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The effects of banking market structure on corporate cash holdings and the value of cash☆

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ABSTRACT

We investigate the impact of the local banking market structure on the level of corporate cash holdings and the value of cash. We find that, in more concentrated banking markets, firms increase their cash holdings by issuing more equity. The marginal value of $1 cash increases by 10 cents with a one-standard-deviation increase in bank concentration. The positive relationship between bank concentration and value of cash is robust to a rich set of tests such as for firms having access to bond markets or firms using syndicated loans and is more prominent for more financially constrained firms. We also explore the mechanism, and our results suggest that in more concentrated banking markets firms demand more cash to shield against default risk.

1. Introduction

How does the local banking market impact firms? Prior studies have examined the effects of banking market structure on firms' access to external finance (e.g., Chong et al., 2013; Guzman, 2000; Klein, 1971; Petersen and Rajan, 1995; Ratti et al., 2008; Sharpe, 1990), corporate innovation (Cornaggia et al., 2015), product market competition (Saidi and Streitz, 2021) and the performance of local economies (e.g., Cetorelli and Gambera, 2001; Diallo and Koch, 2018). Remarkably, the literature on the way in which banking market structure impacts firms' access to external finance has not reached a consensus, with two relevant theories providing fundamentally competing predictions of the relationship between bank concentration and firms' access to external finance. On the one hand, the market power theory (Klein, 1971) suggests that a monopolistic or oligopolistic banking market endows banks with strong market power and enables them to maximize profits by charging high rates on loans and paying low interest rates on deposits, leading to lower credit supply and more stringent credit rationing (e.g., Canales and Nanda, 2012; Guzman, 2000). The decrease in the credit supply and the increase in the cost of bank loans result in more financial constraints and worse access to external finance for businesses (e.g., Beck et al., 2004; Chong et al., 2013; Love and Martínez Pería, 2015; Rice and Strahan, 2010). On the other hand, information-based models point to a positive relationship between bank concentration and firms' access to external finance (e.g., Petersen and Rajan,

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1995), because market concentration strengthens lending relationships and increases credit supply at a lower price than in a competitive banking market (e.g., Bräuning and Fecht, 2017; Sette and Gobbi, 2015), improving firms' access to external finance (e.g., Cetorelli and Gambera, 2001; Han et al., 2017; Ratti et al., 2008; Wang et al., 2020; Zarutskie, 2006). We join the debate and conduct research from a novel perspective, examining the effects of bank concentration on the value of corporate cash holdings to evaluate the impact of banking market structure on firms' access to external finance.

Value of cash is the figure that shareholders place on a firm's liquid assets. The literature has established that firms with more investment opportunities but constrained access to external finance have more valuable cash (Faulkender and Wang, 2006; Gamba and Triantis, 2008). Therefore, value of cash is used as an indicator of a firm's access to external finance (e.g., Denis and Sibilkov, 2010; Karpuz et al., 2020; Pinkowitz et al., 2006); ceteris paribus, a higher value of cash indicates greater difficulty in obtaining funds externally. By examining the effect of bank concentration on the value of cash, we can compare the value of cash between firms located in high, and firms located in low, bank concentration areas, and then determine the area in which firms hold more cash to reduce the higher costs of raising external finance. The second key feature is that the value of cash is assigned by the market, instead of being determined by the firm. If one evaluates a firm's access to external finance by examining firm-level financial characteristics such as investment and the level of cash, one encounters an identification issue because, for example, investment and level of cash are influenced by managers' risk-taking (e.g., Liu and Mauer, 2011; Malmendier and Tate, 2005) and are not, therefore, appropriate indicators for firms' access to external finance. Estimating the value of cash allows us to minimize these concerns, because the value of cash is determined by the market instead of by managers, and is therefore, arguably, a more precise indicator.

We use banking market concentration at the state level in the U.S. to capture cross-sectional variation in banking market structure. Specifically, we use the Herfindahl–Hirschman Index (*HHI*) and the Concentration Ratio (CR_3) to measure bank concentration. These measures have been widely used in the literature to study the effects of bank concentration (e.g., Berger and Hannan, 1989; Chong et al., 2013; Saidi and Streitz, 2021). Using these measures, we begin by revisiting the relationship between banking market structure and firms' cash holdings and find that when the local banking market is more concentrated, firms hold more cash. A one-standard-deviation increase in CR_3 is associated with an increase in corporate cash holdings by 1.1 percentage points, equivalent to around $31 million for an average firm. This positive relationship, established for a sample period after the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) of 1994,[1] is in line with prior evidence that firms hold less cash after state-level banking deregulation (Francis et al., 2014). Based on this finding, we take a further step and explore how firms finance their increased cash holdings in more concentrated banking markets. Our results show that such firms have lower retained earnings and issue a similar amount of debt but substantially more equity, demonstrating that they issue equity to finance their higher cash holdings.

Next, we examine the effect of bank concentration on the value of cash. The market power theory proposes that firms have worse access to external finance when the banking market is more concentrated and, therefore, their value of cash should be greater. By contrast, information theory predicts a favorable effect of bank concentration on firms' access to external finance, according to which their value of cash should be lower. To evaluate these two competing predictions, we employ Faulkender and Wang's (2006) framework to estimate the value of cash, and then interact bank concentration with the value of cash coefficient to test the effect of bank concentration on the value of cash. We find that the value of cash is greater when the local banking market is more concentrated. Specifically, with a one-standard-deviation increase in bank concentration, the marginal value of $1 cash increases by 10 cents, equivalent to a 6.8 % increase in the mean value of cash. Our results are robust to alternative measures of bank concentration, including those at the Core-Based Statistical Area level, and to alternative estimation methods. The results are also robust to the use of (Pinkowitz et al., 2006) model to estimate the value of cash, and to firms having access to alternative financing sources, such as bonds and syndicated loans. Overall, these results support the hypothesis we derive by applying the spirit of the market power theory that indicates that firms have worse access to external finance in more concentrated banking markets and that cash holdings are then more valuable. Our results demonstrate that the market power theory provides a more convincing explanation than the information theory of the relationship between banking market structure and firms' access to external finance.

We perform three tests to examine whether the observed effect of bank concentration on the value of cash is subject to endogeneity problems. First, we use propensity score matching to construct a quasi-experiment, and find that the observed positive effect holds. Specifically, for firms subject to the treatment of having their headquarters in a state with greater banking market concentration, the value of cash is greater. Second, we use the placebo test to randomize and reorder the concentration index within the state, and find that the positive effect disappears, indicating that the positive relationship between bank concentration and value of cash is not likely to be driven by an unobservable feature that coincides with state-level bank concentration. Third, we conjecture that, if the observed positive relationship is driven by banks' market power, non-borrowing firms should not be influenced by local banking market concentration. We investigate firms that are not currently borrowing and will not borrow in the near future, and find that their value of cash is independent of banking market concentration, supporting our conjecture. These results reassure us that the positive relationship between bank concentration and value of cash is not subject to endogeneity problems.

We then examine the heterogeneity in the effect of bank concentration on the value of cash, and find that the positive relationship is more prominent for smaller, younger, and more financially constrained firms. For example, when we use the *KZ index* to measure financial constraints, the average bank concentration effect on the value of cash is 1.77 for unconstrained firms but 1.87 for financially

[1] The IBBEA permitted well-capitalized and well-managed banks to open branches or acquire banks in other states after September 29, 1995, providing a uniform set of rules regarding banking in each state. The intention was to remove restrictions on interstate and intrastate banking and branching at the federal level, and the IBBEA greatly improved competition in the U.S. banking market.

constrained firms, and the difference is statistically significant. These results indicate that financially constrained firms, with their greater demand for external finance, are more sensitive to a change in the local banking market structure.

Finally, we examine the possible reasons for the higher level and greater value of cash in more concentrated banking markets, in terms of the roles played by cash in reducing transaction costs, creating precautionary savings and shielding against default risk. We conduct tests to investigate these three channels separately. Our results, from a series of tests, reject the transaction costs motive channel and the precautionary savings motive channel, but support the default risk shielding channel. These results suggest that, in a more concentrated banking market, firms need to hold more cash to shield against default risk, which provides an explanation for the higher level and greater value of cash.

Our study makes novel contributions to three strands of literature. First, by providing evidence from a new perspective we evaluate the relative validity of market power theory (Klein, 1971) and information theory (Petersen and Rajan, 1995) in explaining the effect of banking market structure on firms' access to external finance. These two theories offer competing predictions on the relationship between bank concentration and firms' access to external finance, and empirical studies also provide contradictory results (Berger et al., 2004; Love and Martínez Pería, 2015). In terms of the value of cash, market power theory predicts a positive effect of bank concentration on the value of cash, whereas information theory predicts a negative effect. Our results demonstrate that the value of cash is greater in more concentrated banking markets, suggesting that firms in these markets should hold more cash and implying that there is worse access to external finance for businesses in these markets. Therefore, our results demonstrate that market power theory is more convincing than information theory in explaining the effect of banking market structure on firms' access to external finance.

Second, we extend the literature on the value of cash by investigating an important supply-side factor, banking market structure. The extant literature has examined the value of cash and its determinants, showing that corporate governance quality (Dittmar and Mahrt-Smith, 2007), CEO overconfidence (Aktas et al., 2019), firm diversification (Tong, 2011), financial reporting quality (Karpuz et al., 2020), degree of financial constraint (Denis and Sibilkov, 2010; Faulkender and Wang, 2006), investment opportunities, and cash flow volatility (Bates et al., 2018) impact the value of cash. Less is known, however, about how the credit supply side impacts the value of cash. We fill this important research gap by demonstrating that an important supply-side factor, local banking market concentration, impacts the value of cash. This supply-side effect is robust to whether firms have alternative financing sources, such as access to bond markets and the use of syndicated loans across their state borders. This paper is part of the literature on how the credit supply side impacts corporate financial decision making (e.g., Baker, 2009; Leary, 2009; Lemmon and Roberts, 2010). In addition, our results indicate that the secular increase in bank concentration after the IBBEA could be an important driving factor in the secular increases in the level and value of cash which have been documented in the literature (Bates et al., 2009, 2018).

Third, we extend the literature on the cash holding policy of firms by showing that firms issue more equity to fund their higher cash holdings in more concentrated banking markets. While prior studies (e.g., Francis et al., 2014; Pinkowitz and Williamson, 2001) have indicated a positive relationship between bank market power and the level of cash, it is not yet known how firms accumulate cash. We show that, in more concentrated banking markets, firms have fewer retained earnings, issue a similar amount of debt to firms in less concentrated banking markets, and finance their greater cash holdings by issuing substantially more equity. This result is surprising, because equity finance is associated with relatively higher costs and firms are notoriously reluctant to issue equity given its costs (Myers and Majluf, 1984). Our results imply that a concentrated banking market is inefficient, as firms have to resort to the costliest financing source (i.e., equity finance) to accumulate cash to avoid financial distress.

In a prior study, Francis et al. (2014) examine the impact on the level of cash of state-level banking deregulation from 1971 to 1994. Apart from using different sample periods, tests and variables, our research brings new knowledge to the table. Specifically, considering that the level of cash has a negative impact on the value of cash (Faulkender and Wang, 2006; Gamba and Triantis, 2008) and that bank deregulation promotes competition and has a negative impact on the level of cash (Francis et al., 2014), one would expect a positive relationship between bank competition and value of cash, and, because of this, a negative relationship between bank concentration and value of cash. However, we document a positive relationship; this is different from what one would anticipate from the prior literature. Our results indicate that the stock market sees firms' cash holdings as more valuable in more concentrated banking markets, and assigns a greater value to cash. In addition, while Francis et al. (2014) demonstrate that firms hold a lower level of cash after state-level banking deregulation, the argument that a competitive banking market increases firms' access to external finance and reduces their demand for cash is questionable because of the prior finding that, when the banking market becomes more competitive, banks lose their market power and are less able to impose covenants and persuade firms to accumulate cash and deposits in their bank accounts (Pinkowitz and Williamson, 2001). According to Weinstein and Yafeh (1998) and Pinkowitz and Williamson (2001), firms are persuaded by powerful banks in concentrated banking markets to increase cash holdings for rent extraction, instead of pursuing their own optimums; therefore, increasing cash holdings may benefit their creditors but jeopardize their shareholders. We study the value of cash because this is more objective and reflects the market's valuation of corporate cash holdings, which is beyond the firms' or the banks' control. Therefore, value of cash can better demonstrate whether firms should hold more cash and the impact of banking market structure on firms' access to external finance.

The remainder of this paper is organized as follows. Section 2 discusses the U.S. banking market, with a focus on the increased bank concentration after the passage of the IBBEA. Section 3 reviews the literature and develops hypotheses for the relationship between bank concentration and value of cash. Section 4 details the construction of our variables, the data collection and the method of valuing cash. Section 5 presents the empirical results. Section 6 explores the channels of the impact. Section 7 discusses and concludes the paper.

2. U.S. banking market structure

U.S. banking market regulations and restrictions started to be lifted in the 1970s. Before that, the banking market was under strict regulation, and banks were not freely permitted to set up new branches outside their home states. Intrastate banking regulations were removed from the 1970s onwards, allowing banks to acquire other branches or to open new branches within the state. Maine was the first state to remove its interstate banking restrictions, in 1978, permitting banks from outside the state to open new branches (Jayaratne and Strahan, 1997). Since then, the U.S. banking market has witnessed a great wave of deregulation. As a result, operationally profitable and efficient banks have gained more market share while inefficient banks have been acquired, leading to a significant improvement in market efficiency. The assets of bank branches set up outside their headquarter states rose dramatically from the inception of this possibility in the mid-1970s to 23 % in the mid-1990s (Chava et al., 2013). In 1994, the IBBEA was introduced, with the intention of removing restrictions on interstate banking and branching at the federal level.

The U.S. banking market structure changed dramatically after the passage of the IBBEA. Fig. 1 illustrates the increase of 80 % in the total number of bank branches from 1994 to 2007 but the drop of 30 % in the number of banks, indicating that many banks were taken over and transformed into branches of other banks. Kerr and Nanda (2009) observed that the drop in the number of banks was more prominent among small banks. Furthermore, because of the impact of the 2008 financial crisis on the promotion of bank mergers and acquisitions (Kowalik et al., 2015) and the increasing popularity of digital banking and banking technologies (Fox, 2013; Fox and Beier, 2006), the U.S. banking market witnessed reductions in the numbers of banks and also of branches after 2011.

Following non-local banks being permitted to enter a market, the number of local banks drops. We calculate the percentage of local banks (or branches) to total banks (branches), and the trends are illustrated in Fig. 2. We define a bank as local if it had a branch in the state in 1994. Fig. 2 shows that the percentage of local banks fell from 100 % in 1994 to approximately 70 % by 2018, indicating that 30 % of the banks in 2018 were not local banks. The percentage of branches owned by local banks decreased from 100 % in 1994 to around 54 % in 2018, indicating that non-local banks made up nearly half of the banking market by the end of 2018.

The number of branches per head of population increased initially, but eventually dropped towards the 1994 level. Fig. 3 illustrates the evolution of the cross-state distribution of bank branches. The median number of branches per 1000 people initially increased, from 0.28 in 1994 to 0.33 in 2011. The rise is associated with a decline in the number of banks per head of population, as displayed in Fig. 4. These results show that, despite the greater number of branches to which individuals had access, many of these new branches belonged to a smaller number of banks, indicating that the remaining banks had gained higher market share. Further, Fig. 3 shows that the median number of branches per 1000 people decreased from 0.33 in 2011 to around 0.3 in 2018, which is close to the 1994 level, suggesting that the increased number of bank branches after the IBBEA vanished. All three quartile breakpoints in Fig. 3 move together, showing that the evolution of bank branches was homogeneous across states. When it comes to the number of banks per population (Fig. 4), the median and the 25 % quartile boundary show a steady but mild decrease. The 75 % quartile boundary decreases more drastically, showing that the decrease in bank competition was most prominent in states that previously had a competitive banking market.

Overall, the U.S. banking market has become increasingly concentrated since the IBBEA, with the number of banks continuing to decrease. Banks have become bigger by acquiring branches and their market shares have risen, granting banks greater market power in the states in which they operate.

3. Bank concentration and value of cash: development of hypotheses

3.1. Literature on the value of cash

A firm's cash holding policy impacts the wealth of its shareholders in an imperfect capital market. On the one hand, cash reserves benefit firms, by enabling them to avoid the transaction costs of raising external finance (Baumol, 1952), to reduce their refinancing risk (Harford et al., 2014) and to shield against a default (Arnold, 2014; Peat, 2008). On the other hand, cash holdings lead to both opportunity costs (Baumol, 1952) and agency costs (Jensen, 1986) being incurred. Thus, the optimal level of cash is determined by the tradeoff between the benefits and the costs of holding cash, and it can increase if the cost of external finance is higher (Kim et al., 1998). In an empirical study, Opler et al. (1999) examine the determinants of cash holdings and establish that firms with worse access to external finance hold more cash as a buffer to avoid the costs of converting cash substitutes into cash.

Faulkender and Wang (2006) develop an empirical model and use a firm's stock return with respect to the change in its cash holdings to estimate the marginal value of cash. They find that cash is more valuable if investment opportunities are available but the firm has limited access to capital markets (e.g. if it has no bond rating or commercial paper rating). Gamba and Triantis (2008) provide theoretical support and prove that the marginal value of liquidity is greater for firms with more investment opportunities, lower liquidity, and higher costs of external finance. Subsequent studies use Faulkender and Wang's (2006) framework to examine the variation in the value of cash. For example, it has been shown that the value of cash is higher for firms with good quality corporate governance (Dittmar and Mahrt-Smith, 2007) and overconfident CEOs (Aktas et al., 2019), but lower for those with more business diversification (Tong, 2011). Meanwhile, Bates et al. (2018) find that the value of cash increases over time and that the secular increase is driven by investment opportunities, cash flow volatility, product market competition, credit market risk, and within-firm diversification. Pinkowitz et al. (2006) use an alternative model to estimate the value of cash and find that it is lower in countries with poor investor protection. Despite the rich evidence on how firms' characteristics determine the value of cash, prior studies are silent on the effects of credit supply-side variation or, in other words, how the supply of funds influences the value of cash after controlling for firm-level characteristics. One would expect that, if the supply of credit is sufficient and a firm's access to external finance is not

constrained, cash holdings would be less valuable because the firm can easily raise funds externally and investors would prefer it to hold less cash to reduce opportunity costs and agency costs. By contrast, if the supply of credit is insufficient, cash holdings would be more valuable because investors would prefer the firm to hold more cash so that it does not miss investment opportunities.

3.2. Bank concentration and value of cash

3.2.1. Bank concentration, market power and value of cash

Klein (1971) establishes a market power theory according to which a monopolistic or oligopolistic banking market enables banks to maximize profits by charging high rates on loans and paying low interest rates on deposits. Extant studies have documented empirical evidence supporting the market power theory. For example, Berger and Hannan (1989) show that, in a more concentrated banking market, banks pay lower deposit rates. Mi and Han (2020) report that the prices of syndicated loans are higher if the lead bank is from a more concentrated banking market. Furthermore, a concentrated banking market results in lower credit supply and more stringent credit rationing. Guzman (2000) develops a model for the impact of banking market competition and shows that a monopolistic banking system increases credit rationing, which has an adverse impact on capital accumulation. Empirically, Black and Strahan (2002) show that U.S. banking deregulation removing intrastate and interstate banking restrictions had a positive impact on new incorporations. Canales and Nanda (2012) demonstrate that decentralized banks offer more loans to small businesses in Mexico. Using survey data, Chong et al. (2013) report that local banking market concentration is associated with severe financial constraints in China. These studies establish that market concentration enables banks to increase the cost of loans and strengthen credit rationing, leading to worse access to external finance for firms.

The market power theory predicts a positive relationship between bank concentration and the value of cash. In high bank concentration areas, where the cost of bank loans is high and the supply of capital is low, firms can avoid the high transaction costs and reduce the risk of financial distress by holding more cash, resulting in investors preferring firms with more cash holdings. As a result, investors assign a greater value to cash. Conversely, in low bank concentration areas, where firms can receive bank loans at a low cost, holding cash is less beneficial, and we would expect the value of cash to be lower. Therefore, we develop our first hypothesis:

Hypothesis 1a. *According to market power theory, bank concentration is positively associated with value of cash.*

3.2.2. Bank concentration, lending relationships, and value of cash

In contrast to market power theory, information-based models propose that, in more concentrated banking markets, banks with great market power have strong incentives to acquire private information and build lending relationships because they can subsidize firms at the beginning of the lending relationship and extract rents later (Petersen and Rajan, 1995; Sharpe, 1990). Such a lending relationship, established through multiple interactions between borrowers and lenders, is not, however, sustainable in a competitive banking market where information is dispersed and banks only have information about a small number of borrowers (Marquez, 2002). Therefore, market concentration enables banks to invest in building up lending relationships and to provide loans at a lower cost than in a competitive banking market. Extant studies have documented evidence supporting the information theory. For example, Petersen and Rajan (1995) show that, in a concentrated banking market, creditors are more inclined to fund credit-constrained firms. Zarutskie (2006) reports that newly formed firms have been more financially constrained after the U.S. banking market deregulation. Sette and Gobbi (2015) and Bräuning and Fecht (2017) suggest that lending relationships foster credit supply and reduce the cost of bank loans. Ratti et al. (2008) show that firms in a highly concentrated banking market are less financially constrained and that their investments are less sensitive to cash holdings. Overall, these studies assert that market concentration enables banks to build lending relationships with borrowers, which reduces the cost of loans and increases firms' access to external finance.

Information-based models point to a negative relationship between bank concentration and value of cash. According to these models, in high bank concentration areas where banks develop strong lending relationships with local businesses, firms have better access to external finance and cash holdings benefit firms to a smaller extent. Therefore, investors would prefer firms not to accumulate cash, and they assign a lower market value to cash. Conversely, in low bank concentration areas where it is difficult for lending relationships to persist, banks would raise the price of loans and firms would benefit more from their cash holdings, leading to a greater value of cash. Hence, we develop our second hypothesis:

Hypothesis 1b. *According to information theory, bank concentration is negatively associated with value of cash.*

4. Variables, data and the empirical model

4.1. Bank concentration measures

We use cross-state variation in bank concentration for three reasons. First, defining a local banking market for a business at the county or MSA (Metropolitan Statistical Area) level is no longer appropriate because of the improved ability of both borrowers and lenders to transact more distantly and beyond the boundary of a county or MSA (Radecki, 1998). Second, those multi-market banks that operate in different MSAs but within the same state tend to set uniform prices for their branches in different MSAs (Heitfield and Prager, 2004). Third, although the IBBEA removed federal-level interstate banking restrictions, states have considerable leeway in how they govern the entry of banks from other states (Rice and Strahan, 2010). We therefore use cross-sectional variations in bank concentration at the state level to test our hypotheses. In a robustness test, we measure bank concentration at the CBSA (Core-Based Statistical Area) level, following the most up-to-date standards used by the Office of Management and Budget (OMB) to define

metropolitan and micropolitan areas.

Following the literature (e.g., Berger and Hannan, 1989; Chong et al., 2013; Saidi and Streitz, 2021), we use the Herfindahl–Hirschman Index (*HHI*: the sum of the squared market shares) and the Concentration Ratio (CR_3: the sum of the market shares of the largest three banks in the state) to measure bank concentration for the state in which a firm has its headquarters.[2] *HHI* is calculated using the following equation:

$$HHI_j = \sum_{k=1}^{K} s_{kj}^2, \tag{1}$$

where s_{kj} stands for the deposit market share of bank k in state j and K is the number of banks in state j. We collect bank deposit data from the Federal Deposit Insurance Corporation (FDIC) at the branch level. The sample period is from 1994 to 2018. We then determine the state-level bank deposits by aggregating the deposits from all branches of bank k located in state j.[3] We use Eq. (1) to calculate the level of bank concentration for each state-year. CR_3 is calculated as the sum of the market shares of the largest three banks in the state. These two measures are widely used and are regarded as exogenous indicators of banking market concentration (Berger et al., 2004). The mean values of *HHI* and CR_3 between 1994 and 2018 are 0.087 and 0.426, respectively. Both variables have values between 0 and 1, and a higher value represents a higher degree of bank concentration.

4.2. Firm characteristics

We collect firm data from *Compustat* and match firm data with bank concentration data using the firms' headquarters. We exclude regulated firms in finance (SIC codes 6000–6999) and utility (4900–4949) sectors. We define the variables in Appendix 1 and report their descriptive statistics in Table 1. We use those firm-year observations with adequate information to perform both the cash level and the cash value regressions to report our main results.[4] The variables are winsorized at the 1st and 99th percentiles to reduce the impact of outliers. A typical firm in our sample has $2753 million of total assets, with $518 million (18.8 %) of the assets being cash and short-term investments.

We examine the distribution of sample firms and firm-year observations across states with the state average *HHI*, CR_3, and corporate cash holdings. Arkansas, Iowa, Illinois, Indiana, Kansas, Kentucky, Missouri, North Dakota, and Oklahoma have relatively lower values of *HHI* and CR_3, indicating more competitive banking markets in these states. Firms located in these states have much lower cash holdings than firms in the states with more concentrated banking markets, such as District of Columbia, Delaware, Maine, Puerto Rico, and Utah. Detailed data on bank concentration and average cash holdings for each individual state are reported in Table OA1 of the online appendix.

4.3. Valuing cash

We utilize (Faulkender and Wang, 2006) framework to estimate the marginal value of cash:

$$r_{i,t} - R_{i,t}^B = r_0 + \beta_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma X + \varepsilon_{i,t}, \tag{2}$$

where $r_{i,t} - R_{i,t}^B$ is firm i's excess stock return in year t, calculated as the firm's stock return $r_{i,t}$ minus the return of its benchmark portfolio $R_{i,t}^B$. The benchmark portfolio is the Fama and French 25 Portfolio. $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ is the change in cash holdings (C) in year t scaled by the lagged market value of equity, $M_{i,t-1}$. The coefficient β_1 directly measures the extent to which a $1 change in cash leads to a change in the firm's market value of equity, and it reflects how much the stock market values corporate cash holdings. X is a vector of variables controlling for changes in earnings (ΔE), net assets (ΔNA), R&D expenses (ΔRD), interest expenses (ΔI), and dividends (ΔD), the firm's net financing (NF), the one-year lagged cash holdings, and the leverage ratio (L). We interact the bank concentration measures (*HHI* and CR_3) with the cash value coefficient to test the effect of bank concentration on the value of cash. Specifically, we estimate the following equation:

[2] Because financial reporting information is not available at the branch level, it is not possible to accurately construct non-structural measures for banking market competition (e.g., using H-statistics or the Lerner Index) at the state or metropolitan level. To construct these non-structural measures, branch-level financial statement data are essential because multiple branches from different states could belong to the same institution. For example, KeyBank National Association (Cert ID: 17534) has branches in WA, VT, NH, MI, ID, KY, AK, OH, and NY, etc., but their financial statement data are only available at the institutional level, headquartered in state OH.

[3] Although competition is mainly between banks but not branches of the same bank, our finding is robust to using branch-level data. Specifically, we calculate the branch-per-population (branches per 1,000 people) and use it as a robustness check measure of the banking market structure. We find a negative impact of branch-per-population on the value of cash, which is consistent with our main finding. This result is reported in Table OA6 of the online appendix.

[4] Our key finding of a positive relationship between bank concentration and value of cash is robust to including the observations with adequate information to run the cash value regression but insufficient data to run the cash level regression. These results are reported in Table OA2 of the online appendix.

$$r_{i,t} - R^{B}_{i,t} = r_0 + \beta_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \beta_2 \frac{\Delta C_{i,t}}{M_{i,t-1}} \times Concentration_{i,t-1} + \beta_3 Concentration_{i,t-1} + \gamma X + \varepsilon_{i,t}, \quad (3)$$

where a positive (negative) coefficient β_2 indicates that a greater bank concentration increases (decreases) the value of cash. We incorporate dummy variables to control for fixed effects at the state, industry and year levels, following Cornaggia et al. (2015). We cluster errors by firm and year, following Thompson (2011).

5. Empirical results

5.1. Bank concentration, corporate cash holdings, and source of cash

We start our empirical analysis by revisiting the relationship between bank concentration and level of cash. While the literature has implied a positive relationship,[5] we still know little about whether this holds in the post-IBBEA periods when we quantify bank concentration taking the nuances into account. We incorporate the bank concentration measures into the regression model of Bates et al. (2009) to test the effect of bank concentration on the level of cash. Our results in Table 2 show a positive relationship, indicating that firms hold more cash when their banking market is more concentrated. According to columns (1) and (2), for a typical firm with $2753 million of assets (the mean value of firm size), a one-standard-deviation increase in *HHI* (0.051) and CR_3 (0.111) is associated with an increase in cash and short-term investments of $15.57 million and $31.15 million, respectively. The increase is statistically significant and is robust to using cash without short-term investments to calculate the cash to assets ratio as reported in columns (3) and (4).

Further, we explore how firms in high bank concentration states finance their increased cash holdings. Specifically, we partition the sample firms into two subgroups based on whether their banking market concentration is higher or lower than the sample mean value. Then, we calculate and test the differences in the annual changes in retained earnings, net debt issuance, and net equity issuance for these two subgroups of firms.

The results, shown in Table 3, suggest that firms in high bank concentration states finance their increased cash holdings by issuing more equity. Panel A of Table 3 shows that the mean cash ratio of firms in high bank concentration states is 0.229, while it is 0.161 for those in low bank concentration states. The difference is statistically significant at the 1 % level. Further firms in high bank concentration states have lower values of return on assets (ROA), retained earnings, and cash flow. These results indicate that firms in a more concentrated banking market are less able to generate funds internally, which can be explained by the theory of rent extraction by powerful banks (Weinstein and Yafeh, 1998). The net debt issuance of firms in concentrated banking markets is marginally greater, whereas their net equity issuance is substantially greater. A typical firm in a high concentration banking market issues $300 million (= 0.109×2753 million) more equity than a firm in a low concentration banking market. These results are robust if we compare sample median values in columns (4)-(6), using CR_3 as an alternative measure of bank concentration in Panel B, and if we use annual median values of bank concentration to partition the sample firms in Panels C and D. These results suggest that firms in high bank concentration states have lower income through earnings and issue a similar amount of debt; however, they issue significantly more equity to cover their loss in earnings and their high cash holdings. This finding is surprising because equity finance is associated with high costs, and is the last resort in the pecking order of financing sources (Myers and Majluf, 1984). However, our results show that, to avoid financial distress, firms in concentrated banking markets have to incur the direct costs of issuing equity, as well as the likely decline in their stock prices following the announcement of the equity offering, just to park money on their balance sheets.

5.2. Effect of bank concentration on the value of cash

We first replicate (Faulkender and Wang, 2006) regression model using more recent data (i.e., 1995–2019) and controlling for fixed effects at the state, industry and year levels. Column (1) of Table 4 shows that the marginal value of $1 cash is $1.457 for a zero-cash and zero-leverage firm. Our estimate is economically close to the marginal value of $1.466 reported by Faulkender and Wang (2006) based on a sample period from 1971 to 2001. Among the control variables, we find that changes in earnings ($\Delta E_{i,t}$), changes in net assets ($\Delta NA_{i,t}$), lagged cash holdings ($C_{i,t-1}$), and net financing ($NF_{i,t}$) are positively correlated with excess stock return, while changes in interest expenses ($\Delta I_{i,t}$) and leverage ratio ($L_{i,t}$) are negatively correlated with excess stock return. These results are consistent with those reported by Faulkender and Wang (2006). Changes in R&D expenses ($\Delta RD_{i,t}$) and dividends ($\Delta D_{i,t}$) remain positive but are statistically insignificant in predicting excess stock return.

We interact the cash value coefficient with our bank concentration measures to test the effect of bank concentration on the value of cash, and our results demonstrate a positive relationship. Specifically, Table 4 shows that, with a one-standard-deviation increase in *HHI* (column 2) or CR_3 (column 3), the marginal value of $1 cash increases by 10 cents (= 1.968×0.051 or 0.956×0.111). In columns (4)-(5), we measure *HHI* and CR_3 at the CBSA level following the Office of Management and Budget's (OMB) 2015 definition of a geographic area based on the data of the 2010 Census. Our main finding, the positive relationship between bank concentration and value of cash, is robust. Our results indicate that the value of cash is greater when the local banking market is more concentrated,

[5] Pinkowitz and Williamson (2001) show that Japanese firms held more cash than U.S. and German firms when Japanese banks had high market power in the 1970s and early 1980s. Francis et al. (2014) find that firms held a lower level of cash after the U.S. state-level banking deregulation from 1971 to 1994.

implying that it is more difficult for firms to access external finance in more concentrated banking markets and therefore that cash holdings are more valuable. Overall, the results in Table 4 support our *Hypothesis 1a* and suggest that the market power theory provides a more convincing explanation than the information theory of the effect of banking market structure on firms' access to external finance.

Next, we employ alternative estimation methods to check the robustness of our findings. First, we follow Cameron and Miller (2015), who recommend clustering standard errors at an upper level (at the state, industry and year levels), to check the robustness of our findings. Second, we control for firm-level fixed effects to remove firm-specific unobservable heterogeneity. We find that the coefficients of $\Delta C_{i,t} \times Concentration_{i,t-1}$ remain positive and statistically significant, indicating that our key finding, the positive relationship between bank concentration and value of cash, is robust to these alternative estimation methods. These results are reported in Table OA3 of the online appendix.

Last but not least, we employ Pinkowitz et al.'s (2006) model as an alternative specification to examine the effect of bank concentration on the value of cash. Our base model following Faulkender and Wang (2006) is subject to criticisms that the change in cash, $\frac{\Delta C_{i,t}}{M_{i,t-1}}$, is correlated with control variables, such as earnings and net external finance, which may lead to inconsistent estimates, and that a change in cash holdings can be determined by either a change in total cash holdings or a change in the optimal level of cash (Dittmar and Mahrt-Smith, 2007). Pinkowitz et al. (2006) develop an alternative model to estimate the value of cash, interpreting the coefficient of liquid assets in determining firm value as the value of cash, and the model explains a substantial amount of the cross-sectional variation in firm values (Bates et al., 2009). Therefore, we use Pinkowitz et al.'s (2006) model as a robustness check and interact bank concentration with the coefficient of liquid assets. We continue to find a positive relationship, supporting our *Hypothesis 1a* derived from the market power theory. Specifically, the coefficient of the interaction term in Table 5, $L_{i,t} \times Concentration_{i,t-1}$ is positive, indicating that firms from a high concentration banking market have a higher value of cash. These results demonstrate that our finding is robust to using an alternative specification to estimate the value of cash.

5.3. Accessing alternative financing sources

We examine whether the observed relationship between bank concentration and value of cash is affected by the firm's access to alternative financing sources (bond markets and the syndicated loan market). The literature has used having a bond rating as an indicator of better access to capital markets and found that it impacts the level and value of cash (Faulkender and Wang, 2006; Opler et al., 1999). It is therefore important to examine whether the observed effect of local bank concentration holds for firms having access to bond markets. We follow the literature and use a dummy variable *Rating* to denote whether a firm has access to bond markets. First, we follow Opler et al. (1999) and define *Rating* as 1 if the firm has an S&P long term bond rating score of BBB- or above (the investment grade), and zero otherwise. Second, we follow Faulkender and Wang (2006) and define *Rating* as 1 if the firm has an S&P long term bond rating score of C or above, showing that the firm is not in default. According to the descriptive statistics in Table 1, 10.1 % of our sample firms have a rating score of BBB- or above, and 22.9 % of our sample firms have a rating score of C or above. We interact *Rating* with the cash value coefficient to control for the effects of having a bond rating on the value of cash, and examine whether the positive relationship between bank concentration and value of cash holds.

The results in Table 6 suggest that the supply-side effect of bank concentration on value of cash is robust to controlling for whether the firm has access to bond markets. Specifically, in columns (1) and (2), when we use $\triangle C_{i,t} \times Rating_{i,t-1}$ to control for the impact of having a bond rating on the value of cash, the coefficients of $\triangle C_{i,t} \times Concentration_{i,t-1}$ are economically close to those in our base results of Table 4 and remain statistically significant. In addition, the three-way interaction term, $\triangle C_{i,t} \times Concentration_{i,t-1} \times Rating_{i,t-1}$, is not statistically significant, indicating that the effect of bank concentration on value of cash is not subject to whether the firm has a bond rating. These results are robust to using a rating score of C or above to define a firm's access to bond markets, as shown in columns (3) and (4). Overall, our results demonstrate that the effect of bank concentration on value of cash is robust to whether the firm has access to bond markets.

We then test whether the observed relationship between bank concentration and value of cash is robust to whether the firm has access to the syndicated loan market. Syndicated loans have become an increasingly popular instrument for external finance, and enable firms to access bank loans beyond their state borders (Keil and Muller, 2020). An underlying assumption of our base tests is that firms borrow locally and are subject to the credit supply from local banks. Hence, the mechanism may not exist for firms that borrow distantly from other states and, in particular, for firms using syndicated loans across their state borders. Therefore, we check whether the observed effect of local bank concentration on value of cash is robust to a sample of firms that use syndicated loans. We collect syndicated loan data from DealScan to identify a subsample of firm-year observations with records of using syndicated loans. Then, we conduct our base tests for this subsample of firms.

The results in Table 7 show that the effect of bank concentration on the value of cash is robust to whether the firm uses syndicated loans. In columns (2)-(3), $\triangle C_{i,t} \times Concentration_{i,t-1}$ has positive signs, showing that local bank concentration is positively associated with the value of cash for the 12,069 firm-year observations where firms use syndicated loans. In columns (5)-(6), in which we use the 9196 observations for firms using syndicated loans led by banks from outside their state borders, the positive relationship remains significant. These results demonstrate that using syndicated loans does not eliminate the impact of the local banking market and that even for the firms using syndicated loans to borrow across their state borders, the impact of local banks remains.

Another interesting finding is that, for the firms with access to the syndicated loan market, the average value of cash is lower than the sample average. For example, the firms with a record of using syndicated loans have an average marginal value of cash at $0.985 (column 1), which is substantially lower than the $1.457 from our base model in Table 4. The figure for a firm using syndicated loans

led by a bank outside of their state decreases further to $0.634 (column 4). These results show that having access to syndicated loans reduces the benefits and necessity for a firm to hold cash; however, it does not remove the impact of the local banking market on value of cash.

5.4. Effect of bank concentration on the value of cash: dealing with endogeneity concerns

In addition to controlling for fixed effects at multiple levels to reduce unobservable heterogeneity, we perform three tests to examine whether the relationship between bank concentration and value of cash is subject to endogeneity problems.

First, we use propensity score matching (PSM) to construct a quasi-experiment to test our main conjecture. PSM is widely used to address the endogeneity concern related to a misspecification of the functional form (Shipman et al., 2017). We use PSM to construct a control group of firms from low concentration banking markets to compare with a treated group of firms being located in high concentration banking markets. We use the firm-level control variables in the cash value regression to match the sample firms. Specifically, we first use the firms located in the top 50 % high concentration banking markets of each year as the treated firms and look for one-to-one matched firms from the remaining sample to construct a control group. Second, we use the firms located in the top 25 % high concentration banking markets of each year as the treated firms and look for one-to-one matched firms from the bottom 25 % banking markets to construct a control group. This method of constructing a group of firms with similar characteristics to those in the treated group creates a quasi-experiment to test the effect of bank concentration on the value of cash. We find that the firms in the treated group have a greater value of cash than the firms in the control group, showing that the observed positive relationship between bank concentration and value of cash is robust to the quasi-experiment setting. For example, when we use the firms located in states with the top 50 % *HHI*, the average cash value of the treated group is $1.588, whereas it is $1.403 for the control group. These results are reported in Table OA4 of the online appendix.

Second, we follow Cornaggia et al. (2015) and use a placebo test to address the endogeneity concern that our results may be driven by omitted variables at the state level which coincide with banking market concentration. Since our model may miss important control variables influencing regional banking market structure and value of cash at the same time, we use the placebo test to remove the effects of bank concentration and examine whether the observed relationship disappears. Specifically, we randomly reorder the *HHI* and CR_3 index within the state and construct a randomized concentration index, *Concentration_random*. For example, the value of *Concentration_random* for Alaska in 2000 is a random value from its time series between 1994 and 2018. We maintain the distributions of *HHI* and CR_3 in each state. The random reordering by time disrupts the influence of bank concentration but keeps state-specific unobservable factors. We construct three sets of randomly reordered concentration indexes and expect that the observed positive relationship between bank concentration and value of cash will disappear. In contrast, a significant relationship would indicate that an unobservable factor at the state level is driving our results. The results show that the coefficients of $\triangle C_{i,t} \times Concentration\_random_{i,t\text{-}1}$ are not statistically significant, suggesting that the relationship between bank concentration and value of cash is not driven by omitted state-specific factors. These results demonstrate that our baseline model does not suffer from the endogeneity problem of omitting state-specific characteristics. These results are reported in Table OA5 of the online appendix.

Third, we partition the sample firms according to their use of debt finance, to test whether there is a causal relationship between bank concentration and value of cash. As the positive relationship is expected to be driven by the impact of banks' market power, firms not borrowing from banks should not be influenced by changes in banking market concentration, and hence the relationship between bank concentration and value of cash should not hold for these firms. We test this conjecture and define firms as not borrowing if they do not have debt, either from a bank or from bond markets, two years running (from t to $t + 1$). Although this definition using annual report data does not monitor whether firms ever use bank loans, the identified firms are far less likely to borrow from a bank currently and in the near future than the other firms, and hence, we expect that these firms will be far less likely to be influenced by banks' market power.

The results in Table 8 are in line with our conjecture and suggest a causal relationship between bank concentration and value of cash. Columns (1)-(2) report a strong relationship between bank concentration and value of cash for the firms using debt. For example, the coefficient of $\triangle C_{i,t} \times Concentration_{i,t\text{-}1}$ is 2.316 in column (1), which is economically greater than the 1.968 from our base model for the full sample in Table 4. In line with our conjecture, we find little evidence of the relationship for the firms that do not borrow. As shown in columns (3)-(4), the coefficients of $\triangle C_{i,t} \times Concentration_{i,t\text{-}1}$ are not significantly different from zero, indicating little effect of bank concentration on the value of cash for the firms not using debt currently and in the near future. Therefore, we infer that bank concentration has a causal impact on the value of cash.

5.5. Effect of bank concentration on the value of cash: heterogeneity

We examine whether the relationship between bank concentration and value of cash is moderated by the degree of financial constraint. The existing literature has clearly established that financially constrained firms have worse access to external finance (e.g., Kaplan and Zingales, 1997; Whited and Wu, 2006), and that the effect of banking deregulation on such firms' cash holdings is stronger because financially constrained firms are more sensitive to the variation in credit supply (e.g., Francis et al., 2014). Hence, if bank concentration influences firms' value of cash through bank credit supply, the value of cash of financially constrained firms should be more sensitive to changes in bank concentration. To test this conjecture, we interact financial constraint measures with the cash value $\times$ bank concentration coefficient and apply different financial constraint proxies to check the robustness of our results. These proxies include firm size, dividend payment, firm age, the *KZ index* (Kaplan and Zingales, 1997), the *WW index* (Whited and Wu, 2006), and the *SA index* (Hadlock and Pierce, 2010). For the three financial constraint indexes, we use dummy variables in the regression analysis. A

firm with a value for these indexes greater than its industry-annual median value is assigned a value of 1, and 0 otherwise. Small and young firms, firms that do not pay dividends, and firms with greater values of the *KZ index*, the *WW index* and the *SA index* are regarded as more financially constrained firms. We lag the financial constraint measures for one period to address the reverse causality concern.

The results in Table 9 show that the sensitivity of cash value to bank concentration is greater for more financially constrained firms. The interaction term, $\Delta C_{i,t} \times Concentration_{i,t\text{-}1} \times \text{Constraints}_{i,t\text{-}1}$, has negative signs when we use firm size, dividend payment and firm age to measure financial constraints, and positive signs when we use *KZ index, WW index* and *SA index*. These results show that small and young firms, firms that do not pay dividends, and firms with high values of *KZ index, WW index* and *SA index* have a greater sensitivity of cash value to bank concentration than do their counterparts, supporting our conjecture. For example, when we use the *KZ index* to measure the degree of financial constraint, the average bank concentration effect on unconstrained firms is 1.770, whereas it is 1.868 ($= 1.770 + 0.098 \times 1$) for financially constrained firms. Overall, the results in Table 9 demonstrate that the effect of bank concentration on value of cash varies according to the degree of financial constraint. Using lagged financial constraint measures and demonstrating the heterogeneous bank concentration effects provide further exogeneity assurance for interpreting the causal relationship between bank concentration and value of cash.

6. Effect of bank concentration on the value of cash: channels of the impact

The previous section has presented empirical results and demonstrated that when the local banking market is more concentrated, firms hold more cash, and the value of cash is greater. A further question concerns the channel of the impact. To put this in another way, why do firms located in a more concentrated banking market need more cash and why does their cash have a greater value? In this section, we review the three motives for holding cash (i.e., reducing transaction costs, creating precautionary savings, and shielding against default risk), develop hypotheses, and empirically examine the mechanism for the relationship between bank concentration and value of cash.

6.1. Transaction costs motive channel

Businesses hold cash to reduce the transaction costs of external finance, which could be subject to bank concentration. In an imperfect market, buying or selling real assets is associated with transaction costs, and cash reserves help avoid or reduce such costs (Baumol, 1952). Firms that face higher transaction costs from raising external finance, such as those with riskier cash flows, demand more liquid assets (Opler et al., 1999), and the value of their cash is greater (Faulkender and Wang, 2006). Prior studies have investigated the transaction costs motive of holding cash by examining the sensitivity of corporate investments to cash holdings, and a positive relationship indicates that a firm's investments rely on and are sensitive to its cash reserves (e.g., Ratti et al., 2008; Chen and Chen, 2012). In the spirit of the market power theory, which has gained support from our Section 5, we conjecture that, if increased cash holdings are used to reduce the higher transaction costs for external finance in more concentrated banking markets, firms' investments should, for those firms located in more concentrated banking markets, rely more on their cash holdings. Conversely, the investment–cash sensitivity should be lower for firms located in more competitive banking markets.

Hypothesis 2. *Firms' investments are more sensitive to their cash holdings in more concentrated banking markets.*

To test the transaction costs motive channel, we follow the literature examining the effect of cash reserves on future investments (e.g., Chen and Chen, 2012; Ratti et al., 2008) by including the lagged cash ratio into the Euler equation specification of firm investments (Bond and Meghir, 1994).[6] We then interact the concentration measures with the lagged cash ratio to test whether the investment–cash sensitivity is greater in more concentrated banking markets. Specifically, we use the following regression model and control for state-, industry- and year-fixed effects:

$$\left(\frac{Capx}{ppent}\right)_{i,t} = \alpha_0 + \beta_0 Cash\ ratio_{i,t-1} + \beta_1 Cash\ ratio_{i,t-1} \times Concentration_{i,t-1} + \beta_2 Concentration_{i,t-1} + \beta_3 \left(\frac{Capx}{ppent}\right)_{i,t-1} + \beta_4 \left(\frac{Capx}{ppent}\right)^2_{i,t-1} + \beta_5 \left(\frac{CF}{ppent}\right)_{i,t-1} + \beta_6 \left(\frac{Sales}{ppent}\right)_{i,t-1} + \beta_7 \left(\frac{Debt}{ppent}\right)^2_{i,t-1} + \varepsilon_{i,t}, \tag{4}$$

The results in Table 10 show that the investment–cash sensitivity is lower when the banking market is more concentrated. For example, in column (2), the coefficient of $Cash\ ratio_{i,t\text{-}1} \times Concentration_{i,t\text{-}1}$ is negative and statistically significant (-0.279, $t=-2.22$), indicating that firms in more concentrated banking markets rely less on cash holdings for investments. This result is against our *Hypothesis 2* for the transaction costs motive channel but is in line with the results of Ratti et al. (2008), who analyze EU data and find that bank concentration and relationship-lending promote corporate investments. Therefore, our results reject the conjecture that bank concentration impacts corporate cash policy via the transaction costs motive channel.

[6] Our finding is robust to defining investments as (capital expenditures + M&A expenses + R&D expenses – Sales of property, plant and equipment + Investment to maintain existing assets) following Li et al. (2021) and Richardson (2006).

6.2. Precautionary motive channel

The precautionary purpose indicates that firms hold cash to protect them against negative cash flow shocks that mean they must cut dividends, liquidate their assets, or renegotiate their financial contracts (Bates et al., 2009; Keynes, 1936). The literature uses the cash flow sensitivity of cash to demonstrate the precautionary motive of cash holdings (e.g., Almeida et al., 2004; Chen et al., 2014; Harford et al., 2014), where a larger coefficient for cash flow indicates a higher propensity to save. Following this logic, we conjecture that, according to the market power theory in which a concentrated banking market is associated with lower credit supply, firms need more cash to shield against negative cash flow shocks and hence should have a higher propensity to save from cash flows. By contrast, in a competitive banking market where businesses can access external finance at a lower cost (e.g., with a low price of loans), the propensity to save should be lower.

Hypothesis 3. *Changes in cash are more sensitive to firms' cash flows in more concentrated banking markets.*

To examine the precautionary motive conjecture, we use Almeida et al.'s (2004) framework and interact the bank concentration measures with the cash flow variable to test whether firms save more from cash flows in more concentrated banking markets. Specifically, we use the following regression model and control for state-, industry-, and year-fixed effects:

$$\Delta Cash\ ratio_{i,t} = \alpha_0 + \beta_0 Cash\ flow_{i,t} + \beta_1 Cash\ flow_{i,t} \times Concentration_{i,t-1} + \beta_2 Concentration_{i,t-1} + Control\ variables + \varepsilon_{i,t}, \quad (5)$$

The results in Table 11 suggest that the relationship between bank concentration and value of cash is unlikely to be driven by the precautionary motive. In column (2), the coefficient of $Cash\ flow_{i,t-1} \times \text{Concentration}_{i,t-1}$ is not significant (−0.011, t=−0.99), indicating little relationship between bank concentration and firms' propensity to save. The coefficient is negative in column (3), where we use CR_3 to measure bank concentration, but again, a negative relationship does not support our *Hypothesis 3*. One possible explanation for our results is that firms in more concentrated banking markets have lower cash flows, as shown in Table 3; hence, they are less able to accumulate cash from cash flows than firms in more competitive banking markets. Therefore, our results reject the conjecture that bank concentration impacts the value of cash via the precautionary motive channel.

6.3. Default risk shielding channel

The default risk shielding motive suggests that firms hold cash to shield against default risk, because cash holdings provide a buffer that reduces the probability of corporate failure (e.g., Arnold, 2014; Peat, 2008). To examine the default risk shielding motive channel, we test the role of cash in shielding against default risk and whether bank concentration moderates such a role. The existing literature has noted that, in more concentrated banking markets with decreased credit supply and increased loan prices, firms are subject to greater liquidity risk (Detragiache et al., 2000). Hence, we expect that firms will demand more cash to shield against this high default risk and that investors with full information about this would prefer firms to hold more cash and assign a greater value to cash. By contrast, in competitive banking markets, firms can borrow from multiple channels and access more bank credits, giving them a form of insurance against default, and hence, they need less cash to shield against default risk and their cash holdings have a lower value. Therefore, if the relationship between bank concentration and value of cash is via the default risk shielding channel, we expect a negative relationship between corporate cash holdings and default risk, and that this buffer role of cash is weaker if the local banking market is more concentrated so that firms need more cash to achieve a certain level of safety.

Hypothesis 4. *The effect of cash in reducing default risk is weaker in more concentrated banking markets.*

To investigate the default risk shielding channel, we test the effect of cash in shielding against default risk and examine whether this effect depends on the level of bank concentration. We use the *Altman Z-score* (Altman, 1968) and the *probability of default hazard rate* (*PDH*) developed by Shumway (2001) to measure a firm's default risk. Both measures are constructed using a set of firm-level financial ratios, and a low *Z-score* (or a high value of *PDH*) indicates a high default risk. Specifically, we use the following regression model and control for firm-, state-, industry- and year-fixed effects:

$$Default\ risk_{i,t} = \alpha_0 + \beta_0 Cash\ ratio_{i,t} + \beta_1 Cash\ ratio_{i,t} \times Concentration_{i,t-1} + \beta_2 Concentration_{i,t-1} + Control\ variables + \varepsilon_{i,t}, \quad (6)$$

The results in Table 12 suggest that default risk shielding is likely a driving factor for the positive relationship between bank concentration and value of cash. Column (1) shows that the coefficient of lagged cash ratio is positive in determining the *Z-score* (11.30, t = 10.76), indicating that firms holding more cash have a lower default risk. The interaction term, $Cash\ Ratio_{i,t-1} \times \text{Concentration}_{i,t-1}$, is negative (−26.23, t=−2.85), showing that the buffer role of cash is weaker in more concentrated banking markets. Ceteris paribus, firms located in these markets need to hold more cash to achieve a certain *Z-score* and a certain level of safety. For example, if *HHI* increases by one standard deviation from the mean value of 0.087 to 0.138, an average firm needs to hold $52.3 million more of cash to increase Z-score by 1 unit.[7] This result is robust to using CR_3 to measure bank concentration in column (2). Furthermore, we use *PDH* to measure default risk in columns (3) and (4), and find that *Cash ratio* has a negative sign and, again, that the effect is partially mitigated by firms being located in more concentrated banking markets. These results indicate that firms in more

[7] To increase Z-score by one unit, ceteris paribus, firms in high-HHI states need to hold more cash. The calculation is $1/(11.30 - 26.23 \times 0.138) - 1/(11.30 - 26.23 \times 0.087) \approx 0.019$. Then, we use the total assets of an average firm times this increase in cash ratio to compute the cash needed, $2,753 million $\times$ 0.019 $\approx$ $52.3 million.

concentrated banking markets need to hold more cash to effectively reduce the probability of default. Overall, results in Table 12 are consistent with *Hypothesis 4* and suggest a reason why firms in high concentration banking markets hold more cash and why the market assigns a greater value to firms' cash holdings. In summary, our results reject the transaction costs motive channel and the precautionary savings motive channel but support the default risk shielding channel.

7. Discussion and conclusion

The literature debates the impact of banking market concentration on firms' access to external finance, with market power theory (Klein, 1971) predicting an unfavorable effect but information theory (Petersen and Rajan, 1995; Sharpe, 1990) suggesting a positive effect. By examining the effect of bank concentration on the value of corporate cash holdings, we join the debate by providing evidence from a novel perspective. We obtain robust evidence that, in more concentrated banking markets, cash is more valuable, suggesting that firms in these markets have worse access to external finance and that therefore the market rewards their cash holdings with a greater value. Conversely, firms in more competitive banking markets have a lower value of cash, suggesting that these firms have better access to external finance and benefit less from holding cash. Our results demonstrate that market power theory provides a more convincing explanation than information theory for the effect of banking market structure on firms' access to external finance. Furthermore, we find that the relationship between bank concentration and value of cash is more pronounced for financially constrained firms. After exploring the potential mechanisms for the positive relationship, we find that firms located in more concentrated banking markets need more cash to shield against default risk.

Our study also contributes to the literature exploring supply-side effects on corporate financial decisions, obtaining novel evidence that the local banking market structure impacts the value of cash. We find that the U.S. banking market has become increasingly concentrated since the IBBEA, with banks gaining greater market share and potentially greater market power. Considering our finding that an increase in bank concentration is associated with increased cash holdings and a greater value of cash, our results shed new light on the secular increases in the level and value of cash (Bates et al., 2009, 2018), which could be partially explained by the secular increase in banking market concentration.

Our results offer practical implications for both business managers and investors. First, our results suggest that, to mitigate the adverse impact of high bank concentration on accessing external finance, businesses need to hold more cash; they also suggest that the stock market reacts to the increased cash favorably by assigning it a greater value. We find that equity finance is the primary source for the higher level of cash, although issuing equity is usually associated with high costs. For investors, we show that, ceteris paribus, cash holdings have different values in markets with different degrees of bank concentration. We recommend that such a variation in the value of cash, driven by the local banking market and impacting the market value of a firm, should be factored into asset pricing models. We also recommend future research to explore how the local business environment impacts the pricing of assets from other perspectives. Managers and investors may rely on this future research to refine their strategies and optimize their financial decisions.

Another suggested direction for future research is whether the composition of lenders impacts corporate financial decisions and values. Borrowers, especially public corporations, may have dispersed banking relationships and borrow from multiple banks in the same or different banking markets (Bolton and Scharfstein, 1996). As a result, borrowers may be influenced by several lenders or banking markets. Therefore, with the availability of more detailed loan portfolio data, future research could investigate how the composition of lenders influences corporate financial decisions and ultimately value for shareholders.

CRediT authorship contribution statement

Shengfeng Li: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Liang Han:** Conceptualization, Methodology, Writing – review & editing, Writing – original draft, Supervision. **Biao Mi:** Methodology, Resources, Formal analysis, Writing – original draft.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jempfin.2023.101460.

Appendix 1 Definitions of variables

Variables	Definitions
Herfindahl-Hirschman Index (*HHI*)	The sum of squared deposit market share of banks in the state
Concentration ratio (CR_3)	The market share of the largest three banks in the state
HHI_CBSA	We use the core-based statistical area defined by the OMB using the 2010 Census as an alternative definition of local banking market to compute *HHI*.
CR_3_CBSA	We use the core-based statistical area defined by the OMB using the 2010 Census as an alternative definition of local banking market to compute CR_3.

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(*continued*)

Variables	Definitions
Cash ratio	Cash and short-term investments/assets
Cash/assets	Cash/assets as an alternative measure for the level of cash
Firm size (Assets)	Book value of total assets in million dollars
M/B ratio	(book value of assets - book value of equity + market value of equity)/book value of assets
Cash flow/assets	(Income before extraordinary items + depreciation and amortization)/assets
Net working capital/assets	Working capital net of cash/assets
Capital expenditures	Capital expenditures/assets
Leverage	Total debt/total assets
Industry sigma	Standard deviation of cash flows of the industry over the past 10 years
Dividend payment indicator	A dummy variable equalling 1 if the firm pays dividends and 0 otherwise
RD/sales	R&D expenses/sales
Acquisitions/assets	Acquisitions/assets
ROA	EBIT/total assets
△Retained earnings	Change in retained earnings/lagged total assets
Net debt issuance	Change in total debt/lagged total assets
Net equity issuance	(Change in Shareholders' equity - Change in retained earnings)/lagged total assets
Excess stock return ($r_{i,t} - R^B_{i,t}$)	Firm stock return - the stock's benchmark return using the Fama and French 25 Portfolio
$\triangle C_t$	Change in cash at year *t* scaled by market value of equity at *t-1*
C_{t-1}	Cash holdings at year *t-1* scaled by market value of equity at *t-1*
$\triangle E_t$	Change in earnings at year *t* scaled by market value of equity at *t-1*
$\triangle NA_t$	Change in net assets at year *t* scaled by market value of equity at *t-1*
$\triangle RD_t$	Change in R&D expenses at year *t* scaled by market value of equity at *t-1*
$\triangle I_t$	Change in interest expenses at year *t* scaled by market value of equity at *t-1*
$\triangle D_t$	Change in dividend payouts at year *t* scaled by market value of equity at *t-1*
Market leverage (L_t)	Total debt / (Total assets - Book value of equity + Market value of equity)
Net financing (NF_t)	Net external financing at year *t* scaled by market value of equity at *t-1*
Rating_investment	A dummy variable equalling one if the firm has an S&P long term bond rating score of BBB- or above, and 0 otherwise.
Rating_C	A dummy variable equalling one if the firm has an S&P long term bond rating score of C or above, and 0 otherwise.
Age	Number of years that the firm has records in *Compustat*
KZ index	We follow Kaplan and Zingales (1997) to measure a firm's financial constraints.
WW index	We follow Whited and Wu (2006) to measure a firm's financial constraints.
SA index	We follow Hadlock and Pierce (2010) to measure a firm's financial constraints.
Capx/ppent	Capital expenditures/property, plant, and equipment (net)
CF/ppent	(Income before extraordinary items + depreciation and amortization)/property, plant, and equipment (net)
Sales/ppent	Sales/property, plant, and equipment (net)
Debt/ppent	Total debt/property, plant, and equipment (net)
Z-score	We use Altman Z-score (Altman, 1968) to measure a firm's chance of bankruptcy. Z-score = 1.2*working capital/assets + 1.4*retained earnings/assets + 3.3*ebit/assets + 0.6*Market value of equity/Book value of liabilities + Sales/assets
Probability of Default Hazard (*PDH*)	We follow Shumway's (2001) Hazard model to measure a firm's probability of default. PDH = −3.226 – 0.732*working capital/assets −0.818*retained earnings/assets −8.946*ebit/assets −1.712*Market value of equity/Book value of liabilities + 0.158*Sales/assets + 0.015ln(age)

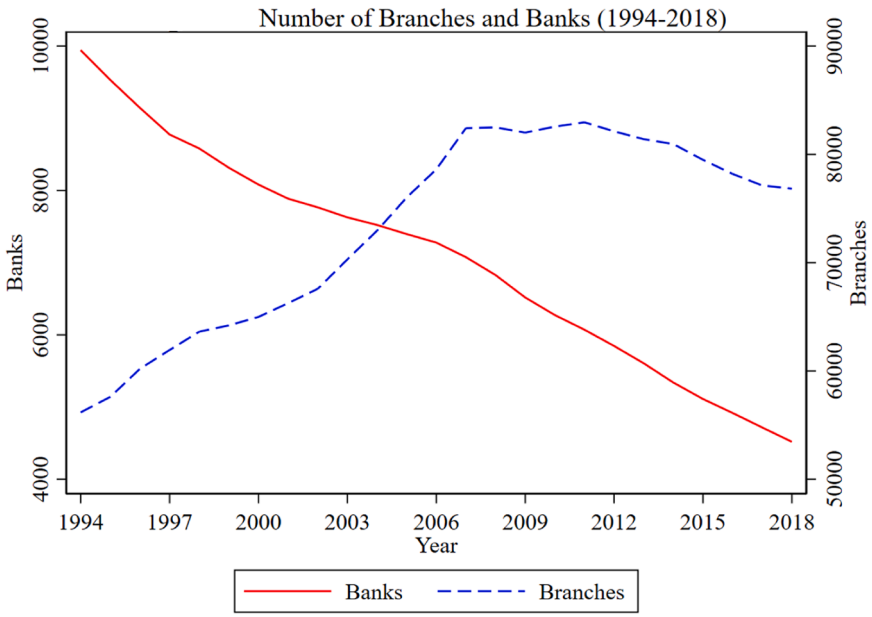

Fig. 1. This figure displays the trends in the number of banks and branches in the U.S. between 1994 and 2018. Data sources: FDIC.

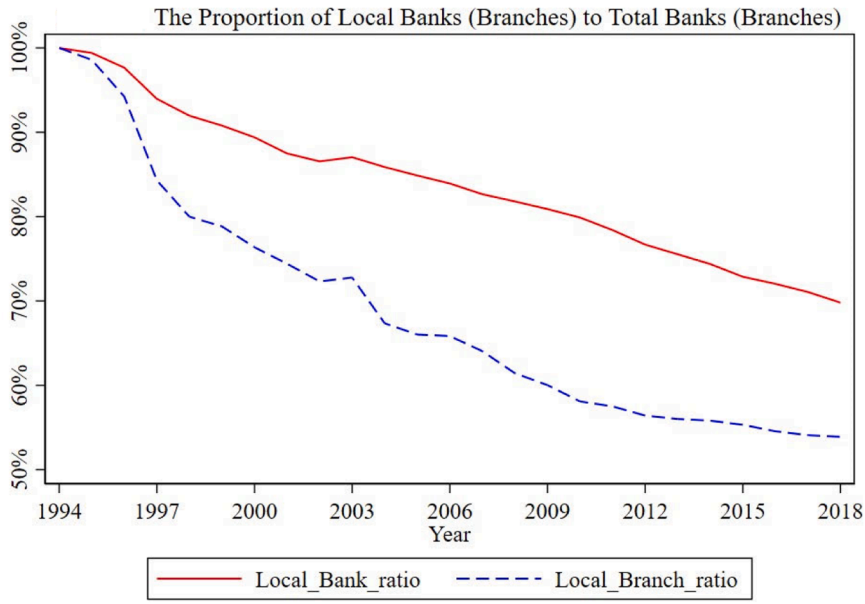

Fig. 2. displays the trend in the percentage of local banks (and branches) to total banks (branches) in the U.S. between 1994 and 2018. Data sources: FDIC.

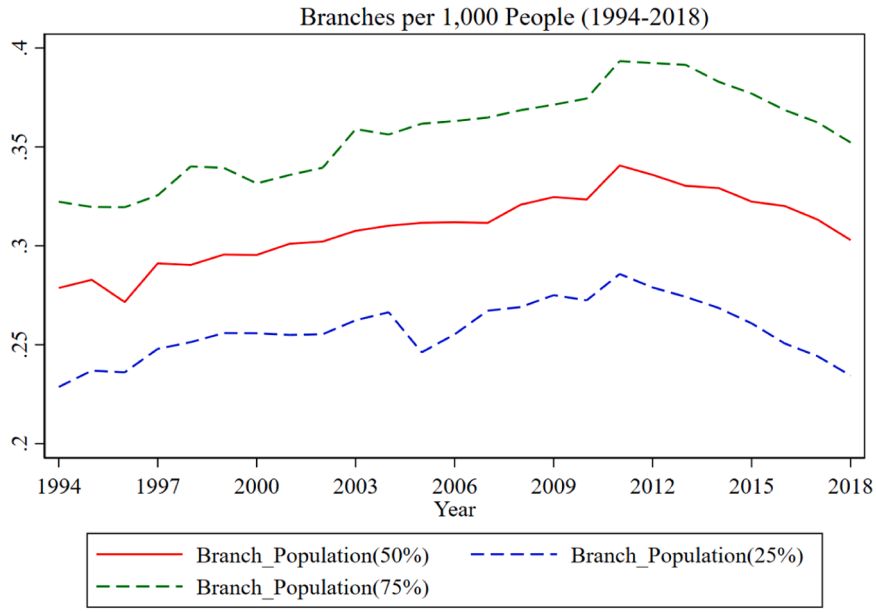

Fig. 3. displays the trend of the branches per population ratio (branches per 1000 people) in the U.S. between 1994 and 2018. We show the median state and the 25th and 75th percentiles. Data sources: FDIC.

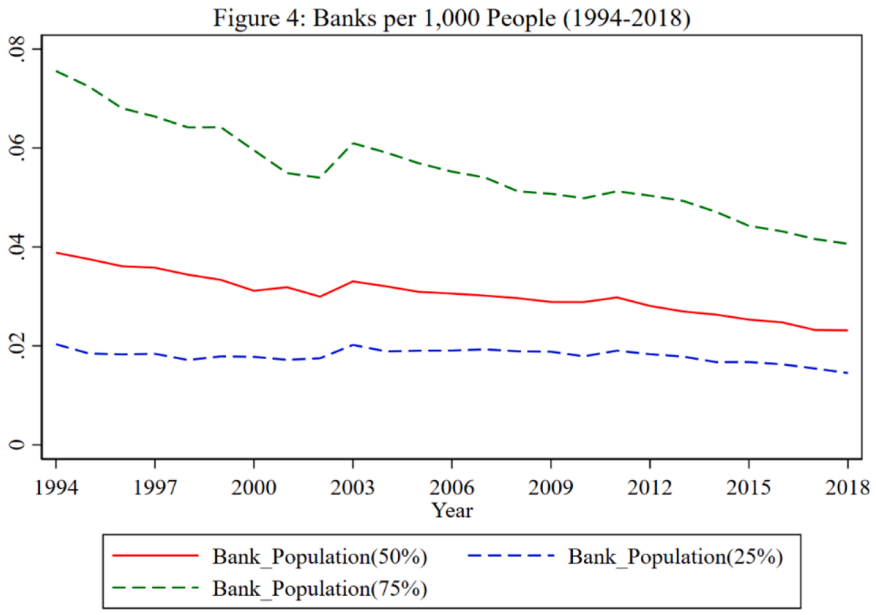

Fig. 4. displays the trend of banks per population ratio (banks per 1000 people) in the U.S. between 1994 and 2018. We show the median state and the 25th and 75th percentiles. Data sources: FDIC.

Table 1
Descriptive statistics.

Variables	N	Mean	Median	Std. Dev	p5	p95
HHI	77,505	0.087	0.080	0.051	0.032	0.164
CR_3	77,505	0.426	0.426	0.111	0.255	0.630
HHI_CBSA	77,505	0.126	0.114	0.072	0.056	0.231
CR_3_CBSA	77,505	0.508	0.492	0.125	0.337	0.721
Cash ratio	77,505	0.188	0.096	0.221	0.003	0.700
Cash/assets	77,135	0.139	0.076	0.171	0.003	0.508
Assets	77,505	2753.01	196.36	13,453.72	2.383	10,599.00
M/B ratio	77,505	3.099	1.568	6.571	0.780	8.198
Cash flow/assets	77,505	−0.053	0.060	0.288	−0.855	0.204
Net working capital/assets	77,505	−0.123	0.039	0.989	−0.742	0.387
Capital expenditures/assets	77,505	0.055	0.032	0.308	0.002	0.180
Leverage	77,505	0.321	0.214	0.473	0	0.950
Industry sigma	77,505	0.232	0.194	0.126	0.080	0.433
Dividend payment indicator	77,505	0.260	0	0.438	0	1
RD/sales	77,505	0.281	0.001	1.079	0	1.233
Acquisitions/assets	77,505	0.021	0	0.056	0	0.146
ROA	77,505	−0.152	0.050	0.768	−1.053	0.212
△Retained earnings	77,486	−0.218	0.005	0.896	−1.142	0.185
Net debt issuance	77,486	0.055	0	0.290	−0.178	0.455
Net equity issuance	77,486	0.299	0.010	1.235	−0.064	1.311
Excess stock return $(r_{i,t} - R^B_{i,t})$	77,505	0.075	−0.124	1.091	−0.910	1.673
△C	77,505	0.010	0.001	0.211	−0.213	0.259
C	77,505	0.208	0.090	0.407	0.003	0.733
△E	77,505	0.049	0.005	0.526	−0.418	0.613
△NA	77,505	0.002	0.017	0.765	−0.789	0.702
△RD	77,505	−0.001	0	0.027	−0.037	0.028
△I	77,505	0	0	0.059	−0.041	0.052
△D	77,505	0	0	0.009	−0.001	0.004
L	77,505	0.177	0.122	0.185	0	0.565
NF	77,505	0.122	0.019	0.639	−0.288	0.945
Rating_investment	77,505	0.101	0	0.301	0	1
Rating_C	77,505	0.229	0	0.420	0	1
Age	77,505	20.11	15	14.76	5	52
KZ index	73,596	−4.183	−0.850	9.364	−24.49	3.827
WW index	76,737	−0.226	−0.234	0.145	−0.452	0.026
SA index	77,505	−3.173	−3.278	1.238	−5.123	−1.066
Capx/ppent	76,770	0.260	0.204	0.209	0.026	0.687
CF/ppent	76,770	−3.815	0.217	18.72	−20.2	2.680

(*continued on next page*)

Table 1 (*continued*)

Variables	N	Mean	Median	Std. Dev	p5	p95
Sales/ppent	76,770	13.87	5.699	25.55	0.399	58.90
Debt/ppent	76,770	4.304	0.802	15.89	0	14.22
Z-score	77,499	−0.467	2.567	11.12	−29.93	11.77
PDH	77,499	−1.630	−6.443	24.07	−32.84	60.33

This table presents the descriptive statistics of the sample firms. The data of firms are collected from *Compustat*. The sample includes U.S. firms from 1995 to 2019, excluding financial (SIC Codes 6000–6999) and utility (4900–4949) firms. Bank data are collected from Federal Deposit Insurance Corporation. We use the firm-year observations that have sufficient data to conduct both the cash level and cash value analyses. The variables are winsorized at the 1st and 99th percentiles. Definitions of the variables are summarized in Appendix 1.

Table 2
Effects of bank concentration on the level of corporate cash holdings.

	(1)	(2)	(3)	(4)
Dependent variable	Cash and short-term investments to assets		Cash to assets	
Concentration measures	HHI	CR_3	HHI	CR_3
$Concentration_{i,t-1}$	0.111***	0.102***	0.040*	0.048***
	(3.51)	(7.30)	(1.75)	(4.76)
$M/B_{i,t}$	0.004***	0.004***	0.004***	0.004***
	(8.14)	(8.09)	(7.61)	(7.59)
$Ln\_assets_{i,t}$	−0.008***	−0.008***	−0.011***	−0.011***
	(−7.01)	(−6.98)	(−13.73)	(−13.75)
$Cash\ flow_{i,t}$	0.022***	0.022***	0.006***	0.006***
	(7.35)	(7.35)	(2.84)	(2.84)
$Net\ working\ capital_{i,t}$	−0.035***	−0.034***	−0.014***	−0.014***
	(−8.28)	(−8.22)	(−4.96)	(−4.92)
$Capital\ expenditure_{i,t}$	−0.014*	−0.014*	−0.009*	−0.009*
	(−1.83)	(−1.82)	(−2.00)	(−2.02)
$Leverage_{i,t}$	−0.151***	−0.150***	−0.101***	−0.100***
	(−18.38)	(−18.38)	(−20.13)	(−20.12)
$Industry\ Sigma_{i,t}$	0.614***	0.619***	0.430***	0.435***
	(3.98)	(3.98)	(3.54)	(3.57)
$Dividend\ payment_{i,t}$	−0.039***	−0.038***	−0.017***	−0.017***
	(−9.97)	(−9.74)	(−6.81)	(−6.62)
$R\&D/Sales_{i,t}$	0.064***	0.064***	0.036***	0.036***
	(24.45)	(24.10)	(18.86)	(18.82)
$Aqac_{i,t}$	−0.339***	−0.339***	−0.205***	−0.204***
	(−16.90)	(−16.83)	(−12.86)	(−12.82)
Intercept	−0.135	−0.168*	−0.069	−0.086
	(−1.53)	(−1.87)	(−1.00)	(−1.24)
State fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	77,505	77,505	77,135	77,135
R-squared	37.41 %	37.58 %	28.47 %	28.54 %

This table presents the results for testing the effect of bank concentration on the level of corporate cash holdings. We use the same regression specification as Bates et al. (2009). The data of firm characteristics is collected from *Compustat* and the sample period is from 1995 to 2019, excluding financial (SIC Codes 6000–6999) and utility (4900–4949) firms. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 3
Univariate analysis: sources of the increased cash holdings.

	(1)	(2)	(3)	(4)	(5)	(6)
	Comparing mean values			Comparing median values		
Panel A Using Sample Mean HHI to Split Observations						
	High bank concentration	Low bank concentration	Differences	High bank concentration	Low bank concentration	Differences
Cash ratio	0.229	0.161	0.068***	0.141	0.076	0.065***
Cash/assets	0.165	0.122	0.043***	0.103	0.062	0.041***
ROA	−0.215	−0.111	−0.104***	0.037	0.058	−0.021***
ΔRetained earnings	−0.284	−0.176	−0.108***	−0.007	0.011	−0.018***
Cash flow	−0.082	−0.034	−0.048***	0.049	0.066	−0.017***
Net debt issuance	0.058	0.052	0.006***	0	0	0
Net equity issuance	0.365	0.256	0.109***	0.015	0.007	0.008***
Panel B Using Sample Mean CRK_3 to Split Observations						

(*continued on next page*)

Table 3 (*continued*)

	(1) Comparing mean values	(2)	(3)	(4) Comparing median values	(5)	(6)
	High bank concentration	Low bank concentration	Differences	High bank concentration	Low bank concentration	Differences
Cash ratio	0.224	0.152	0.072***	0.134	0.071	0.063***
Cash/assets	0.163	0.116	0.047***	0.099	0.057	0.042***
ROA	−0.218	−0.087	−0.131***	0.037	0.061	−0.024***
ΔRetained earnings	−0.285	−0.153	−0.132***	−0.006	0.013	−0.019***
Cash flow	−0.083	−0.023	−0.060***	0.049	0.068	−0.019***
Net debt issuance	0.057	0.052	0.005	0	0	0
Net equity issuance	0.364	0.234	0.132***	0.014	0.006	0.008***
Panel C Using Annual Median HHI to Split Observations						
	High bank concentration	Low bank concentration	Differences	High bank concentration	Low bank concentration	Differences
Cash ratio	0.229	0.150	0.079***	0.141	0.071	0.070***
Cash/assets	0.164	0.117	0.047***	0.100	0.058	0.042***
ROA	−0.201	−0.107	−0.094***	0.038	0.059	−0.021***
ΔRetained earnings	−0.264	−0.176	−0.088***	−0.004	0.011	−0.015***
Cash flow	−0.081	−0.027	−0.054***	0.049	0.067	−0.018***
Net debt issuance	0.056	0.053	0.003	0	0	0
Net equity issuance	0.350	0.252	0.098***	0.015	0.006	0.009***
Panel D Using Annual Median CRK_3 to Split Observations						
	High bank concentration	Low bank concentration	Differences	High bank concentration	Low bank concentration	Differences
Cash ratio	0.223	0.155	0.068***	0.134	0.074	0.060***
Cash/assets	0.160	0.120	0.040***	0.097	0.060	0.037***
ROA	−0.203	−0.104	−0.099***	0.039	0.058	−0.019***
ΔRetained earnings	−0.267	−0.174	−0.093***	−0.004	0.011	−0.015***
Cash flow	−0.080	−0.027	−0.053***	0.050	0.067	−0.017***
Net debt issuance	0.057	0.052	0.005	0	0	0
Net equity issuance	0.352	0.250	0.102***	0.015	0.007	0.008***

This table presents the univariate differences of firms in high-concentration and low-concentration states. In Panels A and B, we divide the observations into two subgroups using the sample mean values of *HHI* and CR_3. Then, we calculate and test the differences in the mean (and median) values between the two subgroups. In Panels C and D, we divide the observations into two subgroups using annual median values of *HHI* and CR_3. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 4
Effects of bank concentration on the value of cash.

Dependent variable	(1) Excess stock return ($r_{i,t} - R^B_{i,t}$)	(2)	(3)	(4)	(5)
Concentration measures		HHI	CR_3	HHI_CBSA	CR_3_CBSA
$\triangle C_{i,t}$	1.457***	1.283***	1.044***	1.406***	1.266***
	(14.88)	(9.43)	(5.13)	(10.13)	(5.69)
$\triangle C_{i,t} \times Concentration_{i,t-1}$		1.968**	0.956***	1.260*	0.772**
		(2.78)	(2.88)	(1.78)	(2.36)
$Concentration_{i,t-1}$		−0.079	−0.146	−0.012	−0.024
		(−0.39)	(−1.42)	(−0.25)	(−0.83)
$\triangle E_{i,t}$	0.354***	0.354***	0.354***	0.354***	0.354***
	(8.09)	(8.15)	(8.14)	(8.02)	(7.99)
$\triangle NA_{i,t}$	0.047**	0.047**	0.047**	0.047**	0.047**
	(2.27)	(2.25)	(2.25)	(2.27)	(2.27)
$\triangle RD_{i,t}$	0.092	0.086	0.076	0.093	0.092
	(0.21)	(0.20)	(0.18)	(0.22)	(0.21)
$\triangle I_{i,t}$	−0.877***	−0.876***	−0.877***	−0.880***	−0.881***
	(−4.48)	(−4.46)	(−4.46)	(−4.52)	(−4.52)
$\triangle D_{i,t}$	0.215	0.220	0.208	0.226	0.223
	(0.48)	(0.49)	(0.46)	(0.50)	(0.50)
$C_{i,t-1}$	0.278***	0.279***	0.279***	0.276***	0.276***
	(13.87)	(13.92)	(14.02)	(13.59)	(13.62)
$L_{i,t}$	−0.732***	−0.733***	−0.732***	−0.720***	−0.720***
	(−8.71)	(−8.74)	(−8.76)	(−8.08)	(−8.09)
$NF_{i,t}$	0.256***	0.256***	0.256***	0.257***	0.257***
	(10.05)	(10.11)	(10.09)	(9.96)	(9.92)
$C_{i,t-1} \times \triangle C_{i,t}$	−0.304***	−0.307***	−0.308***	−0.306***	−0.306***
	(−4.54)	(−4.59)	(−4.64)	(−4.61)	(−4.63)

(*continued on next page*)

Table 4 (*continued*)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Excess stock return ($r_{i,t} - R^{B}_{i,t}$)				
Concentration measures		HHI	CR_3	HHI_CBSA	CR_3_CBSA
$L_{i,t} \times \triangle C_{i,t}$	−1.817***	−1.803***	−1.798***	−1.821***	−1.821***
	(−9.15)	(−8.90)	(−8.93)	(−9.30)	(−9.26)
Intercept	0.152	0.159	0.242	−0.035	−0.025
	(1.01)	(1.08)	(1.56)	(−0.41)	(−0.29)
State fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	77,505	77,505	77,505	77,505	77,505
R-squared	12.91 %	12.95 %	12.96 %	12.94 %	12.94 %

This table presents the results for testing the effect of bank concentration on the value of cash. The data of firms are collected from *Compustat*, and the sample period is from 1995 to 2019, excluding financial (SIC Codes 6000–6999) and utility (4900–4949) firms. The dependent variable, *Excess stock return*, is calculated using the firm's stock return $r_{i,t}$ minus the return of the benchmark portfolio $R^{B}_{i,t}$. *C* denotes cash and short-term investments. *E* denotes earnings (income before extraordinary items). *NA* denotes net assets. *RD* denotes research and development expenses. *I* denotes interest expenses. *D* denotes dividends. *L* denotes total debt. *NF* denotes net external financing. Independent variables are scaled by lagged market value of equity. Definitions of the variables are summarized in Appendix 1. In columns (2)-(3), we measure bank concentration at the state level. In columns (4)-(5), we measure bank concentration at the CBSA level as a robustness check. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 5
Effects of bank concentration on the value of cash: an alternative model.

	(1)	(2)	(3)	(4)
Dependent variable	$V_{i,t}$			
Concentration measures	HHI	CR_3	HHI	CR_3
$L_{i,t}$	2.672**	1.947	3.031***	2.364
	(2.74)	(1.07)	(3.10)	(1.30)
$L_{i,t} \times Concentration_{i,t-1}$	18.74*	5.584	16.96*	5.075
	(1.90)	(1.36)	(1.72)	(1.24)
$Concentration_{i,t-1}$	0.877	−0.029	−0.289	−1.403
	(0.37)	(−0.04)	(−0.08)	(−1.05)
$E_{i,t}$	−5.114***	−5.120***	−5.103***	−5.106***
	(−23.01)	(−22.95)	(−22.92)	(−22.88)
$dE_{i,t}$	1.059***	1.060***	1.053***	1.054***
	(4.92)	(4.91)	(4.80)	(4.79)
$dE_{i,t+1}$	−2.016***	−2.015***	−2.013***	−2.012***
	(−11.40)	(−11.40)	(−11.09)	(−11.11)
$dNA_{i,t}$	1.906***	1.911***	1.912***	1.915***
	(5.47)	(5.45)	(5.32)	(5.33)
$dNA_{i,t+1}$	2.864***	2.860***	2.864***	2.864***
	(9.74)	(9.78)	(9.83)	(9.86)
$RD_{i,t+1}$	−2.929***	−2.959***	−2.850***	−2.867***
	(−3.25)	(−3.25)	(−3.18)	(−3.19)
$dRD_{i,t}$	3.929***	3.912***	3.920***	3.910***
	(3.49)	(3.49)	(3.46)	(3.45)
$dRD_{i,t+1}$	3.140***	3.131***	3.163***	3.153***
	(3.32)	(3.31)	(3.31)	(3.29)
$I_{i,t}$	10.97***	10.97***	10.95***	10.937***
	(6.83)	(6.82)	(6.82)	(6.80)
$dI_{i,t}$	−8.457***	−8.425***	−8.415***	−8.381***
	(−4.29)	(−4.26)	(−4.28)	(−4.26)
$dI_{i,t+1}$	6.005***	6.050***	6.005***	6.039***
	(5.09)	(5.11)	(5.12)	(5.14)
Di,t	17.16***	17.18***	16.65***	16.74***
	(9.85)	(10.19)	(9.68)	(9.81)
$dD_{i,t}$	−3.508	−3.586	−3.365	−3.488
	(−1.62)	(−1.69)	(−1.58)	(−1.66)
$dD_{i,t+1}$	13.32***	13.27***	13.05***	13.05***
	(5.16)	(5.15)	(4.91)	(4.90)
$dV_{i,t+1}$	−0.564***	−0.564***	−0.562***	−0.562***
	(−14.68)	(−14.51)	(−14.08)	(−14.07)
Intercept	2.277**	2.394**	2.306	3.274*

(*continued on next page*)

Table 5 (*continued*)

	(1)	(2)	(3)	(4)
Dependent variable	$V_{i,t}$			
Concentration measures	HHI	CR_3	HHI	CR_3
	(2.60)	(2.65)	(1.62)	(2.52)
State fixed effects	No	No	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	79,308	79,308	79,269	79,269
R-squared	60.30 %	60.27 %	60.40 %	60.38 %

This table presents the results for testing the effect of bank concentration on the value of cash using Pinkowitz et al.'s (L. 2006) model. In the model, $X_{i,t}$ denotes the level of variable X of firm i in year t divided by assets in year t; while $dX_{i,t}$ denotes the change in the level of X from year t-1 to year t, divided by assets in year t. V denotes the firm's market value. L denotes liquid assets (cash and short-term investments). E denotes earnings before extraordinary items plus interests, deferred tax credits, and investment tax credits. *NA* denotes net assets. *RD* denotes R&D expenses. I denotes interest expenses. D denotes common dividends. We interact bank concentration with liquid assets. In columns (1)-(2), we present the results without controlling for fixed effects at the state level. In columns (3)-(4), we control for state-level fixed effects. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 6
Effects of bank concentration and accessing bond markets on the value of cash.

	(1)	(2)	(3)	(4)
Dependent variable	Excess stock return ($r_{i,t} - R^B_{i,t}$)			
Measures of rating	Investment grade		C or above	
Concentration measures	HHI	CR_3	HHI	CR_3
$\triangle C_{i,t}$	1.292***	1.066***	1.320***	1.103***
	(9.32)	(5.18)	(8.17)	(4.52)
$\triangle C_{i,t} \times Concentration_{i,-1}$	1.911**	0.914**	1.729*	0.827*
	(2.69)	(2.76)	(1.92)	(1.97)
$\triangle C_{i,t} \times Rating_{i,t-1}$	−0.600	−1.195*	−0.196	−0.271
	(−1.62)	(−1.97)	(−1.05)	(−0.78)
$\triangle C_{i,t} \times Concentration_{i,t-1} \times Rating_{i,t-1}$	4.328	2.315	1.829	0.555
	(1.01)	(1.54)	(1.39)	(0.806)
$Rating_{i,t-1}$	−0.076***	−0.076***	0.027	0.027
	(−4.96)	(−5.02)	(1.26)	(1.25)
$Concentration_{i,t-1}$	−0.087	−0.153	−0.070	−0.144
	(−0.43)	(−1.48)	(−0.35)	(−1.38)
$\triangle E_{i,t}$	0.353***	0.353***	0.354***	0.354***
	(8.25)	(8.20)	(8.15)	(8.16)
$\triangle NA_{i,t}$	0.048**	0.048**	0.046**	0.046**
	(2.29)	(2.30)	(2.20)	(2.16)
$\triangle RD_{i,t}$	0.087	0.077	0.077	0.067
	(0.20)	(0.18)	(0.17)	(0.16)
$\triangle I_{i,t}$	−0.876***	−0.876***	−0.876***	−0.876***
	(−4.45)	(−4.45)	(−4.43)	(−4.45)
$\triangle D_{i,t}$	0.223	0.209	0.194	0.182
	(0.49)	(0.46)	(0.43)	(0.41)
$C_{i,t-1}$	0.273***	0.273***	0.280***	0.281***
	(13.35)	(13.59)	(13.89)	(13.66)
$L_{i,t}$	−0.738***	−0.738***	−0.746***	−0.745***
	(−8.81)	(−8.83)	(−8.30)	(−8.41)
$NF_{i,t}$	0.253***	0.253***	0.258***	0.258***
	(9.95)	(9.89)	(9.90)	(10.12)
$C_{i,t-1} \times \triangle C_{i,t}$	−0.309***	−0.310***	−0.307***	−0.307***
	(−4.58)	(−4.63)	(−4.46)	(−4.66)
$L_{i,t} \times \triangle C_{i,t}$	−1.803***	−1.799***	−1.792***	−1.787***
	(−8.92)	(−8.96)	(−8.92)	(−9.04)
Intercept	0.162	0.247	0.135	0.225
	(1.11)	(1.60)	(0.95)	(1.46)
State fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	77,505	77,505	77,505	77,505
R-squared	13.00 %	13.01 %	12.97 %	12.97 %

This table presents the results for testing the effect of bank concentration on the value of cash while controlling for the effect of having a bond rating. *Rating* is a dummy variable. In columns (1) and (2), *Rating* is equal to 1 for the firms with an investment grade (BBB- or above), and zero otherwise. In columns (3) and (4), *Rating* is equal to 1 for the firms with a rating score of C or above, and zero otherwise. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 7
Effects of bank concentration on the value of cash: firms using syndicated loans.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Excess stock return ($r_{i,t} - R^B_{i,t}$)					
Subsamples	Using syndicated loans			Using syndicated loans from non-local states		
Concentration measures		HHI	CR_3		HHI	CR_3
$\triangle C_{i,t}$	0.985***	0.503*	−0.257	0.634**	0.011	−0.701
	(4.12)	(1.71)	(−0.53)	(2.55)	(0.03)	(−1.25)
$\triangle C_{i,t} \times Concentration_{i,t-1}$		5.826***	3.010***		7.681***	3.299***
		(3.64)	(3.13)		(3.72)	(2.91)
$Concentration_{i,t-1}$		−0.661**	−0.219		−0.799	−0.301*
		(−2.54)	(−1.65)		(−2.86)	(−1.97)
$\triangle E_{i,t}$	0.570***	0.576***	0.576***	0.549***	0.550***	0.553***
	(5.59)	(5.99)	(5.96)	(4.83)	(5.31)	(5.31)
$\triangle NA_{i,t}$	0.015	0.012	0.013	0.035	0.027	0.029
	(0.25)	(0.20)	(0.21)	(0.49)	(0.39)	(0.42)
$\triangle RD_{i,t}$	0.009	0.027	0.028	0.008	−0.028	−0.013
	(0.01)	(0.02)	(0.02)	(0.00)	(−0.02)	(−0.01)
$\triangle I_{i,t}$	−1.978**	−1.921**	−1.947**	−1.873**	−1.796**	−1.816**
	(−2.56)	(−2.53)	(−2.57)	(−2.28)	(−2.23)	(−2.28)
$\triangle D_{i,t}$	0.573	0.566	0.540	0.953	0.959	0.917
	(0.80)	(0.77)	(0.75)	(1.30)	(1.25)	(1.20)
$C_{i,t-1}$	0.255***	0.256***	0.253***	0.258**	0.260**	0.256**
	(3.02)	(2.89)	(2.86)	(2.56)	(2.37)	(2.38)
$L_{i,t}$	−0.562***	−0.569***	−0.566***	−0.508***	−0.521***	−0.516***
	(−4.70)	(−5.14)	(−5.15)	(−4.45)	(−5.06)	(−4.90)
$NF_{i,t}$	0.190**	0.198**	0.197**	0.114	0.126	0.125
	(2.17)	(2.29)	(2.28)	(1.25)	(1.40)	(1.36)
$C_{i,t-1} \times \triangle C_{i,t}$	−0.028	−0.025	−0.022	0.127	0.133	0.133
	(−0.14)	(−0.11)	(−0.10)	(0.77)	(0.74)	(0.76)
$L_{i,t} \times \triangle C_{i,t}$	−1.169	−1.223	−1.238	−0.529	−0.586	−0.641
	(−1.69)	(−1.64)	(−1.69)	(−0.83)	(−0.87)	(−0.98)
Intercept	0.272	0.274	0.209	0.230	0.202	0.201
	(1.51)	(1.22)	(0.81)	(1.13)	(0.71)	(0.69)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,069	12,069	12,069	9196	9196	9196
R-squared	18.77 %	19.25 %	19.28 %	18.43 %	19.10 %	19.02 %

This table presents the results for testing the effect of bank concentration on the value of cash for the firms using syndicated loans. We collect syndicated loan data from DealScan and restrict our sample to those firms that use syndicated loans. Columns (1)-(3) use the firm-year observations with records of using syndicated loans to test the effect of bank concentration on the value of cash. Columns (4)-(6) use the firm-year observations with records of using syndicated loans from a leading bank headquartered in a different state. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 8
Effects of bank concentration on the value of cash: firms not using debt finance.

	(1)	(2)	(3)	(4)
Dependent variable	Excess stock return ($r_{i,t} - R^B_{i,t}$)			
Subsamples	Firms using debt		Firms not using debt	
Concentration measures	HHI	CR_3	HHI	CR_3
$\triangle C_{i,t}$	1.267***	1.024***	1.406***	1.371**
	(9.37)	(4.90)	(4.09)	(2.30)
$\triangle C_{i,t} \times Concentration_{i,t-1}$	2.316**	1.035**	−0.738	−0.075
	(2.72)	(2.77)	(−0.44)	(−0.07)
$Concentration_{i,t-1}$	−0.127	−0.165	0.648	0.144
	(−0.62)	(−1.60)	(1.33)	(0.50)
$\triangle E_{i,t}$	0.348***	0.348***	0.453***	0.454***
	(8.27)	(8.25)	(4.30)	(4.42)
$\triangle NA_{i,t}$	0.050**	0.050**	0.007	0.006
	(2.41)	(2.41)	(0.07)	(0.06)
$\triangle RD_{i,t}$	0.189	0.181	−0.211	−0.205
	(0.49)	(0.47)	(−0.24)	(−0.23)
$\triangle I_{i,t}$	−0.799***	−0.800***	−2.432**	−2.413*
	(−4.34)	(−4.34)	(−2.06)	(−2.02)

(*continued on next page*)

Table 8 (*continued*)

	(1)	(2)	(3)	(4)
Dependent variable	Excess stock return ($r_{i,t} - R^{B}_{i,t}$)			
Subsamples	Firms using debt		Firms not using debt	
Concentration measures	HHI	CR_3	HHI	CR_3
$\triangle D_{i,t}$	−0.146	−0.158	1.895**	1.893**
	(−0.27)	(−0.29)	(2.69)	(2.69)
$C_{i,t-1}$	0.301***	0.301***	0.184***	0.183***
	(15.38)	(15.35)	(3.31)	(3.32)
$L_{i,t}$	−0.798***	−0.797***		
	(−8.64)	(−8.67)		
$NF_{i,t}$	0.240***	0.240***	0.622***	0.621***
	(9.13)	(9.09)	(6.08)	(6.09)
$C_{i,t-1} \times \triangle C_{i,t}$	−0.290***	−0.290***	−0.499***	−0.503***
	(−4.14)	(−4.15)	(−3.40)	(−3.48)
$L_{i,t} \times \triangle C_{i,t}$	−1.848***	−1.843***		
	(−9.08)	(−9.11)		
Intercept	0.179	0.264	−0.198	−0.222
	(1.20)	(1.69)	(−0.61)	(−0.67)
State fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	69,404	69,404	8101	8101
R-squared	12.93 %	12.93 %	17.33 %	17.30 %

This table presents the results for testing the effects of bank concentration on the value of cash for the two subsamples based on whether the firm use debt finance or not. We define that a firm does not use debt finance if the firm has zero debt in years *t* and *t* + *1*. Columns (1)-(2) report the results for the firms that use debt finance. Columns (3)-(4) report the results for the firms that do not use debt finance. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 9
Effects of financial constraints on the concentration-cash value relationship.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	Excess stock return ($r_{i,t} - R^{B}_{i,t}$)											
Concentration measures	HHI						CR_3					
Financial constraints measures	Ln_assets	Div payment	Age	KZ index	WW index	SA index	Ln_assets	Div payment	Age	KZ index	WW index	SA index
$\triangle C_{i,t}$	1.250***	1.288***	1.277***	1.305***	1.253***	1.238***	1.105***	1.069***	1.063***	1.110***	1.066***	1.043***
	(9.24)	(9.60)	(9.48)	(9.54)	(9.23)	(9.34)	(5.27)	(5.27)	(5.19)	(5.75)	(5.51)	(5.32)
$\triangle C_{i,t} \times Concentration_{i,t-1}$	3.649***	2.138**	3.608***	1.770**	2.113**	5.862***	1.430***	0.959***	1.297**	0.840**	0.978***	1.969***
	(3.13)	(3.11)	(4.73)	(2.42)	(2.07)	(4.80)	(3.65)	(2.92)	(3.73)	(2.71)	(2.69)	(4.98)
$\triangle C_{i,t} \times Concentration_{i,t-1} \times Constraints_{i,t-1}$	−0.512**	−4.253**	−0.111***	0.098***	5.312*	1.666***	−0.167***	−1.042***	−0.027***	0.026***	2.062**	0.478***
	(−2.62)	(−4.61)	(−4.57)	(2.81)	(1.72)	(4.55)	(−3.34)	(−4.24)	(−4.45)	(2.80)	(2.45)	(5.20)
$Constraints_{i,t-1}$	−0.028***	−0.127***	−0.002***	0.007***	0.537***	0.066***	−0.027***	−0.127***	−0.002***	0.007***	0.529***	0.064***
	(−5.39)	(−10.93)	(−3.44)	(6.33)	(6.27)	(8.01)	(−5.31)	(−10.88)	(−3.35)	(6.19)	(6.17)	(7.74)
$Concentration_{i,t-1}$	−0.139	−0.067	−0.082	−0.169	−0.164	−0.151	−0.169	−0.145	−0.145	−0.173	−0.177	−0.168
	(−0.76)	(−0.33)	(−0.40)	(−0.84)	(−0.82)	(−0.82)	(−1.69)	(−1.41)	(−1.40)	(−1.62)	(−1.68)	(−1.65)
$\triangle E_{i,t}$	0.355***	0.351***	0.354***	0.364***	0.360***	0.356***	0.355***	0.350***	0.354***	0.364***	0.361***	0.357***
	(7.91)	(8.16)	(8.21)	(8.35)	(8.20)	(8.06)	(7.90)	(8.18)	(8.22)	(8.33)	(8.17)	(8.09)
$\triangle NA_{i,t}$	0.047**	0.050**	0.047**	0.035*	0.045**	0.045**	0.046**	0.050**	0.047**	0.035	0.044**	0.043**
	(2.25)	(2.45)	(2.26)	(1.75)	(2.12)	(2.15)	(2.19)	(2.43)	(2.27)	(1.73)	(2.09)	(2.07)
$\triangle RD_{i,t}$	0.231	0.085	0.055	0.255	0.346	0.222	0.217	0.072	0.035	0.253	0.329	0.203
	(0.52)	(0.20)	(0.13)	(0.60)	(0.73)	(0.51)	(0.49)	(0.17)	(0.08)	(0.60)	(0.70)	(0.46)
$\triangle I_{i,t}$	−0.888***	−0.864***	−0.875***	−0.876***	−0.929***	−0.879***	−0.886***	−0.864***	−0.875***	−0.874***	−0.926***	−0.878***
	(−4.58)	(−4.37)	(−4.44)	(−4.39)	(−4.99)	(−4.53)	(−4.54)	(−4.38)	(−4.45)	(−4.39)	(−4.99)	(−4.50)
$\triangle D_{i,t}$	0.312	−0.448	0.207	−0.359	0.224	0.239	0.282	−0.451	0.200	−0.354	0.204	0.224
	(0.65)	(−0.86)	(0.45)	(−0.75)	(0.47)	(0.50)	(0.59)	(−0.85)	(0.43)	(−0.75)	(0.42)	(0.47)
$C_{i,t-1}$	0.272***	0.265***	0.281***	0.290***	0.267***	0.280***	0.274***	0.266***	0.283***	0.290***	0.268***	0.282***
	(12.58)	(13.27)	(13.59)	(11.83)	(10.86)	(13.15)	(12.74)	(13.35)	(13.78)	(11.78)	(10.94)	(13.34)
$L_{i,t}$	−0.690***	−0.760***	−0.735***	−0.812***	−0.690***	−0.702***	−0.690***	−0.760***	−0.734***	−0.812***	−0.689***	−0.703***
	(−8.31)	(−9.01)	(−8.78)	(−8.99)	(−8.21)	(−8.60)	(−8.39)	(−9.03)	(−8.81)	(−9.00)	(−8.24)	(−8.68)
$NF_{i,t}$	0.232***	0.248***	0.250***	0.238***	0.216***	0.226***	0.233***	0.248***	0.250***	0.238***	0.216***	0.226***

(*continued on next page*)

Table 9 (*continued*)

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Excess stock return ($r_{i,t} - R^{B}_{i,t}$)											
Concentration measures	HHI						CR_3					
Financial constraints measures	Ln_assets	Div payment	Age	KZ index	WW index	SA index	Ln_assets	Div payment	Age	KZ index	WW index	SA index
	(9.70)	(10.05)	(10.26)	(9.51)	(9.63)	(9.48)	(9.73)	(9.99)	(10.21)	(9.55)	(9.66)	(9.47)
$C_{i,t-1} \times \triangle C_{i,t}$	−0.280***	−0.314***	−0.290***	−0.278***	−0.282***	−0.265***	−0.273***	−0.316***	−0.287***	−0.277***	−0.277***	−0.257***
	(−4.14)	(−4.67)	(−4.32)	(−4.01)	(−4.30)	(−3.90)	(−4.07)	(−4.73)	(−4.33)	(−4.01)	(−4.26)	(−3.82)
$L_{i,t} \times \triangle C_{i,t}$	−1.653***	−1.787***	−1.786***	−1.865***	−1.629***	−1.614***	−1.588***	−1.783***	−1.784***	−1.881***	−1.580***	−1.558***
	(−7.96)	(−8.87)	(−8.92)	(−8.77)	(−8.18)	(−7.99)	(−7.68)	(−8.92)	(−8.99)	(−8.70)	(−7.99)	(−7.69)
Intercept	0.295*	0.221	0.157	0.204	0.279*	0.368**	0.373**	0.305**	0.242	0.282*	0.356**	0.437**
	(1.90)	(1.66)	(1.11)	(1.34)	(1.74)	(2.45)	(2.30)	(2.13)	(1.59)	(1.73)	(2.07)	(2.74)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77,447	77,505	77,505	73,416	76,002	77,447	77,447	77,505	77,505	73,416	76,002	77,447
R-squared	13.32 %	13.21 %	13.07 %	13.33 %	13.21 %	13.60 %	13.38 %	13.22 %	13.08 %	13.34 %	13.24 %	13.70 %

This table presents the results for testing the effects of financial constraints on the concentration-cash value relationship. Columns (1)-(6) use HHI to measure bank concentration, and columns (7)-(12) use CR_3 to measure bank concentration. KZ index, WW index and SA index use dummy variables, with the value equal to 1 indicating financially constrained firms and 0 otherwise. Definitions of the variables are summarized in Appendix 1. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 10
Effects of cash and bank concentration on firm investments.

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	Capx/ppent					
Concentration measures		HHI	CR_3		HHI	CR_3
Cash $Ratio_{i,t-1}$	0.134***	0.159***	0.198***	0.174***	0.203***	0.272***
	(11.82)	(8.94)	(6.56)	(20.03)	(12.81)	(9.11)
Cash $Ratio_{i,t-1} \times Concentration_{i,t-1}$		−0.279**	−0.144**		−0.317**	−0.223***
		(−2.22)	(−2.40)		(−2.09)	(−3.31)
$Concentration_{i,t-1}$		0.070*	0.028		0.083**	0.051**
		(1.90)	(1.39)		(2.26)	(2.41)
$Capx/ppent_{i,t-1}$	0.755***	0.755***	0.755***	0.434***	0.434***	0.434***
	(33.64)	(33.60)	(33.68)	(17.01)	(17.05)	(17.08)
$(Capx/ppent)^2_{i,t-1}$	−0.441***	−0.442***	−0.442***	−0.330***	−0.331***	−0.331***
	(−18.73)	(−18.79)	(−18.87)	(−12.57)	(−12.59)	(−12.60)
$CF/ppent_{i,t-1}$	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(−4.41)	(−4.15)	(−4.28)	(−5.44)	(−5.49)	(−5.52)
$Sales/ppent_{i,t-1}$	0.001***	0.001***	0.001***	0.002***	0.002***	0.002***
	(14.64)	(15.82)	(15.75)	(17.70)	(17.79)	(17.76)
$(Debt/ppent)^2_{i,t}$	−0.000	−0.000	−0.000	−0.000**	−0.000**	−0.000**
	(−1.47)	(−1.38)	(−1.44)	(−2.16)	(−2.14)	(−2.14)
Intercept	0.031***	0.013	0.011	0.116***	0.109***	0.095***
	(2.95)	(0.86)	(0.64)	(24.81)	(18.37)	(9.95)
Firm fixed effects	No	No	No	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	76,180	76,180	76,180	75,156	75,156	75,156
R-squared	36.44 %	36.46 %	36.46 %	51.14 %	51.15 %	51.16 %

This table presents the results for testing the effect of bank concentration on a firm's investment-cash sensitivity. We use the Euler equation specification of firm investment (Bond and Meghir, 1994) and then interact bank concentration with cash holding ratio. Columns (4)-(6) further control for fixed effects at the firm level as a robustness check. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 11
Bank concentration and cash flow sensitivity of cash.

Dependent variable	(1)	(2)	(3)
	ΔCash ratio		
Concentration measures		HHI	CR_3
$Cash\ flow_{i,t}$	0.012***	0.012***	0.014***
	(7.31)	(6.99)	(7.11)
$Cash\ flow_{i,t} \times Concentration_{i,t-1}$		−0.011	−0.013***

(*continued on next page*)

Table 11 (*continued*)

Dependent variable	(1) ΔCash ratio	(2)	(3)
Concentration measures		HHI	CR_3
		(−0.99)	(−3.94)
$Concentration_{i,t-1}$		0.036*	0.020*
		(2.01)	(1.94)
$Cash\ ratio_{i,t-1}$	−0.236***	−0.235***	−0.234***
	(−31.35)	(−31.25)	(−31.53)
$M/B_{i,t-1}$	0.001**	0.001**	0.000
	(2.25)	(2.07)	(1.45)
$Ln\_assets_{i,t-1}$	−0.003***	−0.003***	−0.003***
	(−5.00)	(−5.02)	(4.81)
$Net\ working\ capital_{i,t-1}$	−0.010***	−0.010***	−0.009***
	(−4.39)	(−4.14)	(−3.64)
$Capital\ expenditure_{i,t-1}$	−0.022*	−0.022*	−0.024**
	(−1.91)	(−1.91)	(−1.99)
$Leverage_{i,t-1}$	−0.015***	−0.015***	−0.015***
	(−5.17)	(−5.25)	(−5.32)
$Industry\ Sigma_{i,t-1}$	0.159***	0.159***	0.163***
	(2.62)	(2.63)	(2.71)
$Dividend\ payment_{i,t-1}$	−0.005***	−0.005***	−0.005***
	(−4.02)	(−3.98)	(−4.18)
$R\&D/Sales_{i,t-1}$	0.011***	0.011***	0.010***
	(9.64)	(9.51)	(9.18)
$Aqac_{i,t-1}$	−0.060***	−0.060***	−0.060***
	(−8.41)	(−8.25)	(−8.27)
Intercept	−0.043	−0.034	−0.031
	(−1.26)	(−0.97)	(−0.87)
State fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	76,431	76,403	76,403
R-squared	12.95 %	12.94 %	13.00 %

This table presents the results for testing the effect of bank concentration on the cash flow sensitivity of cash. We use the regression specification testing the precautionary motive of cash holdings (Almeida et al., 2004) and then interact bank concentration with the cash flow variable (scaled by total assets). Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Table 12
Effects of cash and bank concentration on firm default risk.

Dependent variable	(1) Altman Z-score	(2)	(3) PDH	(4)
Concentration measures	HHI	CR_3	HHI	CR_3
$Cash\ Ratio_{i,t-1}$	11.30***	15.51***	−29.47***	−39.72***
	(10.76)	(6.89)	(−11.55)	(−7.45)
$Cash\ Ratio_{i,t-1} \times Concentration_{i,t-1}$	−26.23***	−15.03***	65.05***	36.86***
	(−2.85)	(−3.05)	(2.93)	(3.17)
$Concentration_{i,t-1}$	5.784***	2.777***	−14.04***	−7.052***
	(3.15)	(2.84)	(−3.15)	(−3.06)
$ROA_{i,t-1}$	2.398***	2.397***	−5.464***	−5.461***
	(10.55)	(10.62)	(−10.52)	(−10.59)
$Ln\_assets_{i,t-1}$	2.305***	2.305***	−4.853***	−4.852***
	(17.85)	(17.85)	(−16.21)	(−16.21)
$Tangibility_{i,t-1}$	0.253	0.257	−0.502	−0.511
	(0.47)	(0.47)	(−0.41)	(−0.41)
$M/B_{i,t-1}$	0.353***	0.353***	−0.872***	−0.872***
	(16.71)	(16.77)	(−16.81)	(−16.87)
$R\&D/Sales_{i,t-1}$	−0.139	−0.137	0.052	0.045
	(−1.39)	(−1.37)	(0.23)	(0.19)
$Leverage_{i,t-1}$	−3.539***	−3.534***	8.806***	8.795***
	(−11.36)	(−11.38)	(12.43)	(12.45)
$Dividend\ payment_{i,t-1}$	0.488***	0.495***	−1.212***	−1.229***
	(4.24)	(4.31)	(4.48)	(4.55)
$Ln\_age_{i,t-1}$	−4.765***	−4.740***	11.31***	11.24***
	(−16.03)	(−15.99)	(15.98)	(15.95)
Intercept	−1.042	−1.786*	−2.791	−0.843
	(−1.18)	(−1.87)	(−1.34)	(−0.37)

(*continued on next page*)

Table 12 (*continued*)

Dependent variable	(1) Altman Z-score	(2)	(3) PDH	(4)
Concentration measures	HHI	CR_3	HHI	CR_3
Firm fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	75,632	75,632	75,632	75,632
R-squared	80.71 %	80.72 %	77.14 %	77.15 %

This table presents the results for testing the effects of cash and bank concentration on default probability. We use two measures of default risk: Columns (1) and (2) use Altman Z-score, where a greater value indicates lower default risk. Columns (3) and (4) use the probability of default hazard rate (*PDH*), where a greater value indicates higher default risk. Definitions of the variables are summarized in Appendix 1. Standard errors are clustered by firm and year. T-values are reported in parentheses. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.

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