Bank Lending in the Knowledge Economy*

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Abstract

We study bank portfolio allocations during the transition of the real sector to a knowledge economy in which firms use less tangible capital and invest more in intangible assets. We show that, as firms shift toward intangible assets that have lower collateral values, banks reallocate their portfolios away from commercial and industrial (C&I) loans toward other assets, primarily residential real estate loans. This effect is more pronounced for large and less well capitalized banks and is robust to controlling for non-C&I loan demand. Our results suggest that increased firm investment in intangible assets can explain up to 20% of bank portfolio reallocation from commercial to residential lending over the last four decades.

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1 Introduction

Over the past few decades, the importance of intangible capital in corporate balance sheets has steadily increased. Intangible assets tend to be more firm-specific and more difficult to verify, price, and liquidate than tangible assets. As such, they offer less collateral value. Thus, the rise in intangible capital may lead to an increase in intermediation frictions. Borrowers whose technology entails a large share of intangible assets may find it difficult to obtain funding through secured lending. This phenomenon is convincingly documented by a growing literature that links the rise in intangible capital to lower corporate debt capacity and greater reliance on internal financing (e.g., Bates et al. (2009), Falato et al. (2013)). However, how this friction affects the banking sector remains unexplored.

In this paper, we hypothesize that the economy-wide rise in intangible capital has contributed to a secular decline in the share of banks' portfolios allocated to commercial lending. If intangible capital significantly reduces firms' debt capacity, it is plausible that commercial and industrial (C&I) loans decline as firms are less able to rely on bank loans (and debt more generally) to finance their investment opportunities. Reduced commercial lending opportunities arising from this friction may in turn induce banks to reallocate their lending capacity to non-C&I assets, such as real estate loans and liquid assets.

At the aggregate level, the negative correlation between corporate intangible assets and the share of commercial loans in bank portfolios is self-evident (Figure 1). For U.S. corporates, the share of intangible assets relative to firms' tangible assets rose from roughly 40% in the 1970s to over 100% in the 2000s. Over the same period, the share of commercial loans in banks' total assets declined by about 15 percentage points, while the share of real estate loans almost doubled (Figure 2).

To establish a causal link between these trends, we exploit geographical variation in corporate intangible capital and bank portfolio allocations. Our empirical tests examine how banks' commercial loans and total assets respond to the growth in intangible capital for firms located in the same Metropolitan Statistical Area (MSA) as the bank, in a large bank-level panel over 1977-2010. We also examine banks' non-C&I asset allocations, with a focus on the growth rates of real estate loans and liquid assets. If intangible assets imply fewer opportunities for commercial lending, then the decline in commercial loan growth should be more pronounced for banks operating in markets where the increase in intangible assets is larger. We use firms sharing the same MSA location as

banks as a proxy for banks' corporate lending client base. This approach hinges on the assumption that banks cannot easily diversify away intangible asset-related shocks to their commercial lending opportunities by reallocating commercial loan portfolios to other locations. We acknowledge this matching is imperfect. Yet, the measurement error is likely to be smaller in the first half of our sample when banks had limited scope for cross-state activities and could not easily shift operations geographically.[1] Our empirical tests take advantage of these restrictions for a stronger identification.

We find evidence that the rise in corporate intangible capital reduces commercial loan growth, controlling for bank fixed effects, time-varying bank characteristics, and variables that capture MSA-level demand for bank loans. In our main specification, coefficient estimates indicate that a one standard deviation increase in intangible capital is accompanied by a contraction in bank C&I lending by 2 to 3.5 percentage points. This effect is statistically and economically significant and implies that up to 20% of the secular decline in the share of commercial loans in total bank lending since the mid-1970s can be attributed to the increase in corporate intangible capital over the same period. In addition, we find that banks that are exposed to a higher growth rate of MSA-level corporate intangible capital do not reduce their size. Instead, bank balance sheets show a higher growth rate of non-C&I assets, especially residential real estate loans and liquid assets. This result suggests that banks respond to fewer opportunities in corporate lending by reallocating their lending capacity to different types of assets rather than by contracting their balance sheets.

To support a causal interpretation of our results, we present a series of additional results. One potential concern is that intangible corporate capital affects bank lending through channels other than the lower availability of collateral. For example, more intangible-capital intensive firms may systematically attract a different, more skilled and better paid workforce, leading to increased demand for real estate or consumer loans, both of which are part of banks' non-C&I assets. We address this concern in three ways. First, our baseline specifications control for non-C&I loan demand with a battery of MSA-level variables such as population growth, per capita household income growth, and house price growth. Second, we confirm that the results hold up in subsamples of MSAs where intangible capital growth is least correlated to several measures of non-C&I loan

[1]Note that this concern is due to our empirical approach that relies on bank-firm matching on MSA. At the economy-wide level, the rise in intangible capital is significant throughout our sample and is not confined to a subset of firms or sectors. Thus, while better able to diversify local shocks geographically later in the sample, in the time series banks are likely to face similar pressures as those we can identify in the first half of our sample since the economy-wide rise in corporate intangible capital still cannot be easily diversified away by banks.

demand, as well as in subsamples of MSAs that did not experience a house price boom. Third, in specifications that focus on bank balance-sheet interactions with corporate intangible capital, we add interacted MSA×year fixed effects to control for all unobserved time-varying macroeconomic factors that can drive housing demand at the MSA level. In all these tests, the estimated coefficients of interest remain statistically significant and have virtually unchanged magnitudes, suggesting that the demand for non-C&I loans does not drive our results.

We also exploit the deregulation of interstate bank branching activities that took place between the late 1970s and early 1990s to compare the asset allocations of banks facing restrictions in their ability to lend out of state ("regulated") with those not facing such restrictions ("deregulated"). The staggered timing of the removal of geographic restrictions on bank expansion allows us to estimate a differences-in-differences specification. For a given increase in local intangible capital, we expect regulated banks, which are less geographically diversified and hence less able to diversify local intangible capital shocks away, to exhibit a greater contraction of commercial lending. The results are consistent with this hypothesis. In addition, the point estimates for regulated banks are sizable and greater than those in the baseline regressions. We view these point estimates as closer to the true magnitude of the pressures on C&I lending experienced by banks at the aggregate level throughout our sample period since the economy-wide rise in corporate intangible capital cannot easily be diversified away by banks.

This final set of results further helps us rule out that our results are due to unobserved positive shocks to demand for non-C&I loans. If unobserved non-C&I loan demand were driving our results, then this effect should be more pronounced for deregulated banks, which would better be able to attract capital from other locations to accommodate the demand shock (see, e.g., Cortés and Strahan (2015)). However, our results show significantly smaller effects for deregulated banks than for regulated banks. This evidence is consistent with our hypothesis that local intangible capital shocks, which reduce the borrowing capacity of firms, in turn lead banks to reallocate their lending to other sectors.

Our findings offer a new perspective on the long-term decline in the share of commercial loans in bank assets by showing that a significant part of this decline was due to the shift to a higher reliance on intangible capital in the corporate sector. Moreover, our evidence suggests that banks responded to this phenomenon by reallocating their portfolios toward other types of assets, in particular real estate loans and liquid assets, rather than downsizing. Thus, it is plausible that

the rise in corporate intangible capital over the last few decades has contributed to the expansion of real estate lending and the downward pressure on interest rates through this bank portfolio reallocation channel. While the existing literature attributes long-run changes in the composition of bank lending to developments in housing and securities markets,[2] our study is the first to show that developments in the corporate sector may have played an important role as well. While this channel has been articulated theoretically in Caggese and Perez (2016) and Döttling and Perotti (2016), our paper provides the first empirical evidence that the rise of corporate intangible capital is a quantitatively important contributor to the long-run reallocation of bank lending away from commercial loans to real estate loans and liquidity holdings. Thus, even if real estate demand subsides (due to a fall in house prices, for example) and risk appetite in financial markets wanes, our results imply that the supply pressures in real estate lending and the demand by banks for liquid assets, with the resulting downward pressure on interest rates, will likely persist, since they partly emanate from the long-run transformation of the corporate sector.

The remainder of the paper proceeds as follows. Section 2 reviews selected related studies. Section 3 discusses our data and empirical strategy. Section 4 presents the baseline results. Sections 5 and 6 address potential endogeneity concerns and present our robustness checks. Section 7 concludes.

2 Literature Review

A growing literature in corporate finance examines the link between intangible capital and firm financing. Intangible assets are less valuable as collateral and hence increase frictions in debt finance. As a result, firms tend to finance intangible assets primarily through equity or internal cash flows (Carpenter and Petersen (2002); Brown et al. (2009), Brown et al. (2013), Falato et al. (2013)). We borrow heavily from the latter paper for our firm-level measure of intangible capital. This measure captures capitalized past investment in research and development capital, human and organizational capital, and information technology, essentially adapting to firm-level data the aggregate intangible asset measure first proposed in Corrado et al. (2009) and Corrado and Hulten (2010).

Of course, some intangible assets, notably patents, can have collateral value (Loumioti (2012), Mann (2015)). Further, lenders can acquire expertise in lending to intangible-capital intensive

[2]Standard explanations include the rise in house prices and securitization (Loutskina and Strahan (2009) and Chakraborty et al. (2016)) and the development of securities markets.

firms (Chava et al., 2013). Indeed, recent studies find that banking deregulation benefits innovative firms, consistent with a measurable role of bank credit in financing innovation (Amore et al. (2013), Chava et al. (2013), and Cornaggia et al. (2015)). Still, the collateral values of intangible capital remain lower than those for similarly productive tangible capital. Only a small part of intangible capital (select R&D) can be patented. Further, while existing patents can be used as collateral for new projects, firms cannot pledge ongoing innovation as collateral (due to contractual imperfections and the uncertain nature of innovation) and thus have to finance it mostly internally. This contrasts to the investments in tangible capital that can often be financed through loans with a limited down payment. As such, corporate intangible capital remains difficult to finance with debt (Hall and Lerner, 2010). To our knowledge, ours is the first paper to study the effect of frictions associated with intangible productive assets not on the corporate financing of firms, but on the lending constraints and lending dynamics of commercial banks.

3 Data and Empirical Strategy

We are interested in exploring the link between the rise in corporate intangible capital and bank portfolio allocations. The analysis hinges on matching banks and firms based on their headquarters' MSA, and exploring how bank portfolios change in response to changes in corporate intangible capital. For this purpose, we gather data on firms' intangible capital and other characteristics, bank balance sheets, and MSA-level macroeconomic variables. Here we describe our main variables and present descriptive statistics. Summary statistics for our main variables are reported in Table 1. Variable sources and definitions are in Appendix Figure A1.

3.1 Firm and MSA-level measures of intangible capital

Unlike physical (tangible) capital such as property, plant, and equipment, intangible capital is more difficult to measure since investments in intangible assets are typically reported as an expense in the year they are incurred and capital that is created by such investments is not captured on firms' balance sheets. Our measure of intangible capital is constructed from past investments in intangible assets, following the approach in Falato et al. (2013).

To construct intangible capital at the firm level, we use accounting data from Compustat between 1977 and 2010. As is standard in the literature, we exclude financial firms (SIC codes 6000-6999)

and regulated utilities (SIC codes 4900-4999), as well as firms with missing or non-positive book values of assets or sales in any given year. This selection process results in a final set of 176,877 firm-year observations for 18,535 unique firms. The measure of intangible capital is computed, for each firm-year, as the sum of the capital accumulated through three types of intangible investments whose importance has been emphasized in the literature on the economics of innovation: knowledge capital, organizational capital, and informational capital (Corrado et al., 2009; Corrado and Hulten, 2010).

Knowledge capital is constructed by capitalizing past R&D expenditures using the perpetual inventory method with depreciation rate of 15% (Hall et al., 2001).[3] Organizational capital is constructed by capitalizing past selling, general and administrative (SG&A) expenses with depreciation rate of 20% (Lev and Radhakrishnan, 2005; Eisfeldt and Papanikolaou, 2013). Investments in organizational capabilities represent expenditures on enhancing the value of brand names and other knowledge embedded in firm-specific human and structural resources and include employee training costs, payments to management and strategy consultants, and distribution systems. Since SG&A expenditures include many expenses that are unrelated to investments in organizational capabilities, we follow Corrado et al. (2005) and weigh the constructed stock of organizational capital by 0.2. Finally, informational capital is constructed by capitalizing expenditures on computerized information and software with a depreciation rate of 31% following BEA, using (2-SIC) industry BEA Fixed Reproducible Tangible Wealth data.[4]

As the final step, we normalize the measure of intangible capital by total tangible assets, i.e., total balance sheet assets excluding cash. Our resulting estimate for the average intangible-to-tangible capital ratio at the firm level in mid-2000s is about 120%, which is comparable to the estimate in Corrado et al. (2005) based on aggregate National Income and Product Accounts.

Our empirical approach examines the effect of intangible capital for firms in a given MSA on the asset allocations for banks that are headquartered in the same MSA. For each firm in Compustat, we match the state and county of its headquarters as reported in Compustat to MSA by merging the State/County FIPS code[5] with the Metropolitan Areas and Components data defined by the

[3]For each component, we set the initial stock to be equal to the expenditure in the first year divided by the respective depreciation rate. In addition, for R&D, we interpolate missing values following Hall (1993) who shows that this results in an unbiased measure of R&D capital. We set R&D to zero for firms that do not report R&D.

[4]See Falato et al. (2013) for details.

[5]The State/County combination defines the State/County code according to the Federal Information Processing Standards (FIPS).

Office of Management and Budget as of 2010.[6] We define the MSA-level intangible capital as the simple (unweighted) average of the intangible capital to total asset ratio of the firms that are headquartered in that MSA.

The average MSA in our sample has 24 firms with an intangible capital ratio (to book assets net of cash) of 67.8%. The average growth rate of the intangible capital ratio is 14% in the cross-section of MSAs. Among the more populated MSAs (with at least 10 firms), the top 5—Reno-Sparks (NV), Boulder (CO), Riverside-San Bernardino (CA), Denver-Aurora (CO), and Salt Lake City (UT)—experienced an average annual intangible capital growth rate of at least 20% during 1977-2010. In the bottom 5 MSAs—Grand Rapids-Wyoming (MI), Richmond (VA), Louisville-Jefferson (KY), Akron (OH), and Greater Hartford (CT)—corporate intangible capital grew on average at below 10%.

Figure 3 plots the histogram of growth rates of firms' intangible capital ratio (Panel A), showing that about 10% of MSA-year observations experience negative growth rates during the sample period. A time series box plot of intangible capital growth (Panel B) reveals a large amount of cross-sectional (cross-MSA) variation in the data, while the entire distribution of intangible capital growth rates remains fairly stable over time.

3.2 Bank- and MSA-level data

Bank balance sheet data for individual banks comes from the U.S. Call Reports. We restrict our sample to commercial banks (variable RSSD9331). We use data on non-consolidated accounts that reflect domestic operations and ignore banks' foreign activities. The bank-level panel runs from 1977 until 2010, the same time period over which we have data on both intangible capital and bank balance sheets. For each bank we observe the MSA of its headquarters (variable RSSD9180). The baseline regressions cover about 8,500 commercial banks that are headquartered in 278 MSAs.

The outcomes of interest are banks' commercial loans, real estate loans, liquid assets, and total assets. Commercial loans are defined as (secured or unsecured) loans for commercial and industrial purposes to sole proprietorships, partnerships, corporations, and other business enterprises. This

[6] One potential issue with the Compustat location data is that Compustat only reports the current state and county of firms headquarters. Thus, to make reliable inference about firm location, it is important to correct for this deficiency. To this end, we use physical Compustat tapes to collect manually the historical information on firms headquarters on an annual basis over our sample period 1977-2010. This allows us to identify all firms whose corporate headquarters have moved from one location to another during this period.

category excludes loans secured by real estate (which are classified as "real estate loans"), agricultural loans, and personal consumer loans. Liquid assets defined as the sum of cash, U.S. Treasury obligations, mortgage-backed securities, and net interbank lending

The main explanatory variable is the growth rate of intangible capital (as a share of total book assets) of firms that are headquartered in the same MSA as the bank. That is, banks and firms are matched on MSA so that the exposure of each bank to MSA-level intangible capital is the average of intangible capital shares of the firms headquartered in that MSA. This matching comes with the caveat that some firms may borrow from banks that are located in other MSAs and some banks may diversify their C&I lending beyond their headquarters MSA. This might be especially occurring since the mid-1990s as banks have become more geographically diversified due to increased deregulation of bank activities and due to bank consolidation. This imperfect matching introduces measurement error in the specifications, which we address in Section 6.1.

Data on MSA-level macroeconomic variables such as household income and population come from the Bureau of Economic Analysis. Household income is available at the county level and is aggregated at the MSA level using a crosswalk between counties and MSAs from the U.S. Census Bureau. MSA-level house prices come from the Federal Housing Finance Agency (FHFA). We use the "all transactions" seasonally-adjusted house price index (HPI).

3.3 Empirical specifications

We estimate baseline specifications for four bank balance sheet variables: commercial loan growth, total asset growth, and the growth rates of two main components of non-C&I assets: real estate loans and liquid assets. Specifically, we estimate:

$$Y_{ijt} = \alpha_i + \gamma_t + \beta_1 IK_{jt} + \beta_2 X_{jt} + \beta_3 Z_{it} + \epsilon_{ijt} \tag{1}$$

where banks are indexed by i, MSAs by j and years by t. Y_{ijt} is each of the four dependent variables considered. IK_{jt} is the MSA-level growth rate of intangible capital (to total assets). X_{jt} is a matrix of MSA-level macroeconomic variables that serve as proxies for local economic conditions and demand for bank credit (e.g., house prices, per capita income, population, and firm sales). Z_{it} is a matrix of bank-level controls such as bank size (log-total assets) and bank capital (total equity

divided by total capital).

All variables except bank capital and size are expressed in year-on-year growth rates. The point estimates on macroeconomic controls thus capture the relationship between changes in local economic conditions and bank balance sheet components growth. In addition, all specifications with components of the balance sheet as outcome variables—commercial loans, real estate loans, and liquid assets—control for total balance sheet growth. Corporate intangible capital is defined as the growth rate of the share of intangible assets to tangible (book) assets. Thus, the coefficient estimate on this variable, β_1, captures the change in the external finance friction in banks' lending to firms. All specifications include bank and year fixed effects. In robustness checks we also estimate a specification with MSA×year fixed effects to control for all unobserved time-varying macroeconomic factors at the MSA level. All baseline specifications use Ordinary Least Squares (OLS), with standard errors clustered at the bank level.[7]

4 Results

4.1 Corporate intangible capital and bank asset allocations

Table 2 presents the baseline results. The regressions explore the impact of corporate intangible capital on bank balance sheet components: C&I loan growth (the key variable of interest, columns 1-3), total asset growth (columns 4-6), real estate loan growth (columns 7-9), and liquid asset growth (columns 10-12). For each dependent variable, the first specification includes the growth rate of corporate intangible capital, the second specification adds MSA- and bank-level controls, and the third specification adds year and bank fixed effects. The fixed effects control for yearly global shocks to all banks and unobserved time-invariant differences across banks in the growth rates of balance sheet components. All regressions for the growth rates of bank balance sheet components control for a bank's total asset growth, so the coefficients in columns 1-3 and 7-12 can be interpreted as relative growth rates.

The main result, consistent across specifications, is that an increase in the growth rate of corporate intangible capital is associated with a reduction in the growth rate of commercial loans for banks headquartered in the same MSA. Further, there is no change in total bank assets growth rate but there is an increase in the growth rate of real estate loans and liquid assets. To the extent

[7]The results are robust to clustering at bank and year, MSA, or MSA and year, level as shown in Section 6.2.

that the macroeconomic controls appropriately capture MSA-level variables that drive demand for banks' non-C&I lending, the results show that an increase in corporate intangible assets suppresses the growth rate of banks' C&I loans and leads banks to reallocate their portfolios to non-C&I assets, while having no effect on the size of bank balance sheets. This is the key result of the paper, and we seek to more closely explore its drivers and robustness further on.

The estimated coefficients on all macroeconomic controls have expected signs. Banks' total assets, commercial loans, and real estate loans grow faster in response to better local economic conditions (as measured by faster house price growth, per capital income and population growth, and firm sales growth). Liquid assets, in contrast, grow slower in response to better local economic conditions, consistent with better local lending opportunities for banks. For bank controls, we find that larger banks tend to grow slower, consistent with organizational diseconomies of scale, documented also in the previous literature (see, for example, Berger and Mester (1997)). Better capitalized banks have higher relative growth rates of commercial and real estate loans, but lower growth rates of liquid assets, consistent with bank capital offering banks more risk-taking capacity (liquid assets in our definition are predominantly safe assets). Larger banks, in contrast, tend to have lower growth rates of commercial and real estate loans, possibly because larger banks have on average less capital. (We return to the discussion of the relationship between bank capital and size and their impact on bank portfolio allocations in Section 4.2).

Table 3 considers the impact of corporate intangible capital on additional components of banks' balance sheets. The estimates indicate the effect of corporate intangible assets on the growth rate of bank real estate loans is similar for the residential real estate component (column 1) and the commercial real estate component (column 2). This finding is consistent with the possibility that firms with intangible assets respond to frictions in C&I borrowing by pledging more of their commercial real estate. Column 3 establishes that banks do not expand consumer loans in response to higher corporate intangible assets, suggesting that banks are less likely to reallocate their resources toward unsecured lending.

Table 4 examines how the baseline relationship between corporate intangible assets and bank portfolio allocations varies with the size of the intangible capital growth rate. We distinguish between intangible capital growth rates that are above and below the median of the overall distribution of MSA-level intangible capital growth rates.[8] The results are shown by splicing the

[8]Similar results, not shown, obtain for the intangible capital growth rates above and below the median for a given

intangible capital growth variable across the two subsamples.[9] We find that the effects of intangible capital on bank portfolio components are statistically significant only for large (above-median) changes in MSA-level corporate intangible capital. The results in Table 4 provide further support to our baseline result that the reduction in commercial loan growth is indeed due to the rise in corporate intangible capital since large changes in intangible capital are relatively better proxies for fundamental changes in frictions in banks' lending to firms.

4.2 Bank size and capital

Table 5 explores heterogeneity in our baseline results along bank characteristics such as size and capitalization. We can expect stronger effects of corporate intangible capital for large banks because they may have relatively greater difficulty lending without hard collateral, since more information-intensive types of lending are less efficient in large organizations (Stein, 2002). Further, we can expect a weaker effect of corporate intangible capital for better capitalized banks, because such banks might be less averse to risks associated with lending without sufficient collateral due to greater loss-absorption capacity of higher capital.

We start by exploring the effects of bank size (columns 1, 4, 7, 10). We distinguish between banks with size above or below $90 million (in 2010 U.S. dollars) in total assets (close to the median assets of $87 million over the full sample). We present the results by splicing the intangible capital growth variable for banks that are above or below-median of the size distribution. The coefficients of interest on intangible asset growth for large banks are comparable to the point estimates in the full sample and statistically significant, while those for small banks have the expected sign but are imprecisely estimated. These estimates suggest that corporate intangible capital has a stronger effect on the portfolio allocations of large banks rather than those of small banks.[10]

Next, we perform a similar exercise, now distinguishing between banks with above- and below-median bank capital ratios (columns 2, 5, 8, 11). The average bank capital ratio is just above 12%. Consistent with our hypothesis, we find that the growth of corporate intangible capital primarily

MSA.

[9] That is, we split the intangible capital growth variable into two variables that add up to the original variable: one variable whose values are replaced with zeros when intangible capital growth is below median (row 1), and another variable whose values are replaced with zeros when intangible capital growth is above median (row 2).

[10] This result is interesting because large banks are also more likely to have geographically diversified lending, and therefore for them our MSA-level bank-firm match should be less precise than for small banks. Therefore, these relatively larger effects may still understate the true impact of corporate intangible assets on large banks' portfolio allocations.

affects banks with below-median capital.

Finally, we examine if the stronger effects for large banks are due to larger banks having less capital or due to bank size itself (columns 3, 6, 9, 12). We do so by splicing the intangible asset growth variable into four variables, respectively for large banks with low vs. high capital and small banks with low vs. high capital. The estimates indicate that the effects of intangible capital on the C&I loan growth of both large and small banks are driven by those banks that have low capital (column 3). As such, the effects of bank size identified in column 1 seem to be driven by large banks having on average lower capital rather than by bank size. The p-value for a one-sided t-test confirms that the coefficients for large banks with low capital are statistically different in absolute value from those for large banks with high capital. Further, we find that, in response to corporate intangible capital shocks, banks with higher capital tend to reallocate their assets towards real estate loans (columns 8 and 9), while banks with lower capital reallocate to liquid assets (columns 11 and 12), consistent with higher-capital banks having more risk-taking capacity than lower-capital banks.

The finding that larger bank size (through its association with lower bank capital) and lower bank capital amplify the effects of corporate intangible assets on bank portfolio allocations is important, because the pre-crisis period was characterized by long-term trends of bank consolidation and bank capital erosion. These trends therefore may have amplified the economic effects of the secular increase in corporate intangible capital on the portfolio allocations of the banking system.

5 Addressing Potential Omitted Variable Problems

We interpret our baseline results as being driven by the fact that firms' intangible assets create frictions in banks' corporate lending, inducing banks to rebalance their portfolios towards non-C&I assets. This interpretation however requires ruling out alternative explanations related to the general equilibrium effects of corporate intangible assets on the demand for non-C&I loans. For example, more intangible firms may attract different types of employees, who may have higher demand for real estate or consumer loans, both of which are part of non-C&I assets. We call this alternative explanation "the demand channel."

We aim to verify that our results are not driven by the demand channel is several ways. First, the baseline regressions control for MSA-level attributes that capture non-C&I loan demand such as population, per capita household income, and house price growth. However, to the extent that

our macro controls do not fully capture the demand for non-C&I assets, the demand channel may confound our results as an omitted variable problem.

Therefore, to address potential concerns about this alternative channel, we deploy four further strategies. First, we control for all unobserved macroeconomic factors using MSA×year fixed effects. Second, we restrict the regressions to subsets of MSAs where intangible asset growth appears least related to proxies of demand for non-C&I loans. Third, we consider the effects of corporate intangible asset growth on bank profitability. Fourth, in Section 6.1 we use the staggered timing of bank branching deregulation to assess whether the portfolio allocations of regulated vs. deregulated banks are consistent with the channel of interest or the demand channel.

5.1 Control for unobserved macro factors

In Table 6 we estimate a specification with bank size and capital interactions (similar to that of Table 5) using MSA×year fixed effects instead of macro controls. The MSA×year fixed effects absorb all time-varying local economic conditions, including unobserved factors that may drive the demand for non-C&I loans. Since the intangible asset growth variable itself varies at the MSA-year level, its coefficient cannot independently be estimated in a specification with MSA×year fixed effects. Instead, we focus on the interaction of intangible asset growth with bank size and capital, and examine whether these differential balance-sheet effects remain consistent with those found in Table 5. Consistent estimates between specifications with MSA macro controls and specifications with MSA×year fixed effects would suggest that the MSA macro controls used in the baseline analysis appropriately capture the local macroeconomic environment, including factors that may drive the demand channel.[11]

We find that the coefficients on the intangible capital growth interacted with the dummy for large bank size (holding low bank size as the base) are insignificant throughout (columns 1, 4, 7, 10), consistent with the fact that the coefficients for the impact of intangible capital growth for large and small banks in Table 5 (same respective columns) are not statistically different, based on the p-value of the F-test. In contrast, the coefficients on the intangible capital growth interacted with the dummy for low bank capital (holding high bank capital as base) are significant (columns 2, 5, 8, 11), consistent with the statistically different coefficients for the impact of intangible capital growth

[11] In all specifications we further control for interactions of house price growth with indicators of bank size and capital quantiles to allow for the demand channel to vary with bank conditions (see, e.g., Chakraborty et al. (2016)).

for banks with high and low capital in Table 5 based on the p-value of the F-test). The same holds when we interact intangible capital growth with indicators for large banks with low capital, large banks with high capital, and small banks with low capital (holding small banks with high capital as the base). Those coefficients that were different from the coefficient for small banks with high capital in Table 5 (columns 3, 6, 9, 12) are statistically significant in Table 6 as well. For example, both tables suggest that intangible asset growth affects commercial loan growth primarily for banks with low capital (columns 3 in both tables), leads to a contraction of assets of larger magnitude in all groups of banks compared to the contraction (or, indeed, the expansion) of assets in small banks with high capital (columns 6 of both tables), and that in response to corporate intangible asset growth banks with high capital reallocate their assets towards real estate loans whereas banks with low capital reallocate to liquid assets (columns 6 and 12 in both tables). Furthermore, the point estimates of the coefficients in Table 6 are almost identical to the difference between the point estimates of the respective coefficients in Table 5.

Overall, the results in Tables 5 and 6 show that the estimated coefficients on the interaction of intangible assets and bank characteristics are virtually identical in terms of statistical significance and economic magnitudes when we use macro controls for local conditions vs. MSA×year fixed effects. It appears that the macro controls in the baseline specifications capture the effect of the whole range of relevant local economic conditions, which suggests that the omitted variable "demand channel" explanation is unlikely to be driving our main results.

5.2 Exploit correlation of intangible assets and macro variables

In the next test, we aim to reduce the impact or shut down the demand channel. To this end, we identify the subset of MSAs where corporate intangible capital growth is *least* related to several proxies of non-C&I loan demand. We use the following demand proxies: (a) house prices, (b) per capita household income, (c) total household income (to account for changes in population). Figure 4 plots histograms for the cross-section of simple correlation coefficients between MSA-level corporate intangible capital growth and each demand proxy. Interestingly, each distribution has a negative mean and median (as reported in Panel C of Table 1), which already casts doubt on the possibility that corporate intangible capital growth is associated with greater demand for non-C&I loans.

For the formal tests, we use the following criteria for "least relation" between corporate intangible

capital growth and each non-C&I loan demand proxy: (i) negative correlation between corporate intangible capital growth and the proxy, (ii) near-zero correlation (lower than 0.25 in absolute value), and (iii) a rejected hypothesis of Granger causality from corporate intangible capital growth to the proxy (at the 90% level of confidence). We re-run the baseline specification for the subsamples of MSAs defined from the above conditions. Each condition leads us to drop between one third and two thirds of the sample, potentially reducing the precision of our estimates.

Table 7 presents the results in summary form, reporting the coefficient estimate on the variable of interest (intangible capital growth), its standard error, and the number of observations in each regression. Across the board we find that the coefficients on corporate intangible capital growth remain significant, with point estimates close to those of the baseline specification in the full sample (Table 2). These results suggest that our findings in the baseline regressions are not driven by the MSAs with a high correlation between corporate intangible capital shocks and non-C&I loan demand, such as housing. By contrast, our results seem to stem mainly from the MSAs where such correlation is low or even negative.

Table 8 presents estimates from regressions similar to those in Table 7 but now we restrict to MSAs that did not experience a house price boom in the 2000-2007 (columns 1-3) and the 1990-2007 (columns 4-6) periods. The first time period coincides with the nation-wide housing boom while the second period covers a large part of our sample while maintaining the widest availability of MSA-level house price data. We define "housing boom" MSA as those with house price growth above 50th (Panel A), 75th (Panel B), and 90th (Panel C) percentile across all MSAs. Once again we find that that in all MSAs without a housing boom the coefficients on intangible capital growth remain statistically significant, with point estimates close to those in the baseline specification in the full sample (Table 2), suggesting that our baseline results are not driven by MSAs which experienced a contemporaneous housing boom.

5.3 Effects on bank profitability

Table 9 offers an additional test aimed at ruling out the demand channel based on the effects of corporate intangible capital on bank profitability (as measured by net interest margins). If corporate intangible capital affects commercial loan growth through higher demand for non-C&I loans, we would expect bank profitability to increase as a result of a positive demand shock. In contrast, if our hypothesized channel related to higher frictions in bank C&I lending is at work, then

bank profitability should suffer. The presentation of results in Table 9 is similar to that in Table 2, with column 1 showing a specification without any controls, column 2 adding macro controls, and column 3 adding bank and year fixed effects.

Across specifications, we find that higher intangible asset growth is associated with lower bank profitability. These results are consistent with the hypothesized channel but inconsistent with the demand channel. As a specification check, macro controls enter regressions with expected signs: better local conditions are associated with higher bank profitability (column 3). Larger banks and more rapidly growing banks are less profitable, consistent with lower margins on large-scale (not relationships-based) bank activities and in new markets. Finally, bank capitalization is positively related to bank profitability.

6 Robustness Tests

6.1 The effects of bank branching deregulation

Our analysis of the relationship between corporate intangible capital and bank portfolio allocations relies on establishing the bank-firm link at the MSA level, based on co-located headquarters. However, this link may be imprecise: banks can lend to firms that are located in different MSAs and firms can borrow from banks that are located in different MSAs. In this section we make this link more precise by exploiting a deregulation episode in the banking sector as a quasi-natural experiment.

In particular, we use the bank branching deregulation process to exploit banks' ability to lend outside their headquarters' MSA (state) and to establish differences in the impact of intangible capital for banks in pre-deregulated states compared to banks in deregulated states. Interstate bank branching deregulation took place from the mid-1970s to mid-1990s (Jayaratne and Strahan, 1996). While pre-deregulation restrictions mostly concerned inbound branching from other states, most states had reciprocal agreements, so these restrictions simultaneously prevented local banks from expanding elsewhere. We take regulated branching as a proxy that banks in a given MSA are less likely to be able to conduct business elsewhere, i.e., that the MSA-level bank-firm link is more precise in pre-deregulation states.

The results of a differences-in-differences analysis for single-state MSAs are shown in Table 10.

The coefficient estimates for the interaction terms "IK growth×Regulated" are consistent with a more precise bank-firm link: the relationship between corporate intangible assets and bank portfolio allocations was stronger in states with regulated bank branching. The coefficient estimates for MSAs in deregulated states (on the term "IK growth") are weaker yet also statistically significant at conventional level (in 5 of 6 specifications, columns 1-6), indicating a weaker yet present bank-firm link.

Conditioning on MSA with regulated branching offers an additional useful insight, as it allows us to reject the alternative explanation for the documented link between corporate intangible assets and bank portfolio allocations that is based on the demand for non-C&I loans rather than frictions in C&I lending. Just as regulated interstate branching restricts banks' ability to lend outside the headquarters MSA, it also restricts their ability to attract funding from outside that area. If corporate intangible assets had affected bank portfolios by increasing demand for non-C&I loans, banks in regulated MSAs would have shifted relatively less to non-C&I assets loans due to tighter funding constraints. We find that in fact they shifted more to non-C&I assets. This is inconsistent with tighter funding constraints but consistent with a lower ability to reallocate C&I lending geographically towards areas with slower growth of corporate intangible assets.

6.2 Alternative specifications and further refinements

We perform a range of robustness tests to verify that our results are robust to reasonable alternative specifications and refinements. The results are presented in the Appendix tables. Table A1 uses a measure of corporate intangible capital that excludes capitalized IT expenditure (columns 1-4). Since IT expenditure is only available at the industry level, this component of the intangible capital might be less precisely measured than the other components that are based on firm-level R&D and SG&A expenditures. The results are fully consistent with those from our main specification. They also remain robust to alternately using as dependent variables the two main components of intangible capital, namely capitalized R&D expenditure (columns 5-8) and respectively capitalized SG&A expenditure (columns 9-12).

Table A2 presents specifications that include the share of firms with a bond market rating in any given MSA-year (columns 1-4), which accounts for firms' access to alternative sources of financing. This control variable alleviates the potential concern that our results are driven by the development of securities markets that occurred simultaneously with the rise of intangible capital. We also report

the results of our baseline regressions enriched with an MSA-level control variable for the number of patents, both unweighted and citation-weighted (columns 5-12), given that patents are an outcome of R&D activities that can potentially be pledged as collateral against bank loans. The coefficient estimates across columns indicate the relationship between corporate intangible assets and bank portfolio allocations continues to hold. They become less precise for liquid assets likely on account of a significant drop in sample size (columns 8, 12), but remain close in magnitude to the baseline coefficient (Table 2, column 12).

In Table A3 we present specifications where the dynamics of bank portfolio allocations are captured not in growth rates, but in levels (columns 1-4) in specifications otherwise similar to the baseline. Then, we limit the sample to MSAs that headquarter at least 3 Compustat firms (the median number of Compustat firms per MSA is 5) in columns 5-8. Finally, we re-run our baseline specifications in a new dataset that matches banks and firms on state instead of MSA (columns 9-12). The results are again largely robust for these alternative approaches.

Our final robustness test pertains to the approach of estimating the standard errors. In our baseline regressions we clustered the standard errors at the bank level. In Table A4 we alternately cluster on bank and year (columns 1-4), on MSA (columns 5-8), and MSA and year (columns 9-12). We notice that the main coefficient estimates of interest, on intangible capital growth, remain statistically significant at conventional levels. In the three cases considered, for liquid assets the coefficients are statistically significant at the 15% level (columns 4, 8, 12).

7 Conclusions

This paper studies the effects of the corporate sector transition towards a greater use of intangible assets on bank lending. Consistent with intangible assets having lower collateral values, we find that increased corporate intangible capital leads banks to reallocate their portfolios from commercial loans towards non-C&I assets, primarily real estate loans and liquid assets. Through multiple empirical tests we rule out an alternative channel where the reallocation is due to higher demand for non-C&I loans instead of increased frictions in banks' commercial lending.

To our knowledge, this is the first paper to study how the share of intangible assets on corporate balance sheets, a rising trend since at least the late 1970s, affects the structure of bank balance sheets. We find that in response to the rise in corporate intangible assets, banks do not shrink

their balance sheets but rather reallocate their lending capacity away from commercial loans, and primarily towards real estate and liquid assets. Overall, our estimates suggest that the rise in corporate intangible assets since the late 1970s may account for up to 20% of bank portfolio reallocation from commercial loans to real estate loans and liquid assets over the same period.

Our findings shed light on possible reasons for a supply-driven boom in real estate lending in the run-up to the 2007-2008 crisis, for increased safe asset demand in the 2000s (Gorton and Ordonez, 2013), and a "banking glut" (Shin, 2012). The finding that the rise in corporate intangible capital affects primarily large and less well capitalized banks suggests that the trends towards bank consolidation and bank capital erosion since the 1990s may have amplified the impact of corporate intangible assets on bank portfolios. Our analysis suggests that the change in the asset composition in the corporate sector has resulted in a significant shift in the asset composition of the banking sector over the last four decades.

At the macroeconomic level, greater intermediation frictions stemming from corporate intangible assets might lead to a rise in the demand for safe assets. On the one hand, corporate savings increase in expectation of difficulties in obtaining external funding. The need to invest these funds into liquid and relatively safe securities may lead to increased demand from the corporate sector for MBS and sovereign bonds. On the other hand, banks deprived of lending opportunities in the corporate sector may also increase their demand for such assets. In this context, our findings may provide a complementary explanation to the secular decline in safe yields that is at the center of the debate on secular stagnation (Summers, 2015).

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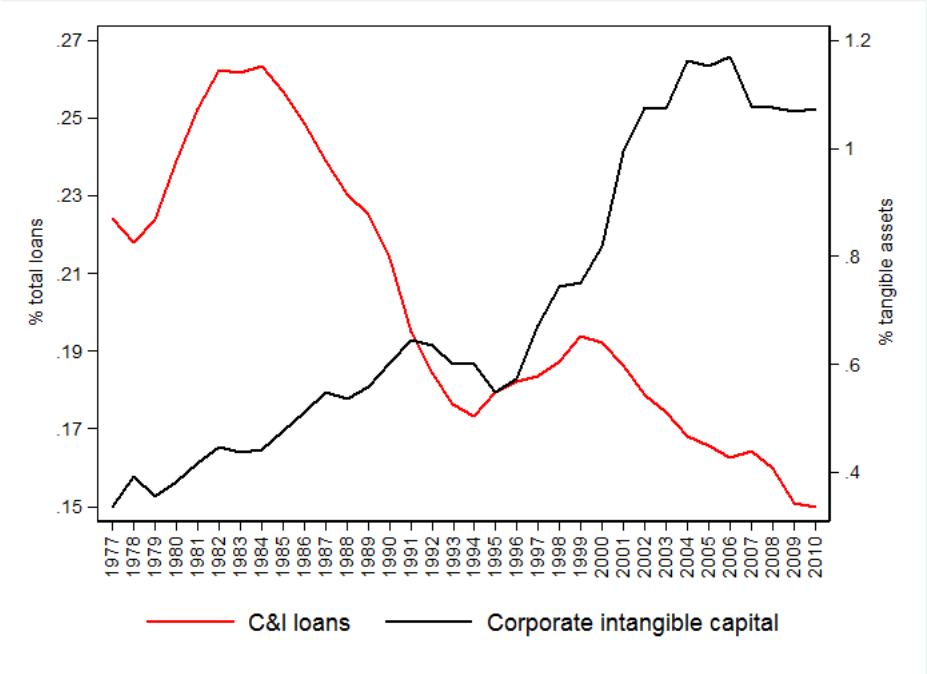
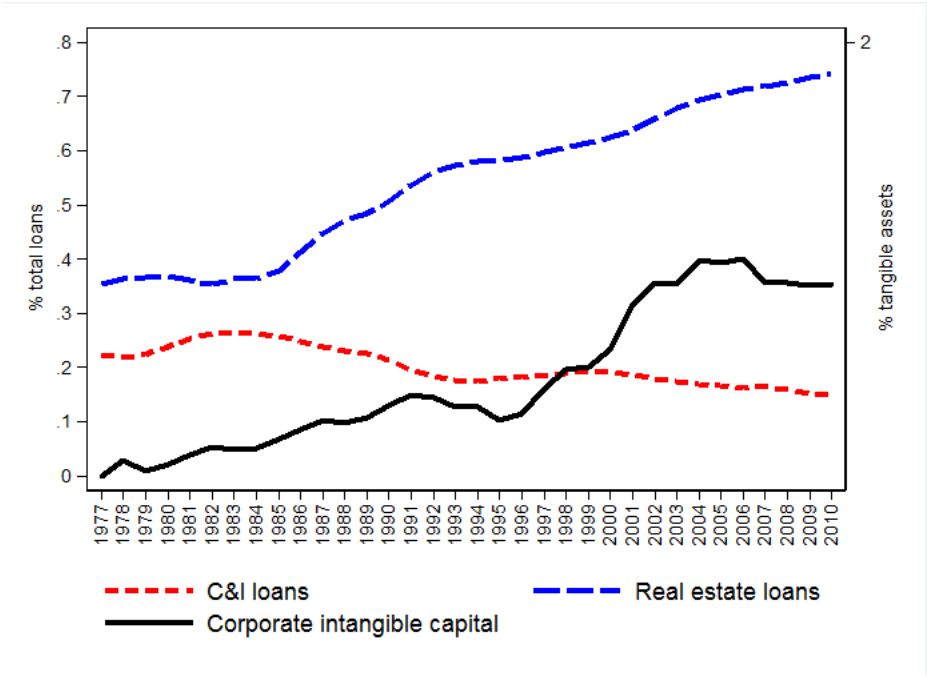
Figures and tables

Figure 1: Corporate intangible assets and bank C&I loans, 1977-2010



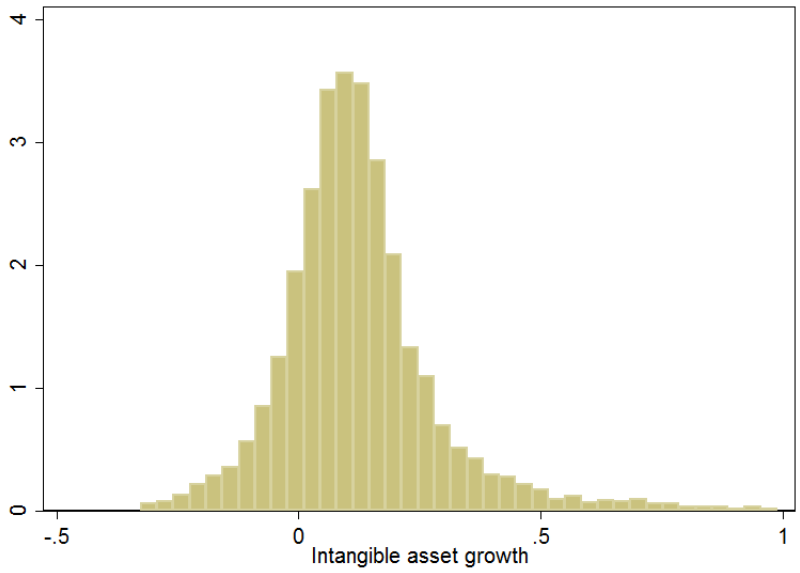
Notes: The figure plots the average share of corporate intangible capital in total assets for US Compustat firms; and the average share of C&I loans in total loans for US commercial banks during 1977-2010. Data sources: Compustat, US Call Reports.

Figure 2: Corporate intangible assets, and bank loan portfolios, 1977-2010

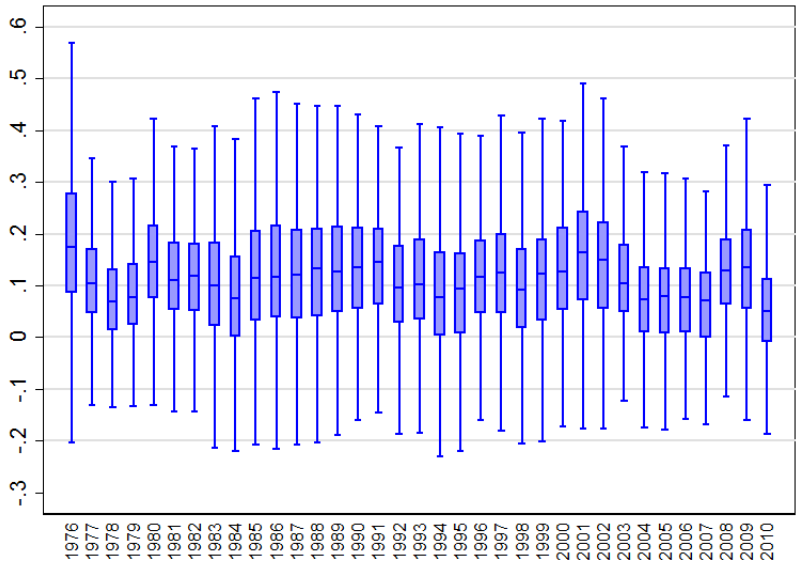


Notes: The figure plots the average share of corporate intangible capital in total assets for US Compustat firms; the average share of C&I loans in total loans; and the average share of real estate loans in total loans for US commercial banks during 1977-2010. Data sources: Compustat, US Call Reports.

Figure 3: Growth rate of corporate intangible assets, 1977-2010



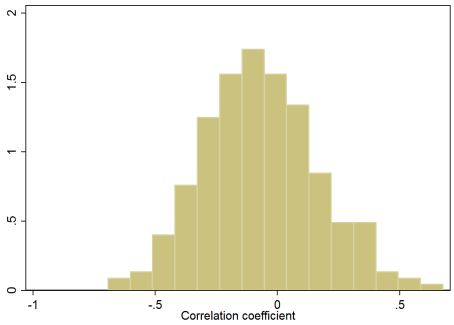
(a) Histogram



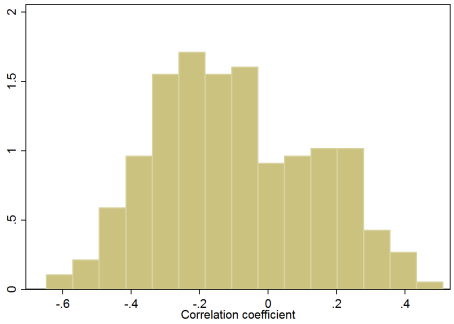
(b) Time-series

Notes: Panel A plots a histogram of the growth rate of corporate intangible capital in the pooled MSA-year panel over 1977-2010. Panel B depicts the yearly distribution of the growth rate of corporate intangible assets at the MSA level over 1977-2010. Data sources: Compustat.

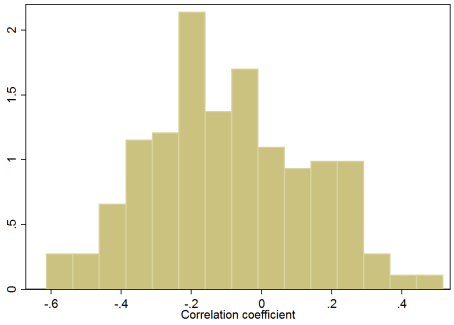
Figure 4: Growth rate of corporate intangible assets, 1977-2010



(a) IK growth and HP growth



(b) IK growth and pc income growth



(c) IK growth and total MSA income growth

Notes: The figure shows histograms of the simple correlation coefficients between intangible asset growth on the one hand and, respectively, house price growth (Panel A), per capita household income growth (Panel B), and total (MSA-level) household income growth (Panel C) on the other hand. The correlations are computed for each MSA over 1977-2010 or the available period (conditional on observing at least 10 consecutive observations).

Table 1: Descriptive statistics

	No. obs	Mean	St. Dev.	Min	p25	Median	p75	Max
A. Selected regression variables								
IK growth	109,710	14.7%	13.9%	-31.8%	8.3%	13.8%	19.6%	102.3%
IK (no IT) growth	109,710	15.4%	14.6%	-32.8%	8.7%	14.3%	20.6%	106.6%
IK (R&D) growth	102,393	11.9%	16.9%	-40.3%	4.0%	11.3%	18.4%	118.9%
IK (SG&A) growth	109,710	15.4%	14.5%	-32.8%	8.5%	14.4%	20.5%	105.4%
C&I loan growth	100,115	6.6%	24.2%	-40.4%	-9.9%	3.5%	19.4%	91.8%
Real estate loan growth	101,855	8.7%	16.6%	-20.3%	-2.9%	6.0%	17.2%	70.0%
Residential real estate loan growth	99,991	8.0%	19.8%	-25.7%	-5.4%	4.2%	17.1%	86.0%
Commercial real estate loan growth	99,375	10.8%	25.0%	-33.8%	-6.2%	6.6%	22.5%	109.9%
Consumer loan growth	98,981	0.8%	18.4%	-34.1%	-12.0%	-1.3%	10.9%	62.1%
Liquid asset growth	86,526	4.7%	18.3%	-30.5%	-8.3%	2.4%	15.5%	60.8%
Bank asset growth	109,710	5.1%	9.0%	-10.6%	-1.3%	3.6%	10.0%	33.6%
Net interest margin growth	76,610	-2.5%	8.1%	-20.2%	-8.2%	-3.0%	2.6%	20.8%
HP growth	109,710	4.4%	6.0%	-35.0%	1.5%	4.1%	6.7%	41.2%
Pc income growth	109,710	5.5%	3.7%	-15.2%	3.4%	5.2%	7.3%	53.0%
Population growth	109,710	1.5%	1.5%	-18.5%	0.6%	1.2%	2.1%	11.0%
Firms' sales growth	109,710	10.6%	14.0%	-38.6%	3.4%	10.1%	16.6%	112.6%
Bank size (log-assets)	109,710	17.99	1.26	14.13	17.13	17.85	18.66	25.14
Bank capital	109,454	12.7%	7.1%	-14.2%	7.9%	11.3%	15.9%	100.0%
% rated firms	109,710	16.4%	19.4%	0.0%	0.0%	13.5%	26.0%	100.0%
Regulated	71,201	38.8%	-	0.00	-	-	-	1.00
B. Selected variables in levels (% assets)								
IK	109,710	67.8%	67.3%	0.8%	34.9%	50.4%	76.5%	1428.3%
C&I loans	109,710	12.1%	8.8%	0.0%	5.8%	10.2%	16.4%	100.0%
Real estate loans	109,710	32.2%	17.0%	0.0%	19.3%	29.8%	43.3%	100.0%
Liquid assets	99,819	34.6%	15.5%	0.0%	23.8%	33.4%	44.1%	100.0%
C. Within-MSA correlations								
B/w IK & HPs	245	-0.070	0.234	-0.695	-0.233	-0.077	0.085	0.678
B/w IK & pc hh income	242	-0.095	0.234	-0.648	-0.266	-0.127	0.096	0.511
B/w IK & total hh income	242	-0.092	0.228	-0.613	-0.257	-0.121	0.072	0.517

Notes: The descriptive statistics are shown for the regression sample (Panels A, B) and in the MSA cross-section (Panel C). Growth rates of bank and firm balance sheet variables are winsorized and trimmed at the 5th and 95th percentiles. Intangible capital growth is winsorized at the 1st and 99th percentile of the firm-level distribution, before aggregating at the MSA level. Firm-level variables such as intangible capital growth and sales growth are computed at the MSA level as simple averages across the firms that are headquartered in each MSA. Intangible capital and its components are scaled by total book assets. Panel C reports the simple MSA-level correlation coefficients between intangible capital growth and respectively three macroeconomic variables, also in growth rates. Data sources: See Table A1.

Table 2: Corporate intangible capital and bank portfolio allocations—Baseline

	C&I loans			Bank assets			RE loans			Liquid assets		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth	-0.0490***	-0.0318***	-0.0204***	0.0085***	0.0161***	0.0002	0.0212***	0.0291***	0.0127***	0.0343***	0.0148***	0.0092**
	(0.005)	(0.005)	(0.006)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
HP growth		0.0574***	0.1073***		0.1752***	0.1468***		0.2669***	0.2125***		-0.2731***	-0.2165***
		(0.014)	(0.018)		(0.006)	(0.006)		(0.010)	(0.013)		(0.012)	(0.014)
Pc income growth		0.4316***	0.1957***		-0.1553***	0.1912***		-0.2175***	0.0314		-0.0891***	-0.0009
		(0.025)	(0.036)		(0.010)	(0.013)		(0.017)	(0.027)		(0.018)	(0.028)
Population growth		0.1989***	0.6911***		0.6212***	0.7392***		0.8772***	1.8827***		-0.1112***	-1.0017***
		(0.054)	(0.101)		(0.030)	(0.038)		(0.042)	(0.088)		(0.039)	(0.078)
Firm sales growth		0.0363***	0.0117*		0.0359***	0.0095***		0.0547***	0.0054		-0.0459***	0.0012
		(0.005)	(0.006)		(0.002)	(0.002)		(0.004)	(0.004)		(0.004)	(0.005)
Bank size		-0.0044***	-0.0129***		-0.0008**	-0.0285***		-0.0028***	-0.0096***		-0.0044***	0.0009
		(0.001)	(0.003)		(0.000)	(0.001)		(0.000)	(0.002)		(0.000)	(0.002)
Bank capital		0.0538***	0.1170***		0.1047***	0.1588***		-0.0145	0.0714***		-0.1158***	-0.1035***
		(0.014)	(0.032)		(0.007)	(0.015)		(0.009)	(0.021)		(0.011)	(0.025)
Bank asset growth	0.6945***	0.6851***	0.6107***				0.7626***	0.7178***	0.5803***	0.8530***	0.8863***	0.9867***
	(0.009)	(0.009)	(0.011)				(0.007)	(0.007)	(0.008)	(0.009)	(0.009)	(0.010)
Observations	99,890	99,890	99,890	109,710	109,710	109,710	101,623	101,623	101,623	86,057	86,057	86,057
R-squared	0.065	0.072	0.168	0.000	0.038	0.339	0.164	0.184	0.318	0.162	0.174	0.293
Year FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Bank FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: The dependent variable is bank-level C&I loan growth (columns 1-3), total asset growth (columns 4-6), real estate loan growth (columns 7-9), and liquid asset growth (columns 8-10). The regressions are run in a bank-level panel over 1977-2010. Intangible capital growth, house price growth, per capita income growth, population growth, and firm sales growth are at the MSA level. Bank size, capital, and total asset growth are at the bank level. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 3: Corporate intangible capital and the components of non-C&I loans

	Residential real estate loans (1)	Commercial real estate loans (2)	Consumer loans (3)
IK growth	0.0111**	0.0113*	-0.0083*
	(0.005)	(0.006)	(0.005)
HP growth	0.1745***	0.2424***	0.1669***
	(0.017)	(0.019)	(0.015)
Pc income growth	-0.0365	0.0482	0.1323***
	(0.034)	(0.040)	(0.027)
Population growth	1.5087***	1.7594***	0.2109***
	(0.107)	(0.118)	(0.078)
Firm sales growth	0.0005	0.0162***	0.0090*
	(0.005)	(0.006)	(0.005)
Bank size	-0.0111***	-0.0083***	-0.0198***
	(0.002)	(0.003)	(0.002)
Bank capital	0.0383	0.0287	0.0561**
	(0.027)	(0.033)	(0.026)
Bank asset growth	0.4844***	0.5635***	0.4058***
	(0.010)	(0.012)	(0.009)
Observations	96,199	95,567	98,657
R-squared	0.231	0.214	0.217
Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes

Notes: The dependent variables represent components of non-C&I lending, respectively residential real estate loan growth (column 1), commercial real estate loan growth (column 2), and consumer loan growth (column 3). The regressions are run in a bank-level panel over 1977-2010. Intangible capital growth, house price growth, per capital income growth, population growth, and firm sales growth are at the MSA level. Bank size, capital, and total asset growth are at the bank level. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4: Corporate intangible capital and bank portfolio allocations—High vs. low changes in intangible capital

	C&I loans (1)	Bank assets (2)	Real estate loans (3)	Liquid assets (4)
IK growth > p50 [1]	-0.0254***	-0.0004	0.0144***	0.0119**
	(0.006)	(0.002)	(0.004)	(0.005)
IK growth < p50 [2]	0.0349**	0.0068	-0.0057	-0.0183
	(0.015)	(0.005)	(0.009)	(0.011)
HP growth	0.1050***	0.1465***	0.2132***	-0.2157***
	(0.018)	(0.006)	(0.013)	(0.014)
Pc income growth	0.1882***	0.1904***	0.0341	0.0023
	(0.036)	(0.013)	(0.027)	(0.028)
Population growth	0.7018***	0.7405***	1.8790***	-1.0072***
	(0.101)	(0.038)	(0.088)	(0.078)
Firm sales growth	0.0129**	0.0096***	0.0049	0.0004
	(0.006)	(0.002)	(0.004)	(0.005)
Bank size	-0.0129***	-0.0285***	-0.0096***	0.0010
	(0.003)	(0.001)	(0.002)	(0.002)
Bank capital	0.1166***	0.1587***	0.0715***	-0.1031***
	(0.032)	(0.015)	(0.021)	(0.025)
Bank asset growth	0.6105***		0.5803***	0.9868***
	(0.011)		(0.008)	(0.010)
Observations	99,890	109,710	101,623	86,057
R-squared	0.168	0.339	0.318	0.293
Year FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
p-value t-test [1]=[2]	0.000	0.149	0.033	0.008

Notes: The dependent variables are bank-level C&I loan growth (column 1), total asset growth (column 2), real estate loan growth (column 3), and liquid asset growth (column 4). The regressions are run in a bank-level panel over 1977-2010. Intangible capital growth, house price growth, per capital income growth, population growth, and firm sales growth are at the MSA level. Bank size, capital, and total asset growth are at the bank level. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5: Corporate intangible capital and bank portfolio allocations—Heterogeneity by bank size and capital

	C&I loans			Bank assets			Real estate loans			Liquid assets		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth*Large bank [1]	-0.0269***			0.0163***			0.0151***			0.0122**		
	(0.007)			(0.003)			(0.005)			(0.006)		
IK growth*Small bank [2]	-0.0119			-0.0193***			0.0095*			0.0048		
	(0.009)			(0.003)			(0.006)			(0.006)		
IK growth*Low capital [3]		-0.0585***			0.0103***			0.0080			0.0470***	
		(0.009)			(0.003)			(0.006)			(0.007)	
IK growth*High capital [4]		0.0052			-0.0063***			0.0160***			-0.0113**	
		(0.007)			(0.002)			(0.004)			(0.005)	
IK growth*Large*Low capital [5]			-0.0616***			0.0272***			0.0109			0.0471***
			(0.010)			(0.004)			(0.008)			(0.009)
IK growth*Large*High capital [6]			-0.0029			0.0069**			0.0160***			-0.0073
			(0.008)			(0.003)			(0.005)			(0.007)
IK growth*Small*Low capital [7]			-0.0524***			-0.0127***			0.0046			0.0442***
			(0.014)			(0.004)			(0.009)			(0.010)
IK growth*Small*High capital [8]			0.0153			-0.0208***			0.0155**			-0.0147**
			(0.012)			(0.004)			(0.007)			(0.007)
Bank and MSA-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99,890	99,890	99,639	109,710	109,710	109,448	101,623	101,623	101,389	86,057	86,057	85,927
R-squared	0.168	0.169	0.169	0.341	0.340	0.343	0.318	0.318	0.318	0.293	0.293	0.294
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p-value F-test [1]=[2]	0.171			0.000			0.421			0.354		
p-value F-test [3]=[4]		0.000			0.000			0.254			0.000	
p-value F-test [5]=[6]			0.000			0.000			0.004			0.000

Notes: The dependent variables are bank-level C&I loan growth (columns 1-3), total asset growth (columns 4-6), real estate loan growth (columns 7-9), and liquid asset growth (columns 10-12). The regressions are run in a bank-level panel over 1977-2010. Large banks have total assets larger than 90 million U.S. dollars (in constant 2010 prices). Intangible capital growth, house price growth, per capital income growth, population growth, and firm sales growth are at the MSA level. Bank size, capital, and total asset growth are at the bank level. All regressions include bank and MSA level controls as in the baseline regressions (Table 2), as well as 8 additional interaction terms of bank capital and size and house price growth. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6: Corporate intangible capital and bank portfolio allocations—Heterogeneity by bank size and capital

	C&I loans			Bank assets			Real estate loans			Liquid assets		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth*Large bank	-0.0182			-0.0063			-0.0023			0.0023		
	(0.012)			(0.004)			(0.008)			(0.009)		
IK growth*Low capital		-0.0525***			-0.0086*			-0.0316***			0.0660***	
		(0.014)			(0.005)			(0.009)			(0.011)	
IK growth*Large*Low capital			-0.0615***			-0.0135**			-0.0343***			0.0637***
			(0.017)			(0.006)			(0.011)			(0.014)
IK growth*Large*High capital			-0.0104			-0.0168***			-0.0006			-0.0066
			(0.016)			(0.005)			(0.009)			(0.011)
IK growth*Small*Low capital			-0.0518***			-0.0189***			-0.0279**			0.0629***
			(0.018)			(0.006)			(0.012)			(0.013)
HP growth*Large bank	0.0373			0.0115			0.1101***			-0.0252		
	(0.033)			(0.012)			(0.022)			(0.023)		
HP growth*Low capital		0.0540			0.1978***			0.1045***			-0.0535	
		(0.049)			(0.018)			(0.035)			(0.039)	
HP growth*Large*Low capital			0.0364			0.2077***			0.1840***			-0.0223
			(0.063)			(0.024)			(0.043)			(0.047)
HP growth*Large*High capital			-0.0383			0.0221			0.0876**			0.0824*
			(0.058)			(0.023)			(0.036)			(0.045)
HP growth*Small*Low capital			-0.0274			0.2050***			0.0673			0.0497
			(0.067)			(0.024)			(0.045)			(0.048)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99,377	99,377	99,125	109,257	109,257	108,994	101,145	101,145	100,910	85,380	85,380	85,250
R-squared	0.224	0.224	0.224	0.403	0.404	0.406	0.381	0.381	0.381	0.366	0.367	0.367
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are bank-level C&I loan growth (columns 1-3), total asset growth (columns 4-6), real estate loan growth (columns 7-9), and liquid asset growth (columns 10-12). The regressions are run in a bank-level panel over 1977-2010. Bank size, capital, and total asset growth are at the bank level. All regressions include bank and MSA*year interacted fixed effects. All regressions include bank-level controls as in the baseline regressions (Table 2). Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7: Corporate intangible capital and bank portfolio allocations—Ruling loan demand out as a possible channel (1)

	Negative correlation			**Low correlation**			**No Granger causality**		
	C&I loans	Bank assets	RE loans	C&I loans	Bank assets	RE loans	C&I loans	Bank assets	RE loans
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Intangible assets and house prices									
Coefficient estimate	-0.0259***	0.0021	0.0105*	-0.0297***	-0.0033	0.0095*	-0.0221**	-0.0004	0.0161**
Standard error	(0.009)	(0.003)	(0.006)	(0.008)	(0.003)	(0.005)	(0.011)	(0.004)	(0.007)
No. observations	42,283	46,553	42,327	59,797	65,325	60,486	41,699	45,821	42,105
B. Intangible assets and pc hh income									
Coefficient estimate	-0.0305***	-0.0044	0.0116**	-0.0198*	-0.0035	0.0181***	-0.0141	-0.0013	0.0112*
Standard error	(0.009)	(0.003)	(0.006)	(0.010)	(0.003)	(0.007)	(0.009)	(0.003)	(0.006)
No. observations	55,324	60,614	56,156	57,981	63,585	58,840	44,780	49,170	45,318
C. Intangible assets and total hh income									
Coefficient estimate	-0.0227**	-0.0008	0.0122**	-0.0200**	-0.0030	0.0167***	-0.0156*	-0.0011	0.0116*
Standard error	(0.009)	(0.003)	(0.006)	(0.010)	(0.003)	(0.006)	(0.009)	(0.003)	(0.006)
No. observations	52,968	58,045	53,777	60,160	65,955	61,192	45,011	49,422	45,554
MSA- and bank-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are bank-level C&I loan growth, total asset growth, and real estate loan growth. The table reports the coefficient estimate on corporate intangible capital growth from regressions that restrict the sample to banks in the MSAs where the loan demand channel is likely to be weak, as reflected in a correlation between corporate intangible capital growth and the three macro variables that is either negative (columns 1-3), lower in absolute value than 25% (columns 4-6) or does not indicate Granger causality from the macro variable to corporate intangible capital growth based on up to 2 lags (columns 7-9). The macro variables considered are house price growth (Panel A), per capita household income growth (Panel B), and total household income (Panel C). The regressions are run in a bank-level panel over 1977-2010. All regressions include the bank and MSA level control variables from the baseline specification (Table 2), as well as bank and year fixed effects. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 8: Corporate intangible capital and bank portfolio allocations—Ruling loan demand out as a possible channel (2)

	No housing boom 2000-2007			**No housing boom 1990-2007**		
	C&I loans	Bank assets	RE loans	C&I loans	Bank assets	RE loans
	(1)	(2)	(3)	(4)	(5)	(6)
A. HP increase below median						
Coefficient estimate	-0.0296***	-0.0014	0.0098	-0.0162	0.0026	0.0132*
Standard error	(0.010)	(0.003)	(0.006)	(0.011)	(0.003)	(0.007)
No. observations	44,801	49,453	45,823	47,541	52,233	48,715
B. HP increase below 75th percentile						
Coefficient estimate	-0.0328***	0.0006	0.0118**	-0.0268***	-0.0018	0.0073
Standard error	(0.008)	(0.003)	(0.005)	(0.008)	(0.003)	(0.005)
No. observations	64,487	70,873	65,453	61,318	67,285	62,421
C. HP increase below 90th percentile						
Coefficient estimate	-0.0256***	-0.0005	0.0128**	-0.0250***	-0.0005	0.0094*
Standard error	(0.008)	(0.003)	(0.005)	(0.008)	(0.003)	(0.005)
No. observations	72,662	79,716	73,719	73,500	80,718	74,513
MSA- and bank-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are bank-level C&I loan growth, total asset growth, and real estate loan growth. The table reports the coefficient estimate on corporate intangible capital growth from regressions that restrict the sample to banks in the MSAs that did not experience a housing boom during 2000-2007 (columns 1-3) or 1990-2007 (columns 4-6). A housing boom is defined as the average rise of house prices over each period considered, in a given MSA, being above the sample median (Panel A) or in the top 75th percentile (Panel B). The regressions are run in a bank-level panel over 1977-2010. All regressions include the bank and MSA level control variables from the baseline specification (Table 2), as well as bank and year fixed effects. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 9: Corporate intangible capital and bank profitability

	Net interest margins		
	(1)	(2)	(3)
Intangible capital growth	-0.0142***	-0.0110***	-0.0036*
	(0.002)	(0.002)	(0.002)
House price growth		0.1532***	0.1887***
		(0.007)	(0.009)
Pc income growth		-0.0436***	0.0720***
		(0.013)	(0.018)
Population growth		0.2859***	0.2632***
		(0.027)	(0.055)
Firm sales growth		-0.0009	0.0005
		(0.002)	(0.002)
Bank size		0.0009***	-0.0013
		(0.000)	(0.001)
Bank capital		0.0319***	0.0542***
		(0.006)	(0.014)
Bank asset growth	-0.2027***	-0.2232***	-0.3453***
	(0.004)	(0.004)	(0.005)
Observations	75,920	75,920	75,920
R-squared	0.048	0.060	0.248
Year FE	No	No	Yes
Bank FE	No	No	Yes

Notes: The dependent variable is bank's net interest margins. The regressions are run in a bank-level panel over 1977-2010. Bank size, capital, and total asset growth are at the bank level. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 10: Corporate intangible capital and bank portfolio allocations—Identification using interstate bank branching deregulation

	C&I loans		Bank assets		RE loans		Liquid assets	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IK growth*Regulated	-0.0444***	-0.0308*	-0.0008	0.0005	0.0604***	0.0429***	-0.0041	-0.0068
	(0.016)	(0.016)	(0.005)	(0.006)	(0.012)	(0.012)	(0.013)	(0.013)
IK growth	0.0140**	-0.0130	-0.0151***	-0.0255***	-0.0080	-0.0098	-0.0050	0.0058
	(0.007)	(0.008)	(0.002)	(0.003)	(0.005)	(0.006)	(0.006)	(0.006)
HP growth*Regulated	-0.0128*	-0.0139*	0.0017	0.0020	-0.0032	0.0002	0.0156***	0.0156***
	(0.007)	(0.007)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
Pc income growth*Regulated		0.1127***		0.0177*		-0.0412*		-0.0502**
		(0.035)		(0.011)		(0.024)		(0.024)
Population growth*Regulated		0.3506***		0.0875***		-0.0826		-0.0947*
		(0.066)		(0.023)		(0.055)		(0.052)
Firm sales growth*Regulated		0.1678		0.3943***		1.1593***		-0.2311**
		(0.133)		(0.051)		(0.108)		(0.111)
Regulated		0.0237		0.0101*		-0.0325**		-0.0146
		(0.017)		(0.005)		(0.013)		(0.014)
Bank and MSA-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	62,430	62,430	68,474	68,474	62,837	62,837	53,136	53,136
R-squared	0.182	0.183	0.339	0.341	0.315	0.317	0.301	0.301

Notes: The dependent variable is bank-level C&I loan growth (columns 1-2), total asset growth (columns 3-4), real estate loan growth (columns 5-6), and liquid asset growth (columns 7-82). The regressions are run in a bank-level panel over 1977-2010. Regulated takes value 1 for states in the years before interstate bank branching deregulation. The sample is restricted to banks in the MSAs that are contained within one state. All regressions include bank and year fixed effects, as well as bank level controls and all the macro variables from the baseline specifications (Table 2). The regressions are run in a bank-level panel over 1977-2010. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Appendix

Figure A1: Variable definitions and sources

	Variable definitions	
	Definition	Data source
Firm variables		
Intangible capital	Capitalized past expenditures on R&D, SG&A, and computerized information and software (IT)	Falato, Kadyrzhanova and Sim (2013) based on Compustat
Firms' sales	Total firm sales	Compustat
Bank variables		
C&I loans	Commercial and industrial loans, in US$ or divided by total assets. For years 1976-2000, we use RCON1600 divided by RCON2170. For years 2001-2010, we use (RCON1755+RCON1766) divided by RCON2170. If RCON1755 is missing, we use RCON1766 instead.	US Call Reports, Chicago Fed website https://www.chicagofed.org/banking/financial-institution-reports/commercial-bank-data
Real estate loans	RCON1410. Split into residential real estate loans (RCON1430+RCON1460) and commercial real estate loans (the difference between total and residential real estate loans)	US Call Reports
Liquid assets	Summation of cash (RCON0010), government securities (RCON0040 + RCON0600+RCON0900 before 1984; RCON0400+RCON0600+RCON0402 between 1983-1994; and RCON0211+RCON1286+RCON1289+RCON1291+ +RCON1294+RCON1297+RCON8496+RCON8498 after 1993), net interbank position (assets - liabilities in federal funds market, i.e. RCON1350-RCON2800 before 2002; and RCON987+RCONB989-RCONB993-RCONB995 after 2002) and mortgage backed securities (RCON8639 before 2009 and RCONG857+RCONG860 after 2008)	US Call Reports
Bank size	Log of total bank assets (RCON2170)	US Call Reports
Bank capital	Total equity (RCON3210) divided by total assets (RCON2170)	
Macro variables		
House price index	All transactions seasonally-adjusted house price index at the MSA level	Federal Housing Finance Agency website http://www.fhfa.gov/DataTools/Down
Per capita household income	Per capital household income at the MSA level	Bureau of Economic Analysis Loan Area Personal Income accounts, website http://www.bea.gov/regional/downloadzip.cfm
Population	Total MSA-level population	Bureau of Economic Analysis Loan Area Personal Income accounts, website http://www.bea.gov/regional/downloadzip.cfm
Regulated	Indicator for single-state MSAs until the year of interstate bank branching deregulation	Michalski and Ors (2012)

Table A1: Corporate intangible capital and bank portfolio allocations—Components of intangible capital

	Exclude IT				**R&D**				**SG&A**			
	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth	-0.0192***	0.0005	0.0119***	0.0093**	-0.0122**	0.0001	0.0045	-0.0018	-0.0180***	0.0003	0.0123***	0.0082*
	(0.006)	(0.002)	(0.004)	(0.004)	(0.005)	(0.002)	(0.003)	(0.004)	(0.006)	(0.002)	(0.004)	(0.004)
HP growth	0.1073***	0.1469***	0.2125***	-0.2163***	0.1107***	0.1450***	0.2130***	-0.2134***	0.1076***	0.1468***	0.2125***	-0.2165***
	(0.018)	(0.006)	(0.013)	(0.014)	(0.019)	(0.007)	(0.013)	(0.015)	(0.018)	(0.006)	(0.013)	(0.014)
Pc income growth	0.1955***	0.1912***	0.0315	-0.0008	0.2077***	0.2319***	0.0554*	0.0039	0.1952***	0.1912***	0.0318	-0.0006
	(0.036)	(0.013)	(0.027)	(0.028)	(0.043)	(0.014)	(0.031)	(0.033)	(0.036)	(0.013)	(0.027)	(0.028)
Population growth	0.6905***	0.7391***	1.8830***	-1.0019***	0.6730***	0.7453***	1.9132***	-0.9853***	0.6901***	0.7392***	1.8829***	-1.0013***
	(0.101)	(0.038)	(0.088)	(0.078)	(0.107)	(0.040)	(0.093)	(0.083)	(0.101)	(0.038)	(0.088)	(0.078)
Firm sales growth	0.0119*	0.0095***	0.0053	0.0012	0.0254***	0.0071***	0.0027	-0.0131**	0.0122**	0.0095***	0.0053	0.0010
	(0.006)	(0.002)	(0.004)	(0.005)	(0.008)	(0.003)	(0.005)	(0.006)	(0.006)	(0.002)	(0.004)	(0.005)
Bank size	-0.0129***	-0.0285***	-0.0096***	0.0009	-0.0122***	-0.0283***	-0.0104***	0.0012	-0.0129***	-0.0285***	-0.0096***	0.0010
	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)
Bank capital	0.1171***	0.1588***	0.0713***	-0.1035***	0.1135***	0.1558***	0.0700***	-0.1060***	0.1170***	0.1588***	0.0713***	-0.1035***
	(0.032)	(0.015)	(0.021)	(0.025)	(0.034)	(0.016)	(0.022)	(0.026)	(0.032)	(0.015)	(0.021)	(0.025)
Bank asset growth	0.6107***		0.5803***	0.9867***	0.6107***		0.5788***	0.9822***	0.6107***		0.5803***	0.9867***
	(0.011)		(0.008)	(0.010)	(0.012)		(0.008)	(0.011)	(0.011)		(0.008)	(0.010)
Observations	99,890	109,710	101,623	86,057	93,040	102,340	94,671	80,155	99,890	109,710	101,623	86,057
R-squared	0.168	0.339	0.318	0.293	0.167	0.340	0.319	0.294	0.168	0.339	0.318	0.293
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table explores the robustness of the results to alternative definitions of intangible capital. The dependent variables are bank-level C&I loan growth, total asset growth, real estate loan growth, and liquid asset growth. In columns 1-4 the definition of intangible capital excludes IT expenditure; in columns 5-8 it only considers the R&D component of total intangible capital, and in columns 9-12 it focuses on the SG&A component. The regressions are run in a bank-level panel over 1977-2010. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A2: Corporate intangible capital and bank portfolio allocations—Additional controls

	Control for % of rated firms				**Control for # of patents**				**Control for # of citation-weighted patents**			
	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth	-0.0197***	0.0006	0.0133***	0.0089*	-0.0415***	-0.0056	0.0288***	0.0068	-0.0420***	-0.0057	0.0279***	0.0077
	(0.006)	(0.002)	(0.004)	(0.005)	(0.012)	(0.004)	(0.007)	(0.008)	(0.012)	(0.004)	(0.007)	(0.008)
HP growth	0.1067***	0.1465***	0.2120***	-0.2161***	0.1319***	0.1417***	0.2281***	-0.2277***	0.1317***	0.1416***	0.2282***	-0.2278***
	(0.018)	(0.006)	(0.013)	(0.014)	(0.023)	(0.008)	(0.016)	(0.017)	(0.023)	(0.008)	(0.016)	(0.017)
Pc income growth	0.1941***	0.1903***	0.0299	0.0010	0.2261***	0.2480***	-0.0083	0.0272	0.2258***	0.2480***	-0.0091	0.0274
	(0.036)	(0.013)	(0.027)	(0.028)	(0.050)	(0.016)	(0.034)	(0.037)	(0.050)	(0.016)	(0.034)	(0.037)
Population growth	0.6794***	0.7324***	1.8716***	-0.9918***	0.5993***	0.8442***	2.3029***	-1.0977***	0.6011***	0.8446***	2.3058***	-1.0999***
	(0.101)	(0.038)	(0.088)	(0.078)	(0.131)	(0.046)	(0.092)	(0.092)	(0.131)	(0.046)	(0.092)	(0.092)
Firm sales growth	0.0119*	0.0096***	0.0057	0.0011	0.0525***	0.0100***	0.0139*	-0.0286***	0.0527***	0.0101***	0.0144*	-0.0290***
	(0.006)	(0.002)	(0.004)	(0.005)	(0.012)	(0.004)	(0.008)	(0.009)	(0.012)	(0.004)	(0.008)	(0.009)
Bank size	-0.0127***	-0.0284***	-0.0094***	0.0008	-0.0111***	-0.0251***	-0.0088***	-0.0038*	-0.0111***	-0.0251***	-0.0089***	-0.0038*
	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Bank capital	0.1170***	0.1588***	0.0714***	-0.1035***	0.1434***	0.1594***	0.0594**	-0.1184***	0.1435***	0.1594***	0.0596**	-0.1185***
	(0.032)	(0.015)	(0.021)	(0.025)	(0.042)	(0.019)	(0.028)	(0.031)	(0.042)	(0.019)	(0.028)	(0.031)
Bank asset growth	0.6105***		0.5800***	0.9869***	0.6063***		0.5554***	0.9980***	0.6063***		0.5554***	0.9980***
	(0.011)		(0.008)	(0.010)	(0.013)		(0.009)	(0.012)	(0.013)		(0.009)	(0.012)
% rated firms	0.0154**	0.0086***	0.0136***	-0.0106**	0.0014							
	(0.007)	(0.003)	(0.005)	(0.005)	(0.002)							
# patents						0.0003	-0.0022*	0.0027*	0.0020	0.0004	0.0001	0.0008
						(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Observations	99,890	109,710	101,623	86,057	75,953	83,739	77,061	65,876	75,953	83,739	77,061	65,876
R-squared	0.168	0.339	0.318	0.293	0.169	0.358	0.320	0.304	0.169	0.358	0.320	0.304
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table explores the robustness of the results to additional controls. The dependent variables are bank-level C&I loan growth, total asset growth, real estate loan growth, and liquid asset growth. In columns 1-4 we add the MSA-level share of firms with an S&P rating; in columns 5-12 we add the MSA-level number of patents (simple summation in columns 5-8 and citation-weighted in columns 9-12). The regressions are run in a bank-level panel over 1977-2010. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A3: Corporate intangible capital and bank portfolio allocations—Alternative approaches

	Specifications in levels				**Keep MSAs with at least 3 firms**				**Match banks and firms on state**			
	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth	-0.0022*	0.0172**	-0.0010	0.0065***	-0.0231**	-0.0040	0.0141**	0.0055	-0.0333***	0.0123***	0.0051	0.0333***
	(0.001)	(0.007)	(0.001)	(0.002)	(0.010)	(0.003)	(0.006)	(0.008)	(0.008)	(0.002)	(0.005)	(0.006)
HP growth	-0.0001**	0.0055***	0.0003***	-0.0005***	0.1001***	0.1494***	0.2196***	-0.2100***	0.1158***	0.0780***	0.1390***	-0.1697***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.020)	(0.007)	(0.014)	(0.015)	(0.013)	(0.004)	(0.008)	(0.009)
Pc income growth	0.0002	0.0004	0.0004	-0.0004	0.2166***	0.2301***	0.0643*	-0.0175	0.0848***	0.2414***	-0.0659***	0.1295***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.044)	(0.014)	(0.033)	(0.034)	(0.032)	(0.009)	(0.020)	(0.020)
Population growth	-0.0068	0.3559***	0.0693***	0.0237***	0.6325***	0.7470***	1.9507***	-1.0088***	1.6284***	1.0494***	2.6976***	-1.7218***
	(0.008)	(0.065)	(0.016)	(0.008)	(0.109)	(0.040)	(0.096)	(0.083)	(0.102)	(0.035)	(0.078)	(0.069)
Firm sales growth	0.0031***	-0.0067	-0.0039***	-0.0022**	0.0326***	0.0098***	-0.0003	-0.0051	0.0368***	0.0086***	0.0003	-0.0207***
	(0.001)	(0.005)	(0.001)	(0.001)	(0.010)	(0.003)	(0.006)	(0.008)	(0.007)	(0.002)	(0.005)	(0.005)
Bank size	0.0664***	-1.6842***	-0.0506***	0.0382**	-0.0119***	-0.0272***	-0.0102***	0.0001	-0.0117***	-0.0209***	-0.0041***	0.0001
	(0.014)	(0.089)	(0.014)	(0.015)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Bank capital	-0.0099***		0.0141***	-0.0215***	0.1275***	0.1595***	0.0753***	-0.1150***	0.0864***	0.0855***	0.0368***	-0.0990***
	(0.002)		(0.003)	(0.003)	(0.035)	(0.016)	(0.023)	(0.027)	(0.018)	(0.008)	(0.012)	(0.012)
Bank asset growth					0.6064***		0.5760***	0.9768***	0.6102***		0.5604***	1.0708***
					(0.012)		(0.009)	(0.011)	(0.007)		(0.005)	(0.006)
Observations	131,076	131,296	131,076	118,541	86,125	94,947	87,592	74,001	272,816	299,715	278,031	240,717
R-squared	0.697	0.928	0.821	0.694	0.168	0.341	0.322	0.293	0.127	0.285	0.265	0.293
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table explores the robustness of the results to additional tests. The dependent variables are bank-level C&I loan growth, total asset growth, real estate loan growth, and liquid asset growth in all columns other than 1-4, where they are C&I loans (as a share of total loans), bank size (log-total assets), real estate loans (as a share of total loans), and liquid assets (as a share of total assets). In columns 1-4 the explanatory variables are also in levels (per capita income, population, and firm sales are log-transformed). In the remaining columns we revert to the usual specification in growth rates. In columns 5-8 we limit the sample to the banks in MSAs for which intangible capital is computed based on at least three Compustat firms. In columns 9-12 we match banks and firms on state (rather than MSA) and all macro controls are at the state (rather than MSA) level. The regressions are run in a bank-level panel over 1977-2010. Standard errors are clustered on bank. *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A4: Corporate intangible capital and bank portfolio allocations—Alternative clustering

	Double cluster on bank and year				**Cluster on MSA**				**Double cluster on MSA and year**			
	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets	C&I loans	Bank assets	RE loans	Liquid assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
IK growth	-0.0204**	0.0002	0.0127**	0.0092#	-0.0204**	0.0002	0.0127**	0.0092#	-0.0204**	0.0002	0.0127**	0.0092#
	(0.008)	(0.003)	(0.005)	(0.007)	(0.009)	(0.003)	(0.006)	(0.007)	(0.010)	(0.004)	(0.006)	(0.008)
HP growth	0.1073***	0.1468***	0.2125***	-0.2165***	0.1073***	0.1468***	0.2125***	-0.2165***	0.1073***	0.1468***	0.2125***	-0.2165***
	(0.030)	(0.022)	(0.051)	(0.033)	(0.027)	(0.013)	(0.027)	(0.029)	(0.032)	(0.023)	(0.053)	(0.034)
Pc income growth	0.1957***	0.1912***	0.0314	-0.0009	0.1957***	0.1912***	0.0314	-0.0009	0.1957***	0.1912***	0.0314	-0.0009
	(0.053)	(0.029)	(0.078)	(0.058)	(0.063)	(0.036)	(0.067)	(0.051)	(0.070)	(0.041)	(0.090)	(0.066)
Population growth	0.6911***	0.7392***	1.8827***	-1.0017***	0.6911***	0.7392***	1.8827***	-1.0017***	0.6911**	0.7392***	1.8827***	-1.0017***
	(0.173)	(0.089)	(0.308)	(0.210)	(0.247)	(0.064)	(0.273)	(0.189)	(0.264)	(0.089)	(0.363)	(0.245)
Firm sales growth	0.0117	0.0095**	0.0054	0.0012	0.0117	0.0095***	0.0054	0.0012	0.0117	0.0095**	0.0054	0.0012
	(0.010)	(0.004)	(0.006)	(0.007)	(0.008)	(0.003)	(0.006)	(0.007)	(0.011)	(0.004)	(0.006)	(0.008)
Bank size	-0.0129***	-0.0285***	-0.0096***	0.0009	-0.0129***	-0.0285***	-0.0096***	0.0009	-0.0129***	-0.0285***	-0.0096***	0.0009
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.001)	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Bank capital	0.1170***	0.1588***	0.0714**	-0.1035***	0.1170***	0.1588***	0.0714***	-0.1035***	0.1170***	0.1588***	0.0714**	-0.1035***
	(0.035)	(0.022)	(0.026)	(0.034)	(0.032)	(0.022)	(0.026)	(0.025)	(0.034)	(0.027)	(0.030)	(0.035)
Bank asset growth	0.6107***		0.5803***	0.9867***	0.6107***		0.5803***	0.9867***	0.6107***		0.5803***	0.9867***
	(0.013)		(0.019)	(0.019)	(0.014)		(0.011)	(0.014)	(0.015)		(0.020)	(0.021)
Observations	99,890	109,710	101,623	86,057	99,890	109,710	101,623	86,057	99,890	109,710	101,623	86,057
R-squared	0.168	0.339	0.318	0.293	0.168	0.339	0.318	0.293	0.168	0.339	0.318	0.293
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table explores the robustness of the results to alternative clustering levels. The dependent variables are bank-level C&I loan growth, total asset growth, real estate loan growth, and liquid asset growth. In columns 1-4 standard errors are double-clustered on bank and year; in columns 5-8 they are clustered on MSA; and in columns 9-12 they are double-clustered on MSA and year. The regressions are run in a bank-level panel over 1977-2010. # indicates statistical significance at the 15% level, *** at the 1% level, ** at the 5% level, and * at the 10% level.