, Center for Economic Studies, U.S. Census Bureau.

Evans, P., and F. Ritchie (2009): "UK company statistics reconciliation project," *Department for Business, Enterprise and Regulatory Reform*.

Fama, E. F., and M. C. Jensen (1983): "Separation of ownership and control," *The journal of law and Economics*, 26(2), 301–325.

Favara, G., and J. Imbs (2015): "Credit Supply and the Price of Housing," *American Economic Review*, 105(3), 958–92.

Flannery, M., and L. Lin (2016): "House prices, bank balance sheets, and bank credit supply," *Working Paper*.

Flannery, M. J. (1986): "Asymmetric information and risky debt maturity choice," *The Journal of Finance*, 41(1), 19–37.

Froot, K., D. Scharfstein, and J. Stein (1993): "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance*, 48(5), 1629–58.

Gan, J. (2007): "Collateral, debt capacity, and corporate investment: Evidence from a natural experiment," *Journal of Financial Economics*, 85(3), 709–734.

Giroud, X., and H. M. Mueller (2016): "Firm Leverage and Unemployment during the Great Recession," *Quarterly Journal of Economics*, (Forthcoming).

Hilber, C. A. L., and W. Vermeulen (2016): "The Impact of Supply Constraints on House Prices in England," *Economic Journal*, 126(591), 358–405.

Holmstrom, B., and J. Tirole (1997): "Financial Intermediation, Loanable Funds, and The Real Sector," *The Quarterly Journal of Economics*, 112(3), 663–691.

Jiangli, W., H. Unal, and C. Yom (2008): "Relationship Lending, Accounting Disclosure, and Credit Availability during the Asian Financial Crisis," *Journal of Money, Credit and Banking*, 40(1), 25–55.

Jimenez, G., S. Ongena, J.-L. Peydro, and J. Saurina (2012): "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications," *American Economic Review*, 102(5), 2301–26.

Jimenez, G., V. Salas, and J. Saurina (2006): "Determinants of collateral," *Journal of Financial Economics*, 81(2), 255–281.

Karolyi, S. A. (2018): "Personal lending relationships," *The Journal of Finance*, 73(1), 5–49.

Kiyotaki, N., and J. Moore (1997): "Credit Cycles," *Journal of Political Economy*, 105(2), 211–48.

Kleiner, K. (2015): "Collateral and Small Firm Labor," *Kelley School of Business Research*.

KUDLYAK, M., AND J. M. SANCHEZ (2017): “Revisiting the behavior of small and large firms during the 2008 financial crisis,” *Journal of Economic Dynamics and Control*, 77, 48–69.

LIU, Z., P. WANG, AND T. ZHA (2013): “Land-Price Dynamics and Macroeconomic Fluctuations,” *Econometrica*, 81(3), 1147–1184.

MANOVE, M., A. J. PADILLA, AND M. PAGANO (2001): “Collateral versus Project Screening: A Model of Lazy Banks,” *RAND Journal of Economics*, 32(4), 726–44.

MIAN, A., AND A. SUFI (2014): “What explains the 2007–2009 drop in employment?,” *Econometrica*, 82(6), 2197–2223.

MICHAELY, R., AND M. R. ROBERTS (2011): “Corporate dividend policies: Lessons from private firms,” *The Review of Financial Studies*, 25(3), 711–746.

MONKS, R. A., AND N. MINOW (1996): *Watching the watchers: Corporate governance for the 21st century*. Blackwell.

MOSCARINI, G., AND F. POSTEL-VINAY (2012): “The contribution of large and small employers to job creation in times of high and low unemployment,” *American Economic Review*, 102(6), 2509–39.

ONO, A., AND I. UESUGI (2009): “Role of Collateral and Personal Guarantees in Relationship Lending: Evidence from Japan’s SME Loan Market,” *Journal of Money, Credit and Banking*, 41(5), 935–960.

PETERSEN, M. A., AND R. G. RAJAN (1994): “ The Benefits of Lending Relationships: Evidence from Small Business Data,” *Journal of Finance*, 49(1), 3–37.

RAJAN, R. (1992): “Insiders and Outsiders: The Choice between Informed and Arm’s-Length Debt,” *Journal of Finance*, 47(4), 1367–400.

RAJAN, R., AND A. WINTON (1995): “Covenants and Collateral as Incentives to Monitor,” *Journal of Finance*, 50(4), 1113–46.

SAIZ, A. (2010): “The Geographic Determinants of Housing Supply,” *The Quarterly Journal of Economics*, 125(3), 1253–1296.

SCHWERT, M. (2018): “Bank capital and lending relationships,” *The Journal of Finance*.

SETTE, E., AND G. GOBBI (2015): “Relationship lending during a financial crisis,” *Journal of the European Economic Association*, 13(3), 453–481.

SHARPE, S. (1990): “Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships,” *Journal of Finance*, 45(4), 1069–87.

STIGLITZ, J., AND A. WEISS (1981): “Credit Rationing in Markets with Imperfect Information,” *American Economic Review*, 71(3), 393–410.

Townsend, R. M. (1979): "Optimal contracts and competitive markets with costly state verification," *Journal of Economic Theory*, 21(2), 265–293.

Voordeckers, W., and T. Steijvers (2006): "Business collateral and personal commitments in SME lending," *Journal of Banking & Finance*, 30(11), 3067–3086.

Xu, B., H. Wang, and A. V. Rixtel (2015): "Do banks extract informational rents through collateral?," BIS Working Papers 522, Bank for International Settlements.

A Tables

Table 1: Variable Definitions

Variable	Description	Source
$Investment_{i,t}$	$(\triangle Fixed\ Assets_{i,t}+Depreciation_{i,t})/Turnover_{i,t-1}$	FAME.
$Collateral_{i,t}$	$LandHoldings_{i,2002}\times\frac{Land\ Price_{j,t}}{Land\ Price_{j,2002}}\times\frac{1}{Turnover_{i,t-1}}$	FAME, Land Registry.
$Cash_{i,t}$	$(Bank\ Deposits_{i,t}\text{-}Overdrafts_{i,t})/Turnover_{i,t-1}$	FAME.
$Profit_{i,t}$	$Operating\ Profit_{i,t}/Turnover_{i,t-1}$	FAME.
$Age_{i,t}$	log(1+Months Since Incorporated$_{i,t}$)	FAME.
$Credit\ Rating_{i,t}$	$Quiscore_{i,t}$	FAME.
$Short\text{-}Term\ Debt_{i,t}$	$(Short\text{-}Term\ Debt_{i,t}+Overdrafts_{i,t})/Turnover_{i,t-1}$	FAME.
$Long\text{-}Term\ Debt_{i,t}$	$Long\text{-}Term\ Debt_{i,t}/Turnover_{i,t-1}$	FAME.
$Public\ Firm_{i,t}$	1 for publicly listed firms, 0 otherwise.	FAME.
$Relationship\ Length_{i,b,t}$	log(1+Months since lending relationship first created between firm i and bank b).	FAME.
$Bank\ Size_{b,t}$	log($Total\ Assets_{b,t}$)	HBRD.
$Bank\ Leverage_{b,t}$	$Tier\text{-}1\ Capital_{b,t}/Total\ Assets_{b,t}\times 100$	HBRD.
$Bank\ Net\ Chargeoffs_{b,t}$	$Net\ Chargeoffs_{b,t}/Total\ Loans_{b,t}\times 100$	HBRD.
$Board\ Majority_{i,t}$	log(1+min(*Relationship Length*,Months served by current director with median tenure))	FAME.
$Board\ Longest_{i,t}$	log(1+min(*Relationship Length*,Months served by longest-serving curent director))	FAME.
$Common\ Personal\ R'ship\ Dummy_{i,t}$	1 for firms with at least one director with a personal mortgage relationship with the firm's bank, 0 otherwise.	FAME, PSD.
$\%Common\ Personal\ R'ships_{i,t}$	Share of current directors with a mortgage relationship with the firm's bank.	FAME, PSD.
$Length\ Common\ Personal\ R'ships_{i,t}$	Mean log of 1+number of common personal relationship months for firms with common bank-firm and bank-director relationships, and 0 for other firms.	FAME, PSD.

Notes - The Table reports variable definitions and sources. PSD: Product Sales Database. FAME: Financial Analysis Made Easy. HBRD: Historical Bank Returns Database.

Table 2: Summary Statistics

	(1)	(2)	(3)
Sample:	**FAME Dataset**		**Final Sample**
Panel A: Coverage			
	% of Observations Reporting	Median Value	Median Value
Total Assets (£000s)	96%	51	1,004
Fixed Assets (£000s)	85%	8	284
Tangible Assets (£000s)	84%	6	224
Land and Buildings (£000s)	59%	0	55
Turnover (£000s)	18%	100	1,574
Number of Employees	5%	22	73
Banking Relationship	19%	0	1
Panel B: Number of Observations			
Total Firm-Year Observations	11,194,476		115,284
of which:			
Multiple-Bank Firms			13,635
Single-Bank Firms			101,649
Single-Bank Firms in Relationship with a "Big-5" Bank			95,698

Notes - This table reports key characteristics of the original FAME dataset (columns 1-2) and our final sample (column 3). Columns 1-2 use all observations for active firms which report at an annual frequency, except those active in industries listed in section 3.3. Column 3 use observations used for our baseline regression, covering the period 2002-2013. Our final sample excludes firms with an ownership stake greater than 50%, those operating in industries listed in section 3.3, and those not reporting the main variables of interest for our baseline regression. Column 1 gives the percentage of observations in the FAME Dataset which report the given variables. Column 2 gives the median value of the given variables in FAME. Column 3 gives the median value of the given variables in our selected sample.

Table 3: Employment In Selected Industries (% total workforce)

	Agriculture, Hunting, Forestry, Fishing	Manufacturing	Wholesale and Retail	Hotels and Restaurants	Transport, Storage, Communications, Business Activities	Education	Health and Social Work	Other Community, Social, Personal Activities	Activities of Private Households	Total Employment
2003										
Sample	3%	33%	22%	7%	31%	0%	2%	3%	0%	1,373,160
FAME	2%	36%	23%	10%	26%	0%	1%	3%	0%	8,000,945
ONS	1%	14%	20%	8%	27%	10%	13%	7%	1%	25,098,000
2008										
Sample	1%	26%	24%	6%	37%	0%	3%	3%	0%	1,343,630
FAME	1%	28%	24%	8%	33%	0%	2%	3%	0%	8,880,385
ONS	1%	11%	19%	8%	29%	10%	14%	7%	1%	26,193,750
2013										
Sample	1%	22%	28%	8%	32%	0%	4%	3%	0%	899,776
FAME	1%	24%	22%	10%	37%	0%	2%	4%	0%	9,584,456
ONS	1%	10%	18%	8%	30%	11%	15%	7%	0%	26,751,500

Notes - The table shows the share of all UK employees active in a given industry included in (i) our final sample ("Sample"), (ii) the "FAME" dataset, and (iii) aggregate UK data from the Office of National Statistics (ONS). The final column shows the total number of employees in a given industry and sample. Industry definitions are based on UK 2003 Standard Industrial Classification (SIC) codes. We exclude firms operating in utilities (2003-SIC: 4011-4100), construction (2003-SIC: 4511-4550), finance and insurance (2003-SIC: 6511-6720), real estate (2003-SIC: 7011-7032), public administration (2003-SIC: 7511-7530), and mining (2003-SIC: 1010-1450).

Table 4: Summary Statistics, by Terciles of Relationship Length

Relationship Length Tercile:	Low	Middle	High
Firm Characteristics			
Investment_{t-1} (ratio to Turnover_{t-1})	0.08	0.055	0.053
	(0.31)	(0.24)	(0.23)
Collateral_{t-1} (ratio to Turnover_{t-1})	0.56	0.61	0.78
	(2.1)	(2.1)	(2.4)
Cash_{t-1} (ratio to Turnover_{t-1})	0.025	0.031	0.083
	(0.31)	(0.32)	(0.41)
Profit_{t-1} (ratio to Turnover_{t-1})	0.021	0.034	0.02
	(0.27)	(0.24)	(0.24)
Total Assets (£000s)	21,284	12,942	7,327
	(289,126)	(163,011)	(37,040)
Credit Rating	59	62	69
	(27)	(25)	(24)
Age (Months)	191	224	397
	(207)	(188)	(220)
Short Term Debt (£000s)	2,062	1,393	846
	(26,669)	(20,467)	(4,454)
Long Term Debt (£000s)	7,158	5,140	1,514
	(100,530)	(77,656)	(122,99)
Public Firm (Dummy)	0.095	0.082	0.059
	(0.29)	(0.27)	(0.23)
Relationship Length (Months)	43	111	260
	(28)	(36)	(113)
Firm Director Characteristics			
Board Majority (Months)	38	94	142
	(23)	(37)	(53)
Board Longest (Months)	40	105	170
	(23)	(35)	(45)
Common Personal R'ship Dummy	0.069	0.071	0.066
	(0.25)	(0.26)	(0.25)
%(Common Personal R'ship)	0.024	0.025	0.021
	(0.1)	(0.1)	(0.092)
Common Personal R'ship Months	31.95	37.18	36.44
	(28.38)	(33.91)	(30.57)

Notes - This table shows the average and standard deviation (in parentheses) of a given variable for three groups of firms sorted by their relationship length. The sample includes 2002-2013 yearly observations for all UK companies with at least one banking relationship, are active in 2002, and report data for all the included controls - except firms in sectors specified in Table 3.

Table 5: Lending Relationships & the Collateral Channel: Baseline Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Var.:			Investment$_{i,t}$			Short-Term Debt$_{i,t}$	Long-Term Debt$_{i,t}$	Investment$_{i,t}$	
Sample:		All Firms		Private Firms	Public Firms	All Firms		2007-10	Other Years
Collateral$_{i,t}$	0.039***	0.035***	0.038***	0.038***	0.053**	0.011***	0.012**	0.040***	0.041***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.021)	(0.002)	(0.005)	(0.008)	(0.005)
R'ship Length$_{i,t}$		-0.034***	-0.024***	-0.027***	-0.027**	-0.004**	-0.016***	-0.022***	-0.026***
		(0.003)	(0.003)	(0.003)	(0.011)	(0.001)	(0.002)	(0.008)	(0.004)
Collateral$_{i,t}$ × R'ship Length$_{i,t}$			-0.018***	-0.018***	-0.013	-0.000	-0.020***	-0.017***	-0.021***
			(0.002)	(0.003)	(0.010)	(0.002)	(0.003)	(0.006)	(0.003)
Firm Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.21	0.23	0.23	0.24	0.22	0.07	0.08	0.27	0.24
Observations	107,649	107,649	107,649	99,014	7,634	56,601	56,601	24,706	77,018

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $Investment_{i,t}$ is $(\triangle Fixed\ Assets_{i,t}+Depreciation_{i,t})/Turnover_{i,t-1}$. $Collateral_{i,t}$ is $Land\ and\ Buildings_{i,2002}\times\frac{Land\ Prices_{j,t}}{Land\ Prices_{j,2002}}\times\frac{1}{Turnover_{i,t}}$. $Relationship\ Length_{i,t}$ is log of 1+months since current relationship started. *Short-Term Debt* is short-term loans and overdrafts over $Turnover_{i,t-1}$. *Long-Term Debt* is long-term debt over $Turnover_{i,t-1}$. Controls included in all columns except column 1 but not reported are: $Cash_{i,t}$, $Profit_{i,t}$, $Age_{i,t}$, $Credit\ Rating_{i,t}$, $Land\ Prices_{j,t}\times Age_{i,2002}$, $Land\ Prices_{i,t}\times Profits_{i,2002}$ and $Land\ Prices_{j,t}\times Total\ Assets_{i,2002}$. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 6: Lending Relationships & the Collateral Channel: Additional interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline	Firm			Bank			
X is:		$\text{Age}_{i,t}$	$\text{Size}_{i,t}$	Credit $\text{Rating}_{i,t}$	$\text{Size}_{b,t}$	$\text{Leverage}_{b,t}$	$\text{Losses}_{b,t}$	Land $\text{Prices}_{j,t}$
$\text{Collateral}_{i,t}$	0.038***	0.059***	-0.056***	0.039***	0.039***	0.038***	0.038***	0.059***
	(0.003)	(0.022)	(0.016)	(0.003)	(0.003)	(0.003)	(0.003)	(0.022)
R'ship $\text{Length}_{i,t}$	-0.024***	-0.181***	-0.033***	-0.025***	-0.026***	-0.024***	-0.024***	-0.181***
	(0.003)	(0.018)	(0.010)	(0.003)	(0.003)	(0.003)	(0.003)	(0.018)
$\text{Collateral}_{i,t}$ ×	-0.018***	-0.017***	-0.016***	-0.018***	-0.016***	-0.018***	-0.018***	-0.017***
R'ship $\text{Length}_{i,t}$	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\text{Collateral}_{i,t}$ * X		-0.004	0.013***	-0.000*	-0.007***	0.000	0.003	-0.004
		(0.004)	(0.002)	(0.000)	(0.002)	(0.002)	(0.003)	(0.004)
R'ship $\text{Length}_{i,t}$ * X		0.029***	0.001	0.000***	0.009***	-0.001	-0.004	0.029***
		(0.003)	(0.001)	(0.000)	(0.002)	(0.002)	(0.003)	(0.003)
Adjusted R^2	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.23
Observations	107,649	107,649	107,618	107,649	107,649	107,649	107,649	107,649

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $Investment_{i,t}$ is $(\triangle Fixed\ Assets_{i,t}+Depreciation_{i,t})/Turnover_{i,t-1}$. $Collateral_{i,t}$ is $Land\ and\ Buildings_{i,2002}\times\frac{Land\ Prices_{j,t}}{Land\ Prices_{j,2002}}\times\frac{1}{Turnover_{i,t}}$. $Relationship\ Length_{i,t}$ is log of 1+months since current relationship started. $Age_{i,t}$ is log number of months since firm incorporated; $Size_{i,t}$ is log total firm assets; $Credit\ Rating_{i,t}$ is the firm's Quiscore; $Bank\ Size_{b,t}$ is log total assets of the firm's bank; $Bank\ Leverage_{b,t}$ is the lag ratio of total Tier 1 capital to total assets of the firm's bank; $Bank\ Losses_{b,t}$ is the lag ratio of net loan loss write-offs (gross write-offs less recoveries) to total loans of the bank's firm; $Land\ Prices_{j,t}$ are real-estate prices in the firm's headquarter region. Controls included in all columns but not reported are: $Cash_{i,t}$, $Profit_{i,t}$, $Age_{i,t}$, $Credit\ Rating_{i,t}$, $Land\ Prices_{j,t}\times Age_{i,2002}$, $Land\ Prices_{i,t}\times Profits_{i,2002}$ and $Land\ Prices_{j,t}\times Total\ Assets_{i,2002}$. All columns include firm, region-time, and bank-time fixed effects. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 7: Lending Relationships & the Collateral Channel: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline	Lag *R'ship Length*	Bank-Region-Year FE	Manufacturing Firms	$Collateral_{i,t}$ measure:		$Investment_{i,t}$ measure:	
					At t-5	Based on CRE prices	Ex-Depreciation	Tangibles only
$\text{Collateral}_{i,t}$	0.038***	0.030***	0.039***	0.034***	0.014***	0.058***	0.023***	0.031***
	(0.003)	(0.003)	(0.004)	(0.007)	(0.003)	(0.006)	(0.003)	(0.003)
$\text{Collateral}_{i,t}$ ×	-0.018***	-0.008***	-0.018***	-0.011*	-0.012***	-0.025***	-0.016***	-0.016***
$\text{R'ship Length}_{i,t}$	(0.002)	(0.002)	(0.003)	(0.006)	(0.002)	(0.004)	(0.002)	(0.002)
Adjusted R^2	0.23	0.22	0.22	0.20	0.22	0.25	0.15	0.24
Observations	107,649	94,347	96,626	22,421	76,239	49,909	117,967	107,347

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. *Investment* is $(\triangle \textit{Fixed Assets}_{i,t} + \textit{Depreciation}_{i,t}) / \textit{Turnover}_{i,t-1}$. $\textit{Collateral}_{i,t}$ is $\textit{Land and Buildings}_{i,2002} \times \frac{\textit{Land Prices}_{j,t}}{\textit{Land Prices}_{j,2002}} \times \frac{1}{Turnover_{i,t}}$. $\textit{Relationship Length}_{i,t}$ is log of 1+months since current relationship started. In column 2 *Relationship Length* is lagged by two years. In column 3 region-year and bank-year fixed effects are replaced by bank-region-year fixed effects. Column 4 includes firms in the manufacturing sector only. In column 5 *Collateral* is lagged by five years. In column 6 *Collateral* is measured using local commercial real-estate prices instead of residential house prices. In column 7, *Investment* is $\textit{Fixed Assets}_t / \textit{Turnover}_{t-1}$. In column 8 *Investment* includes investment in tangible assets only. Controls included in all columns but not reported are: $\textit{Cash}_{i,t}$, $\textit{Profit}_{i,t}$, $\textit{Age}_{i,t}$, $\textit{Credit Rating}_{i,t}$, $\textit{Land Prices}_{j,t} \times \textit{Age}_{i,2002}$, $\textit{Land Prices}_{i,t} \times \textit{Profits}_{i,2002}$ and $\textit{Land Prices}_{j,t} \times \textit{Total Assets}_{i,2002}$. All columns include firm, region-time, and bank-time fixed effects, unless otherwise specified. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 8: LENDING RELATIONSHIPS & THE COLLATERAL CHANNEL: INSTRUMENTAL VARIABLE RESULTS

	(1)	(2)	(3)
Panel A: Instrument Construction			
Dependent Variable:	Land $\text{Prices}_{j,t}$		
$\text{Housing Constraints}_{j,1990} \times$ Mortgage Rate_t	-9.500***		
	(1.583)		
Adjusted R^2	0.95		
Observations	37,800		

	Stage 1		Stage 2
Panel B: Instrumental Variable Regressions			
Dependent Variable:	$\text{Collateral}_{i,t}$	$\text{Collateral}_{i,t} \times$ R'ship $\text{Length}_{i,t}$	$\text{Investment}_{i,t}$
Predicted $\text{Collateral}_{i,t}$	0.027***	-0.021	
	(0.010)	(0.020)	
Predicted $\text{Collateral}_{i,t} \times$ R'Ship $\text{Length}_{i,t}$	-0.007	0.059***	
	(0.011)	(0.019)	
$\text{Collateral}_{i,t}$			0.057***
			(0.015)
$\text{Collateral}_{i,t} \times$ R'ship $\text{Length}_{i,t}$			-0.024***
			(0.009)
Adjusted R^2	0.86	0.78	0.23
Observations	97,989	97,989	97,989
Kleibergen-Paap Statistic			25.04

Notes - Panel A of this Table reports the results of a monthly 1996-2016 panel OLS regression for all UK regions. The dependent variable is real estate prices in UK region j and month t. $\textit{Housing Constraints}_{j,1990}$ is the share of developable land in 1990 for a UK region. $\textit{Mortgage Rate}_t$ is the interest rate on a 2-year 75% Loan-to-Value UK mortgage rate. This regression includes region and month fixed effects. Panel B reports the results of annual stage-1 (columns 1-2) and stage-2 (column 3) 2002-2013 instrumental variable regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $\textit{Investment}_{i,t}$ is $(\triangle \textit{Fixed Assets}_{i,t} + \textit{Depreciation}_{i,t}) / \textit{Turnover}_{i,t-1}$. $\textit{Collateral}_{i,t}$ is $\textit{Land and Buildings}_{i,2002} \times \frac{\textit{Land Prices}_{j,t}}{\textit{Land Prices}_{j,2002}} \times \frac{1}{\textit{Turnover}_{i,t}}$. $\textit{Predicted Collateral}_{i,t}$ is $\textit{Land and Buildings}_{i,2002} \times \frac{\textit{Predicted Land Prices}_{j,t}}{\textit{Land Prices}_{j,2002}} \times \frac{1}{\textit{Turnover}_{i,t}}$; $\textit{Predicted Land Prices}_{j,t}$ are predicted land prices using the relationship estimated in Panel A of this Table. $\textit{Relationship Length}_{i,t}$ is log of 1+months since current relationship started. Controls included in Panel B but not reported are: $\textit{Cash}_{i,t}$, $\textit{Profit}_{i,t}$, $\textit{Age}_{i,t}$, $\textit{Credit Rating}_{i,t}$, $\textit{Land Prices}_{j,t} \times \textit{Age}_{i,2002}$, $\textit{Land Prices}_{i,t} \times \textit{Profits}_{i,2002}$ and $\textit{Land Prices}_{j,t} \times \textit{Total Assets}_{i,2002}$. Control definitions are reported in Table 4. Panel B regressions include firm, region-time, and bank-time fixed effects. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 9: Lending Relationships & the Collateral Channel: Different Samples

Included Firms:	(1) Single-Region	(2) UK-Focused	(3) Audited Firms
$\text{Collateral}_{i,t}$	0.042***	0.043***	0.039***
	(0.006)	(0.008)	(0.013)
$\text{Collateral}_{i,t} \times \text{R'ship Length}_{i,t}$	-0.022***	-0.021***	-0.013***
	(0.004)	(0.006)	(0.002)
Adjusted R^2	0.24	0.25	0.21
Observations	78,919	33,510	59,721

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $\textit{Investment}_{i,t}$ is $(\triangle \textit{Fixed Assets}_{i,t} + \textit{Depreciation}_{i,t}) / \textit{Turnover}_{i,t-1}$. $\textit{Collateral}_{i,t}$ is $\textit{Land and Buildings}_{i,2002} \times \frac{\textit{Land Prices}_{j,t}}{\textit{Land Prices}_{j,2002}} \times \frac{1}{\textit{Turnover}_{i,t}}$. $\textit{Relationship Length}_{i,t}$ is log of 1+months since current relationship started. Single-Region firms are those with a single trading address. UK-Focused firms are those with UK turnover equal to total turnover. Audited Firms are those with annual turnover over £1 million. Controls included in all columns but not reported are: $\textit{Cash}_{i,t}$, $\textit{Profit}_{i,t}$, $\textit{Age}_{i,t}$, $\textit{Credit Rating}_{i,t}$, $\textit{Land Prices}_{j,t} \times \textit{Age}_{i,2002}$, $\textit{Land Prices}_{i,t} \times \textit{Profits}_{i,2002}$ and $\textit{Land Prices}_{j,t} \times \textit{Total Assets}_{i,2002}$. Control definitions are reported in Table 4 notes. All columns include firm, region-time, and bank-time fixed effects. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 10: BOARD RELATIONSHIPS & THE COLLATERAL CHANNEL

	(1)	(2)	(3)	(4)
Board R'Ship Length is:	Board Majority$_{i,t}$		Board Longest$_{i,t}$	
Collateral$_{i,t}$	0.037***	0.038***	0.037***	0.038***
	(0.003)	(0.003)	(0.003)	(0.003)
R'ship Length$_{i,t}$		-0.020***		-0.016***
		(0.003)		(0.005)
Collateral$_{i,t}$ × R'ship Length$_{i,t}$		-0.014***		-0.003
		(0.004)		(0.005)
Board R'ship Length$_{i,t}$	-0.015***	-0.004*	-0.021***	-0.007
	(0.002)	(0.002)	(0.002)	(0.005)
Collateral$_{i,t}$ × Board R'ship Length$_{i,t}$	-0.016***	-0.005	-0.019***	-0.016***
	(0.002)	(0.004)	(0.002)	(0.005)
Adjusted R^2	0.23	0.23	0.23	0.23
Observations	107,518	107,518	107,518	107,518

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $Investment_{i,t}$ is $(\triangle Fixed\ Assets_{i,t}+Depreciation_{i,t})/Turnover_{i,t-1}$. $Collateral_{i,t}$ is $Land\ and\ Buildings_{i,2002} \times \frac{Land\ Prices_{j,t}}{Land\ Prices_{j,2002}} \times \frac{1}{Turnover_{i,t}}$. $Relationship\ Length_{i,t}$ is log of 1+months since current relationship started. $Board\ Majority_{i,t}$ is the the log of 1+months since current lending relationship started and more than 50% of current firm directors were appointed. $Board\ Longest_{i,t}$ is the the log of 1+months since current lending relationship started and the longest-serving current firm director was appointed. Controls included in all columns but not reported are: $Cash_{i,t}$, $Profit_{i,t}$, $Age_{i,t}$, $Credit\ Rating_{i,t}$, $Land\ Prices_{j,t} \times Age_{i,2002}$, $Land\ Prices_{i,t} \times Profits_{i,2002}$ and $Land\ Prices_{j,t} \times Total\ Assets_{i,2002}$. All columns include firm, region-time, and bank-time fixed effects. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).

Table 11: Directors' Personal Mortgage Relationships & the Collateral Channel

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: $Investment_{i,t}$						
R'ship Length is:	Relationship Length with Firm			Relationship Length with Board Majority		
$\text{Collateral}_{i,t}$	0.039***	0.039***	0.039***	0.037***	0.037***	0.038***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\text{R'ship Length}_{i,t}$	-0.025***	-0.024***	-0.025***	-0.016***	-0.015***	-0.016***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
$\text{Collateral}_{i,t} \times \text{R'ship Length}_{i,t}$	-0.019***	-0.019***	-0.018***	-0.017***	-0.017***	-0.017***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\text{Collateral}_{i,t} \times \text{R'ship Length}_{i,t}$	0.016**			0.015**		
$\times$ Common Personal $\text{R'ship Dummy}_{i,t}$	(0.006)			(0.007)		
$\text{Collateral}_{i,t} \times \text{R'ship Length}_{i,t}$		0.026*			0.033**	
$\times$% (Common Personal $\text{R'ship})_{i,t}$		(0.014)			(0.015)	
Collateral $\times$ $\text{R'ship Length}_{i,t}$			0.003*			0.004**
$\times$ Length Common Personal $\text{R'ship}_{i,t}$			(0.002)			(0.002)
Adjusted R^2	0.23	0.23	0.23	0.23	0.23	0.23
Observations	107,649	107,518	107,649	107,518	107,518	107,518

Notes - The table reports the results of annual 2002-2013 panel OLS regressions for all UK companies in sectors listed in Table 3 that have at least one banking relationship, are active in 2002, and report data for all controls. $Investment_{i,t}$ is $(\triangle Fixed\ Assets_{i,t} + Depreciation_{i,t})/Turnover_{i,t-1}$. $Collateral_{i,t}$ is $Land\ and\ Buildings_{i,2002} \times \frac{Land\ Prices_{j,t}}{Land\ Prices_{j,2002}} \times \frac{1}{Turnover_{i,t}}$. $Relationship\ Length_{i,t}$ is log of 1+months since current relationship started. *Common Personal* $R'ship\ Dummy_{i,t}$ is 1 for firms where at least one director has a personal mortgage relationship with the firm's bank, and 0 otherwise. %(*Common Personal* $R'ship)_{i,t}$ is the share of a firm's director with a personal mortgage relationship with the firm's bank. *Length Common Personal* $R'ship_{i,t}$ is the mean log of 1+number of common personal relationship months for firms with common bank-firm and bank-director relationships, and 0 for other firms. Controls included in all columns but not reported are: $Cash_{i,t}$, $Profit_{i,t}$, $Age_{i,t}$, $Credit\ Rating_{i,t}$, $Land\ Prices_{j,t} \times Age_{i,2002}$, $Land\ Prices_{i,t} \times Profits_{i,2002}$ and $Land\ Prices_{j,t} \times Total\ Assets_{i,2002}$. Control definitions are reported in Table 4 notes. Interaction terms included but not reported: *Collateral* $\times$ *Common Personal Relationship Dummy* and *Relationship Length* $\times$ *Common Personal Relationship Dummy* (columns 1,4); $Collateral_{i,t} \times$ %(*Common Personal* $Relationship)_{i,t}$ and $Relationship\ Length_{i,t} \times$ %(*Common Personal* $Relationship)_{i,t}$ (columns 2,5); $Collateral_{i,t} \times$ *Length Common Personal* $Relationship_{i,t}$ and $Relationship\ Length_{i,t} \times$ *Length Common Personal* $Relationship)_{i,t}$ (columns 3,6). All columns include firm, region-time, and bank-time fixed effects. Standard errors clustered by region are reported in parentheses. Stars indicate statistical significance at 1% (***), 5% (**), and 10% (*).