

Correlated Investment Exposure of Commercial Banks: The Case of CMBS ^{*}, ^{**}

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ABSTRACT

We analyze how a bank's portfolio holdings of commercial mortgage-backed securities (CMBS) impact its correlated investment exposure. The correlated investment exposure measures a bank's systemic risk-taking stemming from common asset holdings. We examine the period before the global financial crisis, when the CMBS market was uniquely characterized by unprecedented growth, and bank capital requirements for CMBS dropped from 8% to 1.6%. We employ quantile regression analysis to show that, when analyzed horizontally, banks' holdings of CMBS contributed to a latent buildup of correlated investment exposure across banks.

Keywords: correlated investment exposure, commercial banks, CMBS, securitization, systemic risk

JEL classification: G01, G21, G28

DRAFT: November 5, 2025

* We thank to Mikel Tapia, David Martinez-Miera, Ana Lozano Vivas, Sandro Brusco, Francisco Gonzáles Rodríguez, and Iftekhar Hasan for their valuable comments, feedback, and advice. We highly appreciate the comments from the participants of the seminars at FAU College of Business, Sy Sims Business School, and CUNEF Universidad. We want to acknowledge the comments from the participants at the 16th Financial Risks International Forum, 30th Finance Forum of the Spanish Finance Association, the 10th European Risk Conference, Annual conference of the Royal Economic society, The International conference of the financial engineering and banking society, International Risk Management Conference, International Panel data conference, Boca finance and real estate conference and the International conference of the French Finance association.

**We acknowledge the support of the Madrid Government (Comunidad de Madrid-Spain) under the Multiannual Agreement with UC3M in the line of Excellence of University Professors (EPUC3M12), and in the context of the V PRICIT (Regional Programme of Research and Technological Innovation).

Commercial mortgage-backed securities (CMBS) expanded banks' liquidity and diversification benefits from mortgage securitization beyond those already provided by residential mortgage-backed securities (RMBS). RMBS involve the securitization of residential mortgages, turning illiquid loans into liquid securities, which mitigate the impact of cost-of-funds shocks (Loutskina and Strahan (2009), Loutskina (2011)). CMBS involve the securitization of commercial, rather than residential, mortgages.¹ There are three common objectives behind the issuance of CMBS. The first is to reduce bank exposure to the idiosyncratic risk of real estate prices, i.e., diversification.² The second is to transform an illiquid loan into a liquid marketable security. The third is to comply with regulatory limits on the amount of loans to a single borrower. Consequently, CMBS allow a bank to diversify its exposure to commercial real estate loans (CRE loans), thus acting as a substitute for holding whole commercial mortgages on its balance sheet (Ghent and Valkanov (2016), Duca and Ling (2020), Glancy et al. (2022)).

We document that CMBS expanded banking risks beyond those already known from residential mortgage securitization. Glancy et al. (2022) and Ghent and Valkanov (2016) document that CMBS disproportionately hold extra-large commercial loans in terms of the market value of the asset being financed and the absolute value of the loan. For instance, Glancy et al. (2022) document that CRE loans originated within CMBS setting are, on average, three times as large as those held on bank balance sheets and are disproportionately secured by hotels.³ Under these circumstances, CMBS enable a bank to diversify its exposure to large commercial loans on

¹ "Commercial mortgage" is the commonly used term for commercial real estate loans and includes loans to finance multifamily residential, construction & land development (C&D), commercial rental and owner-occupied commercial property loans (primarily industrial, office and retail).

² It is well established that the majority of price risk in real estate markets is idiosyncratic rather than national or even city specific (see Case and Shiller (1989)).

³ Glancy et al. (2022) show that CMBS' portfolio of originated CRE loans, on average, is composed of 24% hotel loans and 46% retail loans (e.g. shopping malls). For a comparison, banks and life insurers hold 9% and 4%, respectively, of CRE loans secured by hotels.

its balance sheets for bank issuers by transferring the idiosyncratic risk of such loans to the holders of those CMBS. However, such transferred idiosyncratic risk has systemic implications for banks that concentrate CMBS on their balance sheets. In other words, concentrated holdings of CMBS expose banks to a common underlying risk: the risk of investing in income-producing real estate properties. This risk, in turn, increases the likelihood of a banking crisis where multiple banks fail because of these common (and correlated) exposures among banks.

The key contribution of this paper is to show that CMBS generate ***correlated investment exposure*** (CIE) as an overlooked source of risk. Correlated investment exposure represents a source of systemic risk-taking within the framework of Benoit et al. (2017).⁴ They classify systemic risk-taking as a source of systemic risk across four dimensions: correlated investments, liquidity risk, tail risks, and leverage cycles and bubbles. We refer to correlated investment exposure as the systemic risk-taking attributable to correlated investments. It captures the potential risk of facing losses simultaneously with the rest of the banking system because of the common exposure to a particular asset class. It indicates how much each of the banks would do poorly at the same time, because of the common asset holdings.

To the best of our knowledge, ours is the first paper to address CMBS and bank correlated investment exposure in a related context. To date, there is no existing evidence of correlated risks associated with CMBS holdings on bank balance sheets. Current literature examines the overall risk and return profile of CMBS only considering the performance of the underlying asset of CMBS - commercial mortgages (An et al. (2011), Stanton and Wallace (2018), Ashcraft et al. (2019)). Overall, we are the first to show that the risk attributes of CMBS are different for banks

⁴ Benoit et al. (2017) identify three sources of systemic risk: systemic risk-taking, contagion between financial institutions and amplification mechanisms. They argue that several mechanisms of systemic risk can be combined as well generating systemic loops.

that invest in these securities than for banks that issue them. Ghent and Valkanov (2016) are the first to formally acknowledge the risk-sharing capacity of CMBS for banks issuing them. However, for banks investing in CMBS, we show that CMBS generate correlated investment exposure - a source of systemic risk that could further amplify fire-sale vulnerabilities across banks.

To measure the effects of CMBS on banks' CIE, we analyze U.S. banks during the 2000 – 2008 period preceding the global financial crisis (GFC). This is a unique period when regulatory capital requirements were lowered, triggering an extraordinary boom in CMBS investments by banks.⁵ Figures 1 and 2 depict the evolution of CMBS in the pre-crisis period (2000 – 2008). In Figure 1, we observe that CMBS experienced an extraordinary boom during the 2000s, with CMBS almost tripling in size as a % of GDP. Figure 2 depicts how this pattern was reflected on bank balance sheets across commercial banks of different sizes. Panels A, B, and C show security portfolios' composition for small, midsize, and large banks, respectively. In panel A, we observe that government securities represent the dominant category in small banks' security portfolios; however, CMBS presence is substantial, too. In Panel B, we observe that CMBS holdings gradually rise in midsize banks' portfolios beginning from the 4th quarter in 1999, and following the 4th quarter of 2004, they surpass the RMBS holdings. On the other hand, in panel C, we observe that CMBS holdings on bank balance sheets of large banks are insignificant when compared to RMBS and government securities. Moreover, comparing CMBS across the three subsets, we observe that midsize banks held the majority of the outstanding CMBS (see Figure 3). Hence, for midsize banks, CMBS improved banks' diversification, seemingly allowing banks to better manage the risk and returns on their liquid portfolios. On the other hand, we observe that banks'

⁵ The market has returned to health in the post-crisis period, but normalized by GDP, the volume of CMBS has managed to reach only its level of the early 2000s. (see Fuster et al. (2023))

asset portfolios became more similar for another asset class at a horizontal level. That is, in addition to government securities and RMBS, the midsize banks generated common exposures to CMBS as well.

Of course, regulatory capital requirements played a critical role in such positioning of the CMBS on bank balance sheets. Between 1990 and 2002, Basel I required at least 8% equity capital to fund CMBS holdings. Basel II cut this to 1.6% for Aaa- and Aa-rated CMBS. Moreover, A-rated CMBS securities had a 50% risk-weight (4%), half of the 100% risk-weight (8%) on whole commercial mortgages. Therefore, besides the liquidity provision and risk diversification benefits of holding CMBS, this regulatory change appeared to incentivize banks to increase positions in CMBS. Not surprisingly, depositories (including foreign banks) held one-fourth of the total outstanding CMBS in the pre-crisis period.⁶ Thus, this period provides us with a quasi-natural experiment for analyzing bank holdings of CMBS and CIE.

We perform this analysis using a unique data set of midsize publicly traded U.S. commercial banks with strong incentives for a high concentration of CMBS on their balance sheets. The properties of CMBS, as shown in Ghent and Valkanov (2016) and Glancy et al. (2022) suggest that the largest commercial banks have interests in issuing and selling CMBS but not necessarily in concentrating holdings of CMBS.⁷ The stylized facts in Figures 2 and 3 suggest the same. Therefore, we argue that the midsize commercial banks are most relevant for our analysis. Hence, we construct a data set of midsize commercial banks that are not subsidiaries of BHCs. Furthermore, the banks in our dataset are depository institutions with restricted regulatory capacity

⁶ See CMSA, 2007

⁷ In the period from 1983-2008 commercial and investment banks dominate in CMBS issuances with a combined market share of more than 83% (Bloomberg, L.P.). For instance, looking at the Bloomberg data the largest issuer of CMBS during the same period was Credit Suisse (with approximately a 13% market share), followed by Lehman Brothers (9.2%), and JPMorgan Chase (8.3%). The remaining list of top issuers is dominated by large global banks as well.

to originate extra-large commercial real estate loans, so holding CMBS represents an alternative strategy for this set of banks to invest in such loans. Banking regulations limit the amount a bank can lend to one borrower, which often precludes many banks from originating or holding very large commercial mortgages. Glancy et al. (2022) compare CRE loan balances outstanding across three lender types--banks, CMBS, and life insurers. They explain how CMBS allow investors to buy tranches tailored to their own risk tolerance and have an investment that is more liquid and more diversified than if the investor held a whole loan. The regulatory benefits attached to CMBS make investing in CMBS the preferred strategy for small and midsize banks versus originating large commercial real estate mortgages.

To measure CIE, we construct a ratio as the covariance of an individual bank's stock returns with returns of the banking industry (proxied in our analysis by the rest of the banks in our dataset), divided by the variance of the bank's stock returns. The numerator of this ratio measures the co-movement of an individual bank's stock return with the return of the rest of the banks, while the denominator measures the bank's total risk exposure. This ratio enables us to compare correlations across banks to their individual total risk exposures.

Suppose that the correlated investment exposure ratio (CIE ratio) increases over time, or under specific regulatory or market circumstances. In that case, it implies that the bank's underlying risk stems from its co-movement with the rest of the banks rather than from its individual total risk. The Basel approach in computing capital requirements relies on the assumption that banks have infinitely granular portfolios and, as a result, are all exposed to the same single risk factor. According to this assumption, CMBS' holdings shouldn't affect significantly the numerator of the CIE ratio. On the contrary, showing that CMBS holdings significantly impact the numerator of the CIE ratio relative to its denominator implies that many

other banks in the system have taken the same exposure to the CMBS market, so that the performance of each bank is affected by the CMBS' exposure of the rest of the banks. Increasing correlations across banks in the presence of CMBS holdings imply that banks' asset portfolios follow imperfect diversification, resulting in an unattended common risk-factor exposure. Our measure, therefore, allows us to show that CMBS holdings lead to higher correlation of returns across banks instead of contributing to maximally diversified asset portfolios only.

Considering that we are primarily interested in determining if CMBS increased banks' correlations relative to their total individual risk, we need to identify the impact of CMBS on the numerator of the CIE ratio relative to its denominator. We employ two distinct methodologies to achieve this. First, we employ probit regression to measure the probability that banks with large holdings of CMBS are associated with high values of CIE. Second, we employ quantile regression analysis. The quantile regression analysis allows us to compare the effects of CMBS across the entire distribution of the CIE ratio. The existence of the effects of CMBS in the upper quantiles of the CIE ratio distribution implies that CMBS affected a bank's co-movements rather than affecting only the bank's total individual risk. Moreover, if the effects appear to differ between the top and bottom quantiles of the CIE ratio distribution, it indicates that CMBS significantly contributes to or does not contribute to the bank's correlated investment exposure.

Because the CIE is composed of banks' covariances and variances that are measured using market data (returns), our quantile regression analysis could suffer endogeneity issue from omitted-variable bias. To isolate the effect of CMBS holdings on bank's CIE, we specifically measure this effect around two regulatory announcements that significantly changed banks' ability and willingness to invest in CMBS.⁸

⁸ In early 2003, the Financial Accounting Standards Board (FASB) issued guidance that required consolidation of no-recourse conduits on banks' balance sheets under US GAAP (FASB 46). Such a ruling would have rendered

Finally, accounting for the regulatory capital incentives related to the CMBS investments, we examine whether there are differences in the effects of CMBS on CIE for banks with high vs. low regulatory capital. Banks with higher regulatory capital are banks with high capacity to issue commercial real estate loans and CMBS; therefore, we don't expect significant effects in this subset. On the other hand, banks with lower regulatory capital should have stronger incentives for investing in CMBS; we show that effect exists for this subset of banks only.

The quantile regression analysis shows that the effects of CMBS are statistically significant at a 1% significance level along the upper quantiles of the CIE distribution only. This result highlights that CMBS contribute to the bank's correlated investment exposure, exposing banks to a different source of risk rather than only affecting the bank's total risk. This finding indicates that bank asset portfolios are not constant but rather dynamic in the presence of financial innovation. Specifically, an increase in the exposure of banks to a particular sector, accompanied by financial innovation in the markets, leads to systemic risk exposures. This is exactly the case with the commercial real-estate sector and mortgage-backed securities in the period before the GFC.

Institutional Background and Related Literature

Table I summarizes the risk-based capital requirements for CMBS and commercial real estate mortgages held by commercial banks for the periods 2002 – 2008 (Panel A) and 1997 -2001 (Panel B). As of January 2002, all AAA- and AA-rated CMBS fell to a 20% risk-weight, requiring only 1.6 cents of capital per dollar investment as opposed to 8 cents per dollar. A-rated CMBS received a 50% risk-weight, requiring four cents of capital per dollar investment. On the other

securitized assets too costly to be considered a source of liquidity or capital. In July 2004, however, US bank regulators issued a ruling that there will be no change in the capital requirements for different securitized assets. Loutskina (2011) and Acharya et al. (2013) both exploit these two regulatory announcements as exogenous shocks to the depth of the securitization market.

hand, whole commercial real estate mortgages retained a 100% risk weight. Such regulatory changes may have signaled to banks and other market participants that CMBS' risk had fallen relative to RMBS and government bonds.⁹

However, CMBS do not necessarily share the same palette of banking risks as RMBS, especially because their underlying risks differ in many ways. For instance, commercial mortgages, on average, are much larger than residential mortgages. In addition, Ghent and Valkanov (2016) find that banks tend to securitize most extra-large commercial mortgages into CMBS, those that are above the 90% percentile of the commercial real estate loan portfolio of a bank, to protect from the large exposure to commercial real estate prices. Finally, CMBS are almost exclusively secured by large income-producing properties such as hotels, industrial buildings, offices, and retail properties (e.g., shopping malls), whereas RMBS are backed by a much larger number of small-dollar home mortgages, where residential houses serve as collateral. Consequently, the default risk associated with RMBS is considerably lower. One reason is that the chances of a large number of borrowers defaulting on their repayments at the same time is extremely low.¹⁰ Hence, the likelihood of correlated risks across banks due to RMBS holdings is very low. One could argue that this is not always the case because the opposite happened back in 2008. Many banks ended up in financial distress at the same time, following the common exposures in RMBS. The GFC is a case when the fundamental structure of the RMBS deteriorated. In the period preceding the GFC, RMBS were created from pools of mortgages from the same locations and were therefore not geographically diversified. Regional housing shocks then hit these securities very hard. In contrast, we argue that the fundamental structure of CMBS allows for

⁹ Stanton and Wallace (2018) find that the spread between Aaa- and Aa- rated CMBS and corporate bond yields fell after an easing of capital requirements for highly rated CMBS in 2002-2004.

¹⁰ Begley and Purnanandam (2017) consider residential mortgage-back securities as relatively safe assets.

common exposures across banks to the default risks of extra-large real estate commercial loans backed by income-producing properties. CMBS enable risk-sharing against large commercial loans on bank balance sheets for bank issuers by transferring the idiosyncratic risk of such loans to the holders of those CMBS. Unfortunately, such transferred idiosyncratic risk has systemic implications for banks that concentrate CMBS on their balance sheets.

The insights from this paper are relevant to the ongoing policy discussions on systemic risk regulation. Various regulatory tools and institutional arrangements have been approved to address systemic risk at national and international levels. However, their entire focus is on controlling and regulating systemically important financial institutions (SIFIs). Several works earlier have raised concerns regarding the efficiency of this approach. Acharya et al. (2011) and Acharya and Öncü (2013) discuss some drawbacks of the ongoing regulation of systemic risk concerning the SIFIs only. Instead, they propose a regulatory framework at the level of systemically important assets and liabilities (SIALs) of financial institutions, whether these institutions are deemed systemically important or not. This framework suggests identifying which assets and liabilities have a systemic impact and limiting or regulating their use. This paper emphasizes that certain assets could exercise systemic risk exposure under specific circumstances.

Our paper is relevant to the literature on the role of capital regulation for banking risks. This literature acknowledges that capital requirements serve as an instrument to control banks in risk-taking (Merton (1977) and Freixas and Rochet (2008)). However, a different set of papers suggests that the capital requirements should be based on the asset's systemic importance and not on the risk of individual assets only (Allen and Gale (2007), Morris and Shin (2008), Alter et al. (2015)). Particularly, they show that capital requirements that do not take into account the structure of interconnections among banks can actually increase risk. Our paper provides a shred of

empirical evidence in this matter. We examine the impact of CMBS holdings on banks' correlated exposure during a period in which CMBS were subject to substantially relaxed capital requirements. Our results indicate that such capital requirements led to herding behavior among banks, inadvertently influencing their prudent behavior and imposing unintended risks.

Our paper also relates to the growing literature documenting the performance and properties of CMBS. A large portion of this literature focuses on financial contracting and different aspects of agency problems in the CMBS market (Titman and Tsyplakov (2010), An et al. (2011), Black et al. (2012), Furfine (2014), Wong (2018), Ashcraft et al. (2019)). An increasing number of papers examine the features and outcomes of the commercial real-estate loans retained on bank balance sheets and those originated by capital markets, such as CMBS or life insurers. Downs and Xu (2015) find that banks resolve distressed loans much quickly than CMBS. Black et al. (2017) show that banks are willing to finance risky CRE loans where monitoring and renegotiation are important, unlike the CMBS. Meanwhile, Ghent and Valkanov (2016) show that CMBS hold extra-large loans, significantly larger than CRE loans retained on bank balance sheets. They find that the CRE loans in the highest loan size decile have a 43% chance of securitization, whereas the ones in the lowest decile have only a 1% chance. In addition, they find little evidence in favor of the argument that CRE loans selected for securitization are of lower quality in the sense of carrying greater distress risk. These results are consistent with the evidence of Goetzmann and Newman (2010) on the composition of financial structures similar to CMBS during the 1920s and 1930s. They find that many skyscrapers built during that period were financed using financial structures similar to CMBS. Glancy et al. (2022) recently examined the sources of segmentation in the CRE lending market across the main lender types: banks, life insurers, and CMBS. Their results concerning the size of the CRE loans originated by CMBS are consistent with those of Goetzmann

and Newman (2010) and Ghent and Valkanov (2016). These findings indicate that securitization of large commercial real estate loans allows lenders to diversify against the real estate price risk and thus, minimize their idiosyncratic risk exposures. Therefore, the risk-sharing benefits from securitization are greater with the size of the CRE loan. On the contrary, we show that holdings of CMBS on bank balance sheets increase bank systemic risk-taking, thus exposing banks to downside risk. Hence, our paper expands the literature on CMBS by examining their risk properties.

The remainder of the paper is outlined as follows. Section I presents the data. Section II introduces the variables. Section III describes the methodology. Section IV discusses the results. Finally, section V concludes.

I. Data

We obtain for our analysis from two primary sources. First, we collect daily stock returns from the database of the Center for Research in Security Prices (CRSP), from which we calculate the numerator and denominator of CIE ratio. Second, we obtain quarterly financial accounting data for U.S. commercial banks from the Commercial Bank Database of the Federal Reserve Bank of Chicago (FRB Chicago), which we use to measure CMBS holdings and bank control variables.¹¹

We merge stock return data with the accounting data using the CRSP-FRB links dataset provided by the Federal Reserve Bank of New York.¹² This dataset links a bank's regulatory identification number (RSSD ID) from the National Information Center to the permanent company

¹¹ This database provides financial information for all banks filing the Report of Condition and Income (also known as the "Call Report"), which are also regulated by the Federal Reserve System, Federal Deposit Insurance Corporation (FDIC), and the Controller of the Currency. It does not include data from savings institutions that file the Thrift Financial Report (TFR) with the Office of Thrift Supervision (OTS).

It is available at: <https://www.chicagofed.org/banking/financial-institution-reports/commercial-bank-data>

¹² Available at: https://www.newyorkfed.org/research/banking_research/datasets.html

number (PERMCO) used in the CRSP database. The RSSD ID is a unique identifier that is assigned to commercial banks or bank holding companies by the Federal Reserve; it is the primary identifier of the entities in regulatory reports, such as the Call Report (FFIEC031) and Y9-C. PERMCO is a unique and permanent company identification number that is assigned to publicly traded institutions in the CRSP database. Although a company's name, ticker, and stock exchange ID may change, its PERMCO will remain the same.

Our sample period of interest ranges from 1999-Q1 to 2008-Q3.¹³ Within this period, the dataset of the CRSP–FRB links provides the total RSSD ID–PERMCO links of 99 commercial banks, which are listed on one of the largest U.S. stock markets (NYSE, AMEX, or Nasdaq).¹⁴ However, the CRSP database allowed the merging of stock returns and accounting data for only 58 publicly traded commercial banks for this sample period. Thus, restricted to commercial banks that are listed on the largest U.S. public stock markets (we do not consider commercial banks that are also registered as bank holding companies or that trade over the counter), our final sample is an unbalanced panel comprising 58 U.S. commercial banks accounting for a total of 1,125 observations.

Acharya et al. (2013) also work with a dataset that they constructed by merging commercial banks' accounting data and banks' stock prices from 2000 to 2006. They managed to include 88 commercial banks with more than \$50 billion in Europe and the U.S. within this period. However, they construct their dataset using different sources. They use Bankscope to download bank

¹³ We consider two key arguments on why 1999Q1–2008Q3 is the most relevant sample period for our analysis. First, this research primarily aimed to precisely measure the effects of CMBS that piqued banks' interest exactly in the period before the GFC; moreover, this is the only sample period when Aaa- and Aa- rated CMBS were assigned with significantly lower bank capital requirements, from 8% to 1.6%. Second, we opted for our sample to begin precisely with the data of 1999: Q1 and end with those of 2008: Q3, to avoid contamination from the 1998 Asian financial crisis and 2008 GFC.

¹⁴ Publicly Traded National Commercial Banks with SIC Codes 6020, 6021, and 6022.

accounting data and DataStream to download banks' share prices. They match bank accounting data with their share prices using the International Securities Identification Number (ISIN), which is provided in Bankscope. Nevertheless, both approaches for constructing these datasets where we need to merge bank accounting data with their share prices data for the period (2000–2008), do not include a significantly higher number of banks. We assume that this is a feature of these databases for this particular period.

II. Variables

A. Correlated Investment Exposure (CIE)

Correlated investment exposure measures whether CMBS holdings are correlated across banks in addition to being associated with the changes in banks' individual total risk. To this end, first, we construct a bank-specific coefficient, namely, “bank co-movement coefficient (*bcc*).” We measure our “*bcc*” using the covariance between the individual bank's return and the return of a banking index constructed for our sample of banks, (R_{sbanks}). We compute the return on R_{sbanks} as the weighted sum of the returns of all banks at time t , except the returns of the bank whose *bcc* we measure at time t . We consider this approach effective in capturing the co-movements between each bank and the other banks in the economy at the time t .

$$bcc_{j,t} = Cov(r_{j,t}, R_{sbanks,t}) \quad (1)$$

where

$$R_{sbanks,t} = \sum_{j=1}^N w_{j,t} r_{j,t}. \quad (2)$$

Further, we construct the CIE as a ratio to analyze the effects of CMBS holdings on a bank's systemic exposure with respect to its total risk. It is a ratio of a bank's co-movement coefficient

over a bank's variance for the corresponding quarter. Then, the CIE of a bank, j , in each quarter, t , is given by the following:¹⁵

$$CIE_{j,t} = \frac{bcc_{j,t}}{Var(r_{j,t})} \quad (3)$$

The CIE measures a bank's systemic exposure level in comparison to its total risk exposure. An increasing CIE over time indicates that a bank's underlying risk stems from its systemic exposure rather than its total risk. It indicates that these banks have a high degree of co-movement, raising the risk of default due to bank systemic exposure significantly higher than that already estimated in the bank's individual total risk. For banks where the CIE is low or approximates zero, it would mean their underlying risk is associated only with their individual bank's total risk and not with the bank's CIE level. Such a value of CIE indicates that these banks do not comove with the rest of the banking sector.

The bank's total risk is the sum of the bank's idiosyncratic and systematic risk according to the Markowitz portfolio theory.¹⁶ The literature hasn't provided yet any theoretical evidence on the status of systemic risk with respect to the systematic risk. In general, the systemic risk is considered to be a fraction of the systematic risk. However, it could also appear independently of the systematic risk and deteriorate the asset value or the entire financial system.

In their attempt to make a distinction between systemic and systematic risk, Benoit et al. (2017) specify the defining characteristic of systemic risk as follows:

$$\hat{\pi}_i(y_i^S, y_i^I, \varepsilon^S, \varepsilon^I) \neq \pi_i(Y^S, Y^I, B, \varepsilon^S, \varepsilon^I) \quad (4)$$

¹⁵ We compute the covariance and variance using daily data of banks' stock prices

¹⁶ See Markowitz (1952).

The left-hand side of the inequality (4) denotes the benchmark payoff of a financial institution ($\hat{\pi}_i$) that it would receive if there were no other financial institutions in the system. The right-hand side of the same inequality denotes the payoff of the same financial institution when it belongs to a system of financial institutions.¹⁷ The inequality suggests that the payoff of the same financial institution cannot be equal under the two circumstances because of the links and co-movements among the financial institutions in the system, measured by the matrix of links, B . That is, the payoff of a financial institution within a financial system depends not only on its own systematic and idiosyncratic exposures (the bank's total risk), but on the exposures of other institutions, the idiosyncratic shocks they face, and on the links of each financial institution with other institutions, or even among these other institutions.

Therefore, the structure of the CIE suggests that if a bank's systemic exposure appears to be positive and greater than the bank's total risk (which is the case when $CIE > 1$), the bank has been affected by the common exposures of other institutions in addition to its total risk. This common exposure is actually a systemic exposure. Then, if the bank's systemic exposure appears to be negative or lower than the bank's total risk (which is the case when $CIE < 1$), the major risk exposures of the bank stem from its total bank risk.

B. The focal explanatory variables: government securities, RMBS, and CMBS

We construct the focal explanatory variables as the ratios of the total outstanding amount of the corresponding security (government securities, RMBS, or CMBS) to the bank's total assets. By

¹⁷ y_i^S and y_i^I are the systematic and idiosyncratic exposures of the financial institution i , respectively. ε^S and ε^I are independently distribution variables with zero mean. $Y^S, Y^I, \varepsilon^S, \varepsilon^I$ are the same defining variables of i when i functions in a system of financial institutions. B is an $N \times N$ matrix of direct links among the financial institutions (for instance, interbank loans or derivatives).

construction, securitized assets with high liquidity features represent alternatives to government securities, and consequently, they maintain a position as liquid assets in banks' asset portfolios. While cash dominates government securities and mortgage-backed securities in terms of safe liquidity provisions in all states, banks prefer holding government securities or mortgage-backed securities because they provide positive expected returns. In Figure 2, we observe that midsize banks used CMBS as first-order alternatives to cash holdings along with government securities and RMBS. Our primary interest is the effects of CMBS on a bank's CIE. However, government securities and RMBS represent common asset holdings across all banks because of their liquidity features. Therefore, for comparison with the CMBS, we also examine the effects of government securities and RMBS on a bank's CIE in terms of separate liquid asset categories.

C. Control variables

We control for the following set of bank-specific variables that could potentially drive a bank's correlated risk or its total risk: bank size, bank leverage, equity multiplier, return on assets (ROA), cash holdings, total loans, other borrowed money, and deposit levels. You can find the summary and definitions of all variables in Table AI in the Appendix.

Many studies in the systemic literature provide evidence of bank size and leverage as leading determinants of a bank's systemic risk. For instance, Greenwood et al. (2015) measure fire sales propagation shocks across bank balance sheets, and their measure is based on bank size, leverage, and connectedness. In their survey of systemic risk, Benoit et al. (2017) classify the leverage cycles and bubbles as a separate source of systemic risk-taking. Phelan (2017) shows that bank size and profitability should be related to the amount of correlated risk in banks' assets; thus,

we also employed ROA to control for the bank's performance. To take into account a bank's capacity for immediate liquidity, we use the bank's total cash holdings. Finally, loans represent the main business operations of banks and, consequently, play the main role in banks' risk taking.

We define bank size as the natural logarithm of each bank's total assets. We measure bank leverage following Baker and Wurgler (2015) using total risk-based capital (Tier 1 and Tier 2) divided by average total assets. Then, to make a distinction between a bank's exposure to risk-weighted assets and total assets, we measure the equity multiplier as a bank's total assets divided by total equity.

We control for the effect of bank performance using return on assets, which is net income divided by total assets. We measure a bank's cash holdings as a ratio of cash to total assets. Similarly, we measure a bank's loan portfolio exposure as a ratio of total loans to total assets.

We consider that other borrowed money and deposit levels might be control variables that could bias our estimation if not properly treated. Moreover, as our empirical analysis aims at measuring banks' exposures to co-movements, other borrowed money represents most of any other bank's obligation toward borrowing money that is not reported elsewhere.¹⁸ Consequently, the increasing correlated exposure across banks could be affected by the interbank borrowing. To prevent this bias, we control for the other borrowed money from each bank.

Finally, to address the role of bank's market power over depositors, we control for bank's deposit level per quarter. Loutskina (2011) and Gete and Reher (2021) provide evidence how banks with more market power over depositors choose to securitize fewer of their loans. That is, banks with higher market power over depositors are banks that are exposed less to securitization, meaning the risks in these banks stem from their loan

¹⁸ Line item instructions for the Consolidated Report of Condition for a bank with domestic offices only (FFIEC 032, 033, or 034)

portfolio or other investments. Moreover, the differentiation in banks' securitization activities due to bank's market power over depositors implies that banks with more market power have different risk profiles than banks with low market power. Deposit level is the ratio of the bank's total deposits to the total deposits in the economy in a given quarter. Thus, the ratio captures the time variation in deposit levels using the variations in deposit levels across institutions, as well as the total outstanding deposits of individual banks and total deposits in the economy.¹⁹

$$DepositLevel_{j,t} = \frac{Transaction\ Deposits_{j,t} + Brokered\ Deposits_{j,t} + Time\ Deposits_{j,t} + Savings\ Deposits_{j,t}}{Aggregate\ Deposits_t} \quad (5)$$

D. Summary statistics

Table II presents the summary statistics for the full dataset covering the period from 1999-Q1 to 2008-Q3. Asset portfolios of banks in our dataset are on average composed of 71% loans and 29% cash and securities. The security portfolios are on average composed of 9.6% government securities, 5.1 % RMBS, 2.9% CMBS and 11.4% cash and other securities. The heterogeneity in bank sizes in our dataset is significant: The smallest bank in our dataset has total assets of \$ 45 million, whereas the largest one has total assets of \$ 62.4 billion. The summary statistics reveals that banks with higher total assets are characterized by high CIE, high CMBS holdings, high leverage, and high profitability (ROA).

¹⁹ We exclude the demand deposits in the computation of the deposit levels.

Table III reports the summary statistics of the top vs. bottom capitalized banks in our dataset when we rank banks by their Tier 1 capital / Total assets ratio. We compute the averages of all variables for the top capitalized and bottom capitalized banks, separately. We then compute univariate comparisons between the means using a *t-test* of differences in means, where the null hypothesis is that the bottom capitalized banks are not statistically different from the top capitalized banks. Looking at the bank level variables, there are substantial differences. The most striking difference is that unconditionally, the bottom capitalized banks have much higher CMBS holdings, a difference that is economically meaningful and statistically significant at the 1% level. Other significant differences are that bottom capitalized banks are larger by total assets but have lower total loans than top capitalized banks. In addition, the bottom capitalized banks are characterized by a higher equity multiplier and higher leverage than the top capital banks. That is, the bottom capitalized banks appear riskier than the top capitalized banks. Furthermore, bottom capitalized banks have higher deposit levels compared to the top capitalized banks.

III. Methodology

To show the significance of a bank's portfolio holdings of CMBS to the bank's correlated investment exposure, we perform several different empirical tests. First, we estimate a probit regression model of the likelihood that a bank that has relatively large holdings of CMBS falls in the set of banks at the upper tail of the CIE distribution.

Next, we employ a quantile-regression approach to estimate how the relationship between the CMBS and the CIE varies for different percentiles of the CIE distribution. We present two sets of results on the basis of the quantile-regression approach. First, we examine the effects of CMBS

on the CIE using the full set of banks. Thereafter, we examine whether these effects are different when banks exhibit substantial distinctions based on regulatory capital, measured as Tier 1 capital to total assets. Therefore, we run the quantile regression specification on banks with high capital ratios vs. banks with low capital ratios.

A. Probit regression analysis

We argue that CMBS caused correlated risks not captured in banks' total risk exposure. In terms of the CIE specification, this implies that CMBS holdings should affect the high quantiles of the CIE distribution but not necessarily the low quantiles. These differences suggest that we might predict the probability that large CMBS holdings in banks' asset portfolios are associated with the CIE for the upper quantiles of the CIE. That is, we model a discrete correlation process of whether banks with large CMBS holdings have large values for CIE, too. The observable bank characteristics that influence the correlation process are captured by a vector $x_{j,t-1}$, and enter linearly into the correlation process $Y_{j,t}^*$, where

$$Y_{j,t}^* = x_{j,t-1}\beta + \mu_{j,t} \quad (6)$$

and $\mu_{j,t}$ are the unobservable (to the econometrician) characteristics of the bank j at time t . The bank characteristics in vector $x_{j,t-1}$ have a $t-1$ subscript because we assume that the changes in accounting data have their true impacts on bank returns in the subsequent accounting periods.

The correlation process is unobservable, however, the outcome of high CIE in the presence of large CMBS holdings on bank balance sheet – is observable. Hence, we construct a dichotomous variable, probit CIE - $PCIE_{j,t}$, which equals 1 for all values of CIE equal or above its 95th percentile and zero otherwise. As such, $PCIE_{j,t}$ is related to $Y_{j,t}^*$ as $PCIE_{j,t} = 1$ if $Y_{j,t}^* > 0$ and zero otherwise.

Thus, $P(PCIE_{j,t} = 1) = P(Y_{j,t}^* > 0) = F(x_{j,t-1}\beta)$, where F is the symmetric distribution of $\mu_{j,t}$. We assume that $F(\cdot)$ is the normal distribution, denoted by Φ . Then, we estimate the following probit model:

$$P(PCIE_{j,t} = 1) = \Phi(x_{j,t-1}\beta) \quad (7)$$

B. Quantile regression analysis

Next, we generalize the analysis to the entire distribution of the CIE by employing quantile regression (Koenker and Bassett, 1978).²⁰ We want to measure whether CMBS increased the bank's co-movement coefficient with respect to the bank's total risk, as the latter is a widely established measure of a bank's risk exposure. By showing that CMBS exhibit different effects at the upper and bottom quantiles of the CIE's distribution, our research analysis would provide clear evidence of how CMBS affect banks' correlated risk exposure and their total risk simultaneously. Particularly, the increasing or decreasing effects of CMBS on the extreme quantiles of the CIE would indicate that CMBS affect the bank's co-movement exposure rather than its total risk. Conversely, the absence of the effects of CMBS at the extreme quantiles of the CIE distribution would indicate that holdings of CMBS are not a key determinant of the bank's correlated investment exposure.

We isolate the effects of *CMBS* on the CIE around two regulatory announcements, following Loutskina (2011) and Acharya et al. (2013). Following the Dec. 2, 2001 bankruptcy filing of Enron, U.S. banking regulators considered revising the capital requirements for

²⁰ Additionally, see Koenker and Hallock (2001). Unlike classical regression, which relates the mean of the dependent variable to the explanatory variables, we would like to show how the relationship between the CMBS and a CIE varies for different quantiles of the CIE distribution. Specifically, our primary interest is how CMBS affect the CIE at the extreme quantiles of its distribution. Panel data fixed effects analysis would allow us to measure the average effects of CMBS on the CIE. Still, it does not allow us a direct interpretation of CMBS' simultaneous effects on the bank's co-movement coefficient vs. the bank's total risk

securitized assets, which played a major role in Enron's collapse.²¹ Figure 4, which extracts from Figure 2 in Acharya et al. (2013), presents a summary of media news related to the reactions of regulators and the business environment on this matter. We observe that significant uncertainty existed regarding the treatment of securitized financial products on banks' balance sheets, following the Enron collapse; the collapse further substantially reduced the asset-backed securitized activities of banks.²²

However, in July 2004, U.S. bank regulators published a joint statement announcing a final ruling on bank capital adequacy guidelines that reaffirmed the treatment of securitized assets, including CMBS.²³ This ruling reaffirmed the 20% risk weight for highly rated CMBS. This announcement serves as a second exogenous shock to banks' incentive to hold CMBS.

Hence, we consider that, from the late 2002 to late 2004, bank investments in CMBS were on hold. After July 2004, the uncertainty regarding capital requirements for CMBS was resolved when regulators unexpectedly announced that the 20% risk weight for CMBS was reaffirmed. From this moment forward, banks' investments in CMBS rose sharply.

In our model, we measure the effects of a bank's CMBS portfolio holdings on the CIE by interacting our variables of interest with dummy variables that capture the timing of the regulatory announcements. The baseline specification in our empirical strategy has the following functional form:

²¹ Such reconsideration resulted from the Enron collapse because it employed conduit-style structures similar to securitization to create off-balance sheet leverage.

²² For instance, Acharya and Schnabl (2010) provide evidence on the stagnation of the asset-backed commercial paper market during this period.

²³ See <https://www.federalreserve.gov/boarddocs/press/bcreg/2004/20040720/attachment.pdf>

$$\begin{aligned}
CIE_{j,t} = & \beta_0 + \beta_1 * Ln(govsec_{j,t-1}) + \beta_{2002} * d_{2002} * Ln(govsec_{j,t-1}) + \beta_{2004} * d_{2004} * \\
& Ln(govsec_{j,t-1}) + \beta_2 * Ln(rmb_{j,t-1}) + \beta_{2002} * d_{2002} * Ln(rmb_{j,t-1}) + \beta_{2004} * d_{2004} * \\
& Ln(rmb_{j,t-1}) + \beta_3 * Ln(cmbs_{j,t-1}) + \beta_{2002} * d_{2002} * Ln(cmbs_{j,t-1}) + \beta_{2004} * d_{2004} * \\
& Ln(cmbs_{j,t-1}) + \beta_4 * Controls_{j,t-1} + \gamma_j + \varphi_t + \varepsilon_{j,t}
\end{aligned} \tag{8}$$

Where

- d_{2002} is a dummy variable that is equal to one for every quarter between 2002:Q3 and 2004:Q3; otherwise, it is zero.
- d_{2004} is a dummy variable that is equal to one for every quarter after and including 2004: Q4; otherwise, it is zero.

Therefore, the coefficients of the interaction terms, $\beta_{2002} * d_{2002} * Ln(cmbs_{j,t-1})$ and $\beta_{2004} * d_{2004} * Ln(cmbs_{j,t-1})$ are the main coefficients of interest. Thus, the interaction terms separately capture the marginal effect of CMBS on the increase of CIE in the presence of the regulatory announcement shocks.

Following the regulatory announcement in early 2002, the interest in CMBS had been paused, and we expect that CMBS would be associated with a decreasing effect on the CIE. Thus, we expect $\beta_{2002} * d_{2002} * Ln(cmbs_{j,t-1})$ to exhibit a negative sign.

Conversely, the regulatory event in July, 2004, restored investment incentives for banks in CMBS. Thus, we would expect that the holdings of CMBS positively affected the CIE after 2004, further indicating that $\beta_{2004} * d_{2004} * Ln(cmbs_{j,t-1})$ should exhibit a positive sign.

We allow for the impact of other bank features (such as cash holdings, loan portfolio, leverage, bank size, CAR, and ROA) to change upon the changes in the regulatory capital

announcements by interacting all the bank-specific control variables with the dummies, d_{2002} and d_{2004} .

Moreover, in our identification strategy, the shocks to the capital requirements for CMBS holdings had direct effects on banks' holdings of this asset class. On the other hand, the dependent variable in our regression specification is the CIE. We measure the CIE by applying banks' returns; thus, the shocks to the capital requirements to hold CMBS were barely related or even unrelated to the financial market. Moreover, the regulatory announcements in mid-2002 and mid-2004 were contrary to banks' expectations, clearly making it an unexpected shock to banks' activities in CMBS. Thus, it is unlikely that the effect of CMBS is not clearly identified after the 2002 and 2004 announcements. Therefore, the two contradictory capital announcements allow us to isolate the effects of the bank holdings of CMBS on the CIE and interpret their causal effects on the bank's co-movement coefficient vs. the bank's total risk.

One can also argue that our quantile regression analysis around the regulatory announcements suffers from omitted variable bias. That is, banks at the time had enormous holdings of various structured finance products and securitized assets as off-balance sheet items, too. Consequently, the effect on correlated investment exposure versus its total risk could stem from such off-balance sheet securitized assets. In this matter, we examined the holdings of off-balance sheet securitized assets of the banks in our datasets. These banks are commercial banks and listed on U.S. stock exchanges, but they are not subsidiaries of bank holding companies (or similar structures). As such, their off-balance sheet structures are very modest and insignificantly exposed to off-balance sheet structured finance products or securitized assets. Banks in our dataset are also not exposed to significant holdings of any other asset-backed securities or structured finance products as on-balance sheet items, as it was the case with the U.S. bank holding

companies and investment banks at the time. For instance, in Figure 2, we report the on-balance sheet holdings of asset-backed securities (ABS) along with the government securities, RMBS, and CMBS. We observe that in all three subsets, they represent a very small fraction of banks' security portfolios.

Our focal explanatory variables and the controls are all accounting data as reported in banks' financial statements. We assume that the changes in accounting data have their true impacts on the market in the subsequent accounting periods. To capture this feature of the accounting data, we apply the one-quarter lags of all the independent variables in our regression specifications. In addition, because our core variables of interest and controls are highly skewed, we use their natural logarithmic transformations in our analysis.²⁴

The quantile-regression method does not allow the consideration of a bank's heterogeneity; thus, we do not include bank-fixed effects in the quantile-regression analysis. However, it does allow the inclusion of the quarter-fixed effects.

We test for heteroscedasticity in all the regression approaches. Particularly, regarding the unbalanced panel data, we conduct the modified Wald test for group wise heteroscedasticity in the fixed-effect regression model. For all the regression estimations $\text{prob} > \chi^2$ is near zero, indicating heteroscedasticity. Therefore, to prevent heteroscedasticity and serial correlations concurrently, we use robust standard errors for all the specifications, as well as regression approaches.

²⁴ In doing so, we first added one to any variables that can take a value of 0.

IV. Results

A. Probit regression

In Table IV, we report estimations of β , robust standard errors, and marginal probabilities across various percentiles of the CMBS and CIE distributions of the specification $x_{j,t-1}$ in Eq.6 . Our variables are highly skewed; therefore, we use their natural logarithmic transformations in the estimation. We include bank-fixed effects to control for time-invariant heterogeneity across banks, while the quarter-fixed effects are included to capture any direct impact of other macroeconomic factors that simultaneously affect all the banks in our dataset.

We report log pseudo likelihood for each probit estimation. In probit models, the likelihood function is based on the probability that the observed outcomes occur, given the model's parameters. The log pseudo likelihood is the natural log of this likelihood, often used instead of the regular likelihood because it simplifies mathematical operations. However, there is no “good” or universal threshold of the log pseudo likelihood. More negative values suggest worse model fit, while less negative (closer to 0) values suggest better fit. To evaluate the goodness of the model, we need to compare the log pseudo likelihood across different estimations.

In the estimation presented in column (1), we examine the likelihood that all banks at the 90th percentile of the CMBS distribution (or above) have CIE allocated at the 95th percentile of the CIE distribution (or above). In the estimation in column (2), we examine the likelihood that all banks between the 25th and 75th percentile of the CMBS distribution have CIE allocated at the 95th percentile of the CIE distribution (or above). In the estimation presented in column (3), we examine the likelihood that all banks at the 25th percentile of the CMBS distribution (or below) have CIE allocated at the 95th percentile of the CIE distribution (or above). The observable characteristics that influence the process are the same across all three estimations.

The results from the first three columns in Table IV show that CMBS holdings are positively and statistically significant (at the 1% level) in the estimation in column (1) only. Hence, banks with CMBS holdings at the 90th percentile of the CMBS distribution have a higher likelihood of having a CIE allocated at the highest percentile of the CIE distribution (95th percentile and above). Moreover, comparing the log pseudo likelihood across the three estimations, the specification in column (1) has the least negative value of the log pseudo likelihood.

In column (4), we estimate whether the opposite hypothesis also holds: Do banks with CMBS holdings at the 90th percentile of the CMBS distribution also have low values of the CIE, those allocated at the 25th percentile of the CIE distribution (or below)? We observe that CMBS holdings in this case are not statistically significant, and the log pseudo likelihood has the third highest value across all four estimations.

Overall, the results in Table IV show that banks with high values of CMBS holdings on bank balance sheets are associated with high values of CIE but not with low values of CIE. Such results indicate the existence of correlated risk that has not been captured in banks' traditional risk.

B. Quantile regression analysis

The CIE is composed of two components: the bank's co-movement coefficient, with a role of numerator, and bank's total risk (measured by bank's variance) with a role of denominator. A bank's co-movement coefficient is the numerator in the CIE and, by construction (Eq. 1), could take positive or negative values, whereas a bank's total risk in its denominator role is determined only by positive values by construction. To argue about the effects of any of the securities on CIE, we need to provide evidence on the existence of the effects in the extreme quantiles of the CIE. Such effects are result of banks that commove together, i.e., banks' co-movement coefficients are

different from zero and are greater than banks' total risk on average. This implies that the particular asset actually exerts a greater effect on a bank's correlated investment exposure rather than on the bank's total risk, thus exposing banks to another source of risk,—namely, bank systemic-risk taking.

We perform quantile regression analysis to provide evidence on the existence of these effects. This analysis allows us to measure how the effects of a particular asset vary at different percentiles of the CIE distribution.²⁵ Table V summarizes the coefficient estimates of the lowest quantiles, the medium, and the highest quantiles.²⁶

The results of the quantile regression show that *cmb*s is the only asset category that exerts a statistically significant effect at the 1% significance level on CIE along the upper quantiles of its distribution after the occurrences of both regulatory announcements. For all upper quantiles, the coefficients of the interaction terms with the dummies of the 2002 and 2004 events exhibit the expected sign.

Further, we provide a graphical presentation of the estimated coefficients in the quantile regression. This graphical representation provides a better preview of the estimated coefficients of the three categories of securities across the different quantiles of CIE, allowing us to compare their effects. In panel A of **Error! Reference source not found.**⁵ we present the coefficients across the different quantiles of the three categories of securities following the 2002 regulatory announcement. Additionally, panel B depicts the coefficients across the different quantiles following the 2004 regulatory announcement. First, the results in Figure 5 reveal that the effects

²⁵ We use robust standard errors to control for the heteroscedasticity and serial correlation of the standard errors

²⁶ We presented only the results of the quantile regression analysis wherein we interacted all the bank controls. The results of the baseline specification (without any interactions of the event dummies with the bank controls) are not significantly different.

of the three securities are not monotonic along the entire distribution. In the case of the 2002, we observe that the interaction coefficients that are related to *cmbs* are below zero across the entire distribution of the CIE, with an increasing trend in the magnitudes at the upper quantiles. This result indicates that *cmbs* has a negative effect on CIE. The interaction coefficients of *govsec* and *rmbs* are above zero along the entire distribution following this event; however, we find that most of them are not statistically significant. For the 2004 regulatory announcement, we observe an opposite trend. The interaction coefficients of *cmbs* are above zero across the entire distribution of the CIE, with a significantly higher magnitude in the upper quantiles than in the medium and lower ones. The interaction coefficients of *govsec* and *rmbs* are below zero across the entire distribution of the CIE, although they are not statistically significant.

A reasonable conclusion from the graphical representation is that the effects of *cmbs* dominate in the upper quantiles of the distribution in both exogenous shocks. We observe that the difference between the effects of *cmbs* and the other two securities is very large across the upper quantiles. Figure 6 reveals additional plots of the interaction coefficients of *cmbs* only over the two exogenous events and shows the confidence intervals. We observe that the effects of *cmbs* are opposite across the entire distribution of the CIE and reach extreme magnitudes in the upper quantiles for both exogenous events.

C. Quantile regression analysis on top- and bottom capitalized banks

Finally, we analyze the differences in the effects of CMBS on CIE across banks when banks are ranked by the Tier 1 capital relative to bank's total assets. The reasoning behind this analysis is that regulatory capital is a key banking attribute that exerts different effects on bank

risk-taking. Tables VI and VII present the results of the top-capitalized vs. bottom-capitalized banks in our sample.

We observe that both interaction terms of $cmbs$, $d_{2002} * Ln(cmbs_{j,t-1})$ and $d_{2004} * Ln(cmbs_{j,t-1})$, are statistically significant at the 1% significance level along the upper percentiles of the CIE distribution and have the expected signs with respect to the CIE only in the subset of the bottom-capitalized banks. Thus, $cmbs$ drives correlated investment exposure of banks with lower capital.

The quantile regression analysis across the top- and bottom-capitalized banks provides interesting results. Banks with lower capital cannot afford to maintain diverse asset portfolios; Exactly because of this reason, banks with low capital invested in commercial mortgage-backed securities that carried relatively low estimated risks. These securities are a kind of securities that bring some positive expected returns and are assigned with a certain degree of risk, but at the same time, do not affect capital requirements significantly. Hence, banks had strong incentives to increase holdings in such securities on their balance sheets. Our results indicate that these securities generate a different kind of risk that had not been accounted for. We find that $cmbs$ are likely to be responsible for contributing to banks' correlated investment exposure instead of affecting the bank's total risk only.

V. Conclusion

In this paper, we present empirical evidence on how commercial mortgage-backed securities contributed significantly to establishing correlated investment exposure across banks instead of only affecting bank's total risk. The correlated investment exposure represents a bank's systemic risk-taking due to correlated investments.

Since the occurrence of the GFC, systemic risk has become one of the central banking risks in the eyes of the regulatory bodies. A systemic risk is the risk of disruption to financial services caused by parts or the overall financial system and has the potential to have serious setbacks for the real economy. The definition and scope of systemic risk have evolved, and the literature distinguishes between two types of systemic risk. One is the systemic risk that measures the contribution of a bank to the financial distress of the system. Another is the systemic risk-taking that measures the contribution of the system or parts of the financial system to the financial distress of a bank. Correlated investment exposure is a source of systemic risk-taking because it measures the dependency of a bank's performance on a particular market. Particularly, in this paper, the correlated investment exposure measures bank dependency on the CMBS market because of the banks' common exposure to CMBS at the same time. That is, the existence of correlated investment exposure implies that a distress in the CMBS market contributes to the financial distress of a bank.

Furthermore, we show that correlated investment exposure is a systemic risk that is not captured within the traditional total banking risk. For this purpose, we measure it as a ratio of banks' correlations relative to a bank's total risk. Employing two different empirical methodologies, we find that CMBS holdings affect the banks' CIE at the upper percentiles of its distribution only. This finding implies that the presence of CMBS holdings on bank balance sheets significantly increases bank co-movements rather than only affecting banks' total risk. Put differently, CMBS holdings generate co-movements across banks in addition to their traditional total risk, exposing banks to financial distress due to mutual exposure to the same asset class.

Finally, our findings indicate that CMBS have two-sided effects on bank balance sheets. They provide diversification benefits in the process of issuance - a property already acknowledged

in the literature. They also transform highly illiquid loans into highly liquid securities. However, they generate correlated investment exposure when banks hold them as investments. Therefore, for bank management, our findings indicate that the risk attributes of the commercial mortgage-backed securities are different for banks holding these securities than for banks issuing them. In addition, our results suggest that the undercapitalized banks tend to build investment strategies with CMBS, thereby heightening systemic vulnerability within the banking sector.

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Tables

Table I
Risk-Based Capital Requirements for CMBS and Commercial Real Estate Mortgages

The table presents the risk-based capital requirements for CMBS and commercial real estate mortgages held by commercial banks. Panel A reports the risk-based capital requirements for the period 2002 – 2008. Panel B reports the capital requirements for 1997-2001.

Source: Stanton and Wallace (2018)

	Rating	Risk weight	Capital requirement	Risk-Based Capital requirement per \$1 of Book Value
Panel A: 2002 - 2008				
CMBS				
Investment grade	AAA	20%	8%	\$0.016
	AA	20%	8%	\$0.016
	A	50%	8%	\$0.040
	BBB	100%	8%	\$0.080
Noninvestment grade	BB	200%	8%	\$0.16
Commercial real estate mortgages	BBB	100%	8%	\$0.080
Panel B: 1997 - 2001				
CMBS				
Investment grade	AAA	100%	8%	\$0.080
	AA	100%	8%	\$0.080
	A	100%	8%	\$0.080
	BBB	100%	8%	\$0.080
Noninvestment grade	BB	200%	8%	\$0.16
Commercial real estate mortgages	BBB	100%	8%	\$0.080

Table II
Summary Statistics

This table reports summary statistics of the set of variables used in our analyses during the period from January 1, 1999, to September 30, 2008. *Cie* is the bank's correlated investment exposure. *Govsec*, *rmbs*, and *cmbs* measure the total outstanding amount of treasury and agency securities, residential mortgage-backed securities, and commercial mortgage-backed securities relative to total assets, respectively. *Othersec* shows the total outstanding amount of securities other than *govsec*, *rmbs*, and *cmbs* (relative to total assets). *Totalsec* measures total securities and cash holdings on bank balance sheets relative to total assets. We report its summary statistics here for a better overview of the structure of the bank balance sheets in our dataset. However, we do not include this variable in the regression specification to prevent collinearity issues. *Cash* measures the total cash holdings on banks' asset portfolios relative to total assets. *Loans* measures the total outstanding amount of loans relative to total assets. *Assets* shows the total outstanding amount of banks' total assets. *Banksize* represents the total assets of a bank, and we measure it using the transformation with the natural logarithm. However, for a more informative view on the size of the banks in our dataset, we report the total assets of a bank in dollars in this table. *Otherborrowedmoney* shows mostly of any other bank's obligation toward borrowing money that is not reported elsewhere. We measure it using the transformation with the natural logarithm. *Eqmultiplier* is the ratio of the book value of total assets divided by the book value of total equity. *Leverage* is a ratio of total risk-based capital (Tier 1 and Tier 2) divided by average total assets. *Roa* is the return on assets. *Deplevel* is the ratio of a bank's total deposits to the total deposits in the economy in a given quarter. The total outstanding amounts are measured in thousands of dollars. The exact definition of the variables can be found in Table AI in the Appendix. The total number of banks included in this summary statistics is 58.

Variables	Mean	SD	Skew.	Min	P10	P50	P90	Max	N
<i>cie</i>	8.580	20.236	0.513	-74.739	-11.660	5.578	34.396	94.458	1,125
<i>govsec</i>	0.096	0.081	1.569	0.000	0.012	0.081	0.192	0.459	1,125
<i>rmbs</i>	0.051	0.065	1.887	0.000	0.000	0.029	0.142	0.372	1,125
<i>cmbs</i>	0.029	0.062	3.708	0.000	0.000	0.001	0.087	0.462	1,125
<i>othersec</i>	0.114	0.054	1.274	0.021	0.058	0.102	0.186	0.372	1,125
<i>totalsec</i>	0.290	0.135	1.070	0.033	0.142	0.266	0.491	0.814	1,125
<i>cash</i>	0.037	0.024	1.398	0.000	0.013	0.033	0.068	0.168	1,125
<i>loans</i>	0.710	0.135	-1.070	0.186	0.509	0.734	0.858	0.967	1,125
<i>assets</i>	\$2.2 b	\$8.07 b	\$ 5.34b	\$45 m	\$115 m	\$453 m	\$1.8 b	\$62.4 b	1,125
<i>lbanksize</i>	13.100	1.272	1.397	10.714	11.660	13.024	14.408	17.950	1,125
<i>lotherborrowedmoney</i>	10.086	1.926	-1.019	0.000	7.601	10.337	12.086	16.031	912
<i>eqmultiplier</i>	11.129	3.209	0.545	2.989	7.335	10.921	15.176	27.387	1,125
<i>leverage</i>	0.139	0.046	2.626	0.053	0.104	0.124	0.191	0.519	1,125
<i>roa</i>	0.005	0.007	1.002	-0.030	0.000	0.005	0.012	0.064	1,125
<i>deplevel</i>	0.00035	0.00124	5.043	5.76e-06	0.00002	0.00082	0.00028	0.00772	1,125

Table III
Differences in Means Analysis: Top Capitalized Banks and Bottom Capitalized Banks

This table reports the summary statistics of the top capitalized banks and the bottom capitalized banks. We sort out banks in our dataset by the mean value of their Tier 1 Capital / Assets ratio. Then, we construct the top capitalized banks from the 20 banks with the highest mean value for their Tier 1 Capital / Assets ratio and the bottom capitalized banks from the 20 banks with the lowest mean value for their Tier 1 Capital / Assets ratio. We report the standard error and the p-value from the t-test about the differences in the means of these two subsets.

	Top capitalized banks		Bottom capitalized banks		Differences in means	p_value
	mean	N	mean	N		
<i>cie</i>	8.035 (1.072)	334	8.309 (0.983)	447	0.274	0.851
<i>govsec</i>	0.082 (0.004)	334	0.124 (0.005)	447	0.042***	0.000
<i>rmbs</i>	0.042 (0.003)	334	0.069 (0.004)	447	0.027***	0.000
<i>cmbs</i>	0.009 (0.002)	334	0.035 (0.003)	447	0.026***	0.000
<i>othersec</i>	0.105 (0.003)	334	0.118 (0.002)	447	0.014***	0.000
<i>totalsec</i>	0.238 (0.005)	334	0.347 (0.006)	447	0.109***	0.000
<i>cash</i>	0.029 (0.001)	334	0.043 (0.001)	447	0.014***	0.000
<i>loans</i>	0.762 (0.005)	334	0.653 (0.006)	447	-0.109***	0.000
<i>assets</i>	\$443.8 m (23,196)	334	\$ 4,62 b (584 m)	447	\$ 4.2 m***	0.00
<i>lbanksize</i>	12.552 (0.052)	334	13.685 (0.070)	447	1.133***	0.000
<i>lotherborrowedmoney</i>	9.990 (0.081)	285	10.512 (0.120)	330	0.522***	0.000
<i>eqmultiplier</i>	8.220 (0.122)	334	13.460 (0.135)	447	5.240***	0.000
<i>leverage</i>	0.180 (0.003)	334	0.116 (0.001)	447	-0.064***	0.000
<i>roa</i>	0.006	334	0.005	447	-0.001	0.239

	(0.001)		(0.00025)			
<i>deplevel</i>	0.00008	334	0.00074	447	0.001***	0.000
	(0.000)		(0.00009)			

Table IV

Probit Estimation

The table reports estimates of a probit model given in Equation (6) for two different percentiles of the dependent variable CIE. The CIE is a ratio of the bank's comovement coefficient to the bank's individual variance for the corresponding quarter. Columns 1, 2, and 3 estimate the probability that a bank at the 90th, 25th-75th, and 25th percentile of the CMBS' distribution has a CIE value at the 95th percentile of the CIE's distribution. Column 4 estimates the probability that a bank at the 90th percentile of the CMBS' distribution has a CIE value at the 25th percentile of the CIE's distribution. In all four estimations, the first entry for each variable is the coefficient, the second entry (in parentheses) is the robust standard error, and the third entry is the significance of a one unit change in the independent variable (the other characteristics are held fixed at their actual values). The bank-specific controls include government securities, RMBS, bank's size (*log total assets*), other borrowed money, bank's equity multiplier (b.v. total assets over b.v. total equity), bank's leverage ((tier 1 + tier 2)/ average total assets), return on assets (roa), bank's deposit's level, bank's cash holdings (total cash / total assets), bank's loan portfolio (loans/ total assets). All variables are measured in natural logarithms except for the leverage, roa, and the bank's deposit level. The subscript of 1 attached to all explanatory variables denotes that we apply their lag values in the regression estimation. In all estimations, we include bank and quarter fixed effects. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	PCIE $\geq$ 95%			PCIE $\leq$ 25%
	(1) CMBS>90%	(2) 25%<CMBS<75%	(3) CMBS<25%	(4) CMBS>90%
lcmb _{s-1}	15.25*** (4.930)	-0.334*** (0.115)	-0.127 (0.0928)	0.0474 (0.250)
lgovses ₋₁	0.0536 (1.730)	0.384 (0.397)	-0.0872 (0.372)	-0.0462 (0.892)
lrmb _{s-1}	-1.132 (0.927)	0.130 (0.258)	0.171 (0.169)	-0.162 (0.164)
lbanksize ₋₁	-11.16 (10.11)	-2.985 (1.986)	1.182 (0.868)	1.396* (0.830)
lotherborrowedmoney ₋₁	3.035** (1.249)	-0.0669 (0.191)	0.0574 (0.174)	-0.117 (0.283)
leqmultiplier ₋₁	21.30*** (6.647)	3.473 (4.155)	-2.336 (2.309)	0.573 (2.857)
leverage ₋₁	100.2** (47.54)	18.36 (35.16)	-12.38 (15.69)	0.709 (19.32)
roa ₋₁	-480.2** (236.5)	88.09 (88.49)	-45.83 (41.25)	55.32 (108.1)
deplevel ₋₁	10,021** (4,094)	37,008* (20,540)	-3,874 (7,750)	-219.5 (534.6)
lcash ₋₁	-3.106	0.581*	0.160	0.488

	(2.799)	(0.333)	(0.611)	(1.240)
lloans ₋₁	23.82**	5.794	-3.275	-3.426
	(9.349)	(5.674)	(2.390)	(3.823)
Constant	66.50	28.13	-7.673	-24.82*
	(136.0)	(21.24)	(12.45)	(13.09)
Observations	100	118	225	100
No. banks	5	10	14	5
Log-pseudo R^2	-15.378	-32.230	-56.078	-49.322
Bank FE	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES

Table V
Quantile Regression Analysis: Comparison of the Coefficients Across Low, Medium, and High Percentiles

The table reports coefficient estimates from the quantile regression analysis across different percentiles of the CIE distribution. The CIE is a ratio of the bank's comovement coefficient to the bank's individual variance for the corresponding quarter. Government securities, RMBS, and CMBS are measured in natural logarithms and as ratios of their total outstanding amounts as reported on the bank's balance sheet to total assets. The core variable of interest, CMBS, interacts with dummies corresponding to the two exogenous shocks. d_{2002} (d_{2004}) is a dummy variable equal to one for every quarter after and including 2002:Q3 (2004:Q3) and zero otherwise. The dummy variables d_{2002} and d_{2004} measure the impact of CMBS holdings on a bank's CIE after the two unexpected regulatory announcements in late 2002 and 2004, respectively. The bank-specific controls include bank's size (*log total assets*), other borrowed money, bank's equity multiplier (b.v. total assets over b.v. total equity), bank's leverage ((tier 1 + tier 2)/ average total assets), return on assets (roa), bank's deposit's level, bank's cash holdings (total cash / total assets), bank's loan portfolio (loans/ total assets). All variables are measured in natural logarithms except for the leverage, roa, and the bank's deposit level. We allow for the impact of other bank characteristics (cash holdings, loans, equity multiplier, bank size, leverage, ROA) to change upon the regulatory announcements in 2002 and 2004 by interacting all the bank – specific control variables with the dummies d_{2002} and d_{2004} . The subscript of 1 attached to all explanatory variables denotes that we apply their lag values in the regression estimation. We further control for the quarter fixed effects. Robust t-statistics are reported in parentheses. ***, **, and * correspond to below 1%, 5%, and 10% significance of t-statistics, respectively. (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

	(1) P5	(2) P10	(3) P25	(4) P30	(5) P50	(6) P75	(7) P90	(8) P95	(9) P99
lgovsec ₋₁	1.272 (1.667)	0.962 (1.108)	1.465* (0.867)	0.981 (0.870)	0.453 (0.721)	-0.724 (0.929)	0.767 (1.632)	1.136 (5.853)	-2.969 (2.072)
d2002	-70.10 (201.2)	-93.17 (169.9)	-8.954 (69.77)	4.612 (55.72)	71.39 (69.15)	102.4 (117.0)	196.2 (130.6)	167.4 (228.1)	229.7** (110.9)
d2002 x lgovsec ₋₁	-1.667 (10.56)	3.382 (4.656)	3.465 (3.253)	1.638 (3.089)	4.504** (2.151)	3.190 (3.727)	11.94*** (3.805)	9.596 (14.43)	5.183* (3.069)
d2004	-22.22 (197.4)	65.07 (166.4)	-18.92 (73.67)	-38.17 (53.86)	-128.8** (65.59)	-79.58 (116.4)	-195.7* (117.3)	-247.2 (184.0)	-193.6* (100.3)
d2004 x lgovsec ₋₁	-0.842 (10.82)	-5.408 (4.579)	-5.604* (3.169)	-3.716 (3.080)	-5.940** (2.351)	-3.292 (3.684)	-13.06*** (3.747)	-10.49 (13.34)	2.496 (6.429)
lrmb _s ₋₁	0.104 (1.127)	0.136 (0.845)	-0.149 (0.574)	-0.355 (0.645)	-0.712 (0.494)	-1.256 (0.806)	-0.655 (1.170)	-0.487 (3.014)	1.686 (2.062)
d2002 x lrmb _s ₋₁	3.536 (2.999)	1.765 (1.698)	1.945** (0.959)	1.987* (1.064)	1.719 (1.355)	4.981** (2.240)	4.935** (2.039)	4.454 (4.535)	0.522 (2.422)
d2004 x lrmb _s ₋₁	-2.912 (3.168)	-2.721* (1.560)	-1.421 (0.891)	-1.451 (0.951)	-1.473 (1.412)	-4.202* (2.209)	-5.419*** (1.811)	-4.194 (3.746)	-2.297 (2.318)
lcmb _s ₋₁	-0.203 (0.739)	0.145 (0.553)	-0.342 (0.324)	-0.394* (0.231)	-0.482* (0.291)	-0.0131 (0.519)	0.688 (0.620)	0.210 (1.363)	0.613 (1.462)
d2002 x lcmb _s ₋₁	1.167 (6.175)	-1.736 (2.583)	-1.231 (1.205)	-1.520 (1.009)	-3.027*** (1.108)	-4.145** (1.638)	-5.230*** (1.972)	-8.237*** (2.623)	-8.815*** (1.704)
d2004 x lcmb _s ₋₁	-0.533 (6.306)	1.911 (2.590)	1.358 (1.251)	1.555 (1.019)	3.572*** (1.110)	4.400*** (1.646)	4.456** (2.053)	7.594*** (2.495)	10.35*** (1.497)
lcash ₋₁	-2.367 (4.530)	-1.686 (2.518)	1.653 (1.457)	1.343 (1.336)	1.316 (1.216)	3.196* (1.939)	2.479 (2.929)	0.852 (11.02)	9.186* (4.834)
d2002 x lcash ₋₁	-12.43 (8.267)	-5.071 (6.649)	-5.244 (3.209)	-5.042 (3.164)	-2.633 (2.889)	1.393 (6.471)	-5.006 (5.010)	3.202 (15.58)	-13.36** (5.569)
lloans ₋₁	-13.01 (17.17)	-15.35** (6.546)	-12.71** (6.228)	-16.98*** (5.324)	-6.601 (6.942)	3.357 (7.198)	7.546 (8.769)	8.423 (24.15)	18.28 (19.84)

d2002 x lloans ₋₁	26.27 (49.27)	78.99 (51.60)	28.55 (17.54)	24.73 (15.50)	12.95 (15.62)	16.40 (25.94)	38.26 (29.61)	32.08 (55.72)	-3.349 (27.52)
d2004 x lcash ₋₁	19.39** (8.299)	7.443 (6.469)	4.360 (3.260)	5.741* (3.281)	2.977 (3.157)	-5.395 (6.411)	3.016 (4.527)	-3.434 (11.46)	0.563 (6.349)
d2004 x lloans ₋₁	-13.90 (48.41)	-85.90* (51.63)	-33.10* (18.78)	-19.79 (16.33)	-6.206 (16.62)	-26.72 (27.24)	-43.88 (31.80)	-39.56 (52.78)	1.250 (27.29)
leqmultiplier ₋₁	-25.65* (13.70)	-24.79*** (8.479)	-19.96*** (5.932)	-22.17*** (7.017)	-15.22* (9.148)	-4.334 (8.711)	0.0984 (10.62)	-5.556 (28.74)	-8.940 (20.79)
d2002 x leqmultiplier ₋₁	25.48 (46.98)	39.88 (55.46)	16.61 (19.89)	14.50 (12.59)	4.009 (17.27)	12.54 (21.25)	-4.115 (32.74)	-11.28 (48.83)	-14.20 (24.50)
lbanksiz ₋₁	-1.744 (3.429)	-1.941 (2.755)	-1.934* (1.127)	-1.197 (0.994)	0.539 (1.262)	3.262 (2.131)	4.334 (3.579)	-0.222 (7.286)	6.210 (5.056)
d2002 x lbanksiz ₋₁	-1.845 (9.055)	-2.065 (6.579)	-1.857 (2.353)	-2.567 (2.409)	-6.005** (2.555)	-10.50 (6.728)	-10.38** (5.257)	-7.076 (11.41)	-16.51*** (6.010)
leverage ₋₁	-97.26 (147.8)	-90.51 (90.95)	-94.45* (50.37)	-92.33* (53.62)	-48.45 (72.13)	89.58 (87.64)	87.58 (127.4)	54.39 (269.3)	172.7 (202.3)
d2002 x leverage ₋₁	13.53 (378.9)	284.4 (387.5)	13.37 (147.6)	-30.15 (106.3)	-30.64 (135.0)	63.14 (235.0)	53.33 (297.2)	56.12 (511.2)	-53.98 (242.0)
roa ₋₁	-973.0 (933.1)	-455.1 (579.1)	-547.5* (297.0)	-427.6 (298.0)	-513.2** (210.8)	-1,206*** (332.6)	-574.8 (764.6)	-744.0 (1,274)	-2,486*** (635.0)
d2002 x roa ₋₁	1,353 (1,046)	905.2 (826.7)	1,220*** (390.3)	906.3* (477.8)	409.9 (431.8)	1,484* (869.3)	-535.1 (855.3)	-464.9 (1,736)	-10.53 (630.7)
lotherborrowedmoney ₋₁	-0.455 (0.671)	-0.0729 (0.657)	0.967** (0.414)	0.616 (0.381)	0.795*** (0.296)	0.590 (0.522)	0.722 (0.967)	0.515 (1.525)	1.581 (1.469)
d2002 x lotherborrowedmoney ₋₁	-2.352 (4.172)	-0.942 (2.710)	-1.401* (0.818)	-1.158 (0.784)	0.938 (0.868)	3.199** (1.318)	0.801 (2.557)	2.450 (3.022)	0.248 (1.871)
deplevel ₋₁	-2,635 (5,199)	1,989 (7,357)	703.8 (948.8)	175.2 (895.1)	81.67 (1,092)	-1,114 (1,649)	-2,245 (2,184)	796.8 (5,299)	-4,480 (3,343)
d2002 x deplevel ₋₁	1,732 (8,538)	-3,873 (9,955)	-4,081 (4,516)	-405.2 (3,883)	632.2 (3,774)	404.7 (10,321)	10,498* (5,404)	5,379 (12,360)	13,503*** (4,106)
d2004 x leqmultiplier ₋₁	4.957 (48.31)	-31.24 (55.41)	-10.11 (21.55)	-2.837 (12.77)	13.79 (17.20)	-31.59 (23.02)	-16.94 (33.18)	-8.352 (42.64)	-23.26 (37.29)
d2004 x lbanksiz ₋₁	3.751	1.825	2.298	2.768	7.392***	13.46**	15.83***	17.97*	20.95***

d2004 x leverage ₋₁	(9.249) 146.4 (369.8)	(6.254) -293.5 (380.4)	(2.521) -30.15 (152.7)	(2.551) 33.00 (103.8)	(2.775) 60.87 (128.2)	(6.685) -274.3 (234.5)	(4.413) -246.5 (279.3)	(9.318) -225.6 (464.0)	(4.434) -391.6 (254.7)
d2004 x roa ₋₁	-79.24 (704.9)	5.103 (559.8)	-408.1 (354.2)	-313.4 (451.6)	63.57 (418.7)	-440.7 (861.4)	933.7* (525.1)	711.8 (1,521)	1,970*** (486.0)
d2004 x lotherborrowedmoney ₋₁	0.768 (4.512)	0.976 (2.824)	0.794 (1.150)	1.022 (1.066)	-1.601 (1.257)	-3.567** (1.419)	-0.964 (2.629)	-1.016 (3.405)	2.897 (2.978)
d2004 x deplevel ₋₁	2,196 (7,138)	3,101 (6,802)	3,091 (4,512)	-50.71 (3,880)	-2,764 (3,787)	-4,138 (10,343)	- (5,125) 15,491***	-15,941 (11,472)	-21,197*** (2,914)
Constant	82.50 (64.18)	80.58* (42.50)	84.60*** (22.43)	80.77*** (26.33)	42.21 (37.38)	-12.34 (40.95)	-25.30 (68.00)	59.38 (150.4)	18.55 (99.66)
Observations	833	833	833	833	833	833	833	833	833
No. banks	52	52	52	52	52	52	52	52	52
Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table VI

Quantile Regression Analysis: Top Capitalized Banks Ranked by Tier 1 Capital / Total Assets

The table reports coefficient estimates from the quantile regression analysis across different percentiles of the CIE distribution for the subset of the top 20 capitalized banks when we rank banks in our dataset by the average value of the ratio of Tier 1 capital to the total bank's assets. The CIE is a ratio of the bank's comovement coefficient to the bank's individual variance for the corresponding quarter. Government securities, RMBS, and CMBS are measured in natural logarithms and as ratios of their total outstanding amounts as reported on the bank's balance sheet to total assets. The core variable of interest, CMBS, interacts with dummies corresponding to the two exogenous shocks. $d_{2002}(d_{2004})$ is a dummy variable equal to one for every quarter after and including 2002:Q3 (2004:Q3) and zero otherwise. The dummy variables d_{2002} and d_{2004} measure the impact of CMBS holdings on a bank's CIE after the two unexpected regulatory announcements in late 2002 and 2004, respectively. The bank-specific controls include bank's size (*log total assets*), other borrowed money, bank's equity multiplier (b.v. total assets over b.v. total equity), bank's leverage ((tier 1 + tier 2)/ average total assets), return on assets (roa), bank's deposit's level, bank's cash holdings (total cash / total assets), bank's loan portfolio (loans/ total assets). All variables are measured in natural logarithms except for the leverage, roa, and the bank's deposit level. We allow for the impact of other bank characteristics (cash holdings, loans, equity multiplier, bank size, leverage, ROA) to change upon the regulatory announcements in 2002 and 2004 by interacting all the bank – specific control variables with the dummies d_{2002} and d_{2004} . The subscript of 1 attached to all explanatory variables denotes that we apply their lag values in the regression estimation. We further control for the quarter fixed effects. Robust t-statistics are reported in parentheses. ***, **, and * correspond to below 1%, 5%, and 10% significance of t-statistics, respectively. (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

	(1) P5	(2) P10	(3) P25	(4) P30	(5) P50	(6) P75	(7) P90	(8) P95
lgovsec ₋₁	4.493 (10.49)	4.499 (8.853)	3.801 (14.74)	1.344 (18.03)	-0.220 (8.719)	-0.453 (13.93)	0.893 (9.894)	2.768 (124.2)
d2002	126.5 (3,358)	128.3 (3,226)	139.5 (5,248)	115.9 (8,028)	-938.8 (1,648)	1,162 (7,809)	-731.3 (3,183)	-873.4 (6,562)
d2002 x lgovsec ₋₁	21.32 (81.36)	20.08 (48.95)	9.564 (142.3)	9.735 (82.21)	38.58 (141.2)	35.46 (128.9)	51.28 (50.23)	50.27 (139.4)
d2004	-62.07 (3,376)	32.30 (3,225)	8.208 (5,196)	79.88 (7,999)	1,053 (1,625)	-874.6 (7,813)	1,082 (3,166)	1,301 (6,563)
d2004 x lgovsec ₋₁	-22.61 (80.71)	-26.00 (47.84)	-14.72 (141.5)	-12.19 (80.23)	-39.21 (141.0)	-34.73 (128.2)	-49.58 (48.61)	-51.08 (82.70)
lrmb _{s-1}	-1.384 (1.260)	-1.423 (1.069)	-0.284 (9.550)	-1.149 (1.483)	-2.118 (1.770)	-2.007 (4.190)	-0.965 (2.565)	0.0421 (6.968)
d2002 x lrmb _{s-1}	17.79* (10.69)	17.53 (31.90)	12.23 (25.93)	12.75 (33.87)	30.04 (22.43)	5.001 (164.1)	35.34* (18.22)	34.01 (44.66)
d2004 x lrmb _{s-1}	-13.24 (10.77)	-16.24 (31.87)	-12.89 (24.27)	-12.22 (33.77)	-28.27 (22.37)	-2.651 (164.0)	-33.96* (17.79)	-33.44 (44.24)
lcmb _{s-1}	1.830 (2.138)	1.999 (1.451)	-0.835 (6.734)	-1.480 (1.955)	-0.873 (1.166)	-1.821 (1.461)	-2.286 (2.192)	-2.732 (20.65)
d2002 x lcmb _{s-1}	-8.317 (15.14)	-8.970 (29.35)	-9.105 (13.58)	-6.621 (15.43)	-12.10 (13.08)	-10.19 (32.77)	-10.25 (10.23)	-9.624 (21.10)
d2004 x lcmb _{s-1}	6.623 (15.17)	5.820 (29.29)	9.056 (11.81)	7.263 (15.30)	12.62 (13.05)	12.03 (32.74)	11.29 (10.06)	10.59 (6.968)
lcash ₋₁	7.277 (8.390)	6.991 (5.986)	1.303 (13.87)	2.004 (15.46)	-4.227 (6.313)	-4.886 (8.990)	-9.978 (9.477)	-12.45 (42.21)
d2002 x lcash ₋₁	-16.98 (51.31)	-16.51 (136.3)	-13.87 (128.9)	-18.86 (68.07)	9.242 (37.96)	15.28 (124.6)	-16.75 (64.01)	-13.77 (105.0)
lloans ₋₁	28.88 (74.74)	24.67 (60.39)	44.98 (141.6)	2.905 (160.9)	8.468 (57.45)	-30.18 (122.5)	16.26 (76.42)	-8.415 (842.5)
d2002 x lloans ₋₁	-139.1	-158.0	-279.7	-317.7	212.6	80.72	234.2	299.6

	(480.0)	(342.8)	(561.1)	(857.9)	(501.7)	(1,402)	(407.0)	(1,223)
d2004 x lcash ₋₁	3.314	10.83	15.58	19.18	-2.815	-12.33	23.41	25.35
	(51.60)	(135.9)	(128.4)	(66.27)	(37.18)	(125.4)	(63.53)	(101.4)
d2004 x lloans ₋₁	140.0	120.5	247.8	324.7	-220.7	-52.99	-237.6	-283.2
	(474.0)	(341.3)	(544.4)	(841.7)	(499.5)	(1,394)	(397.1)	(902.1)
leqmultiplier ₋₁	34.86	35.87	12.28	-8.804	-7.979	-27.11	-2.791	-8.285
	(34.77)	(29.11)	(51.58)	(51.11)	(28.74)	(36.74)	(30.20)	(326.2)
d2002 x leqmultiplier ₋₁	-93.38	-102.6	-117.2	-115.9	167.5	-246.5	138.3	171.2
	(687.0)	(845.0)	(953.6)	(2,006)	(328.4)	(1,488)	(561.5)	(1,291)
lbanksiz ₋₁	-3.294	-5.538	2.068	11.68	15.60	27.54	34.07**	33.00
	(25.24)	(11.58)	(39.98)	(37.93)	(17.24)	(21.95)	(16.66)	(143.2)
d2002 x lbanksiz ₋₁	20.37	22.02	19.88	20.48	83.72	-11.46	79.39	86.83
	(62.94)	(126.9)	(288.0)	(124.9)	(91.14)	(307.0)	(122.8)	(270.7)
leverage ₋₁	165.3	158.0	101.3	-5.201	0.790	-56.84	90.20	108.2
	(350.9)	(202.5)	(371.2)	(493.7)	(192.7)	(271.3)	(181.1)	(2,143)
d2002 x leverage ₋₁	-715.3	-765.1	-941.6	-1,064	645.8	-1,692	75.44	201.9
	(6,036)	(11,086)	(7,661)	(15,563)	(3,230)	(11,621)	(4,253)	(8,919)
roa ₋₁	343.0	548.4*	-247.0	-630.9	-737.4	-1,391**	-455.1	-553.9
	(713.7)	(299.3)	(608.8)	(659.8)	(484.7)	(617.1)	(456.1)	(3,321)
d2002 x roa ₋₁	-1,095	-1,211	-609.8	-279.0	-704.5	-2,844	-2,380**	-2,163
	(1,359)	(4,526)	(1,845)	(1,832)	(2,867)	(3,540)	(968.8)	(4,554)
lotherborrowedmoney ₋₁	1.553***	1.471**	-0.135	-0.361	-0.173	-0.271	-0.992	-0.370
	(0.573)	(0.603)	(2.942)	(1.498)	(0.518)	(1.020)	(1.063)	(1.746)
d2002 x lotherborrowedmoney ₋₁	0.871	0.757	-0.526	-0.584	-19.62	2.216	-12.99	-14.38
	(20.48)	(52.91)	(17.67)	(22.27)	(72.45)	(55.17)	(13.78)	(20.84)
deplevel ₋₁	79,745	97,996	5,362	-67,467	-153,081	-237,503	-331,514	-319,212
	(223,264)	(92,862)	(431,691)	(374,976)	(179,036)	(207,541)	(218,171)	(839,058)
d2002 x deplevel ₋₁	-615,111	-617,129	-474,395	-416,920	-1.119e+06	15,731	-1.659e+06	-1.735e+06
	(1.375e+06)	(1.803e+06)	(3.823e+06)	(3.067e+06)	(1.191e+06)	(5.730e+06)	(1.743e+06)	(3.834e+06)
d2004 x leqmultiplier ₋₁	35.49	36.84	92.28	111.3	-152.6	256.9	-156.0	-186.8
	(691.4)	(845.7)	(948.3)	(2,005)	(327.6)	(1,487)	(559.7)	(1,213)
d2004 x lbanksiz ₋₁	-14.60	-22.00	-27.51	-35.79	-94.18	-11.74	-100.8	-113.2

	(60.69)	(126.8)	(285.4)	(118.7)	(89.37)	(307.1)	(120.8)	(257.7)
d2004 x leverage ₋₁	477.2	437.0	775.2	994.3	-664.1	1,633	-255.3	-403.1
	(6,042)	(11,091)	(7,637)	(15,552)	(3,224)	(11,618)	(4,243)	(8,724)
d2004 x roa ₋₁	861.1	869.0	824.5	920.5	1,477	4,227	2,636***	2,389
	(1,137)	(4,445)	(1,781)	(1,754)	(2,856)	(3,459)	(909.2)	(3,710)
d2004 x lotherborrowedmoney ₋₁	-3.018	-1.734	0.995	0.658	19.24	-2.688	13.30	14.86
	(20.33)	(52.95)	(17.50)	(22.28)	(72.43)	(55.17)	(13.74)	(20.97)
d2004 x deplevel ₋₁	479,413	568,235	525,759	521,165	1.227e+06	215,277	1.954e+06	2.059e+06
	(1.386e+06)	(1.802e+06)	(3.798e+06)	(3.038e+06)	(1.177e+06)	(5.740e+06)	(1.722e+06)	(3.856e+06)
Constant	-50.00	-28.82	-44.46	-104.9	-165.2	-251.6	-396.5*	-387.2
	(370.2)	(187.4)	(595.0)	(578.2)	(257.9)	(305.9)	(225.6)	(1,474)
Observations	295	295	295	295	295	295	295	295
Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES

Table VII

Quantile Regression Analysis: Bottom Capitalized Banks Ranked by Tier 1 Capital / Total Assets

The table reports coefficient estimates from the quantile regression analysis across different percentiles of the CIE distribution for the subset of the bottom 20 capitalized banks when we rank banks in our dataset by the average value of the ratio of Tier 1 capital to total bank's assets. The CIE is a ratio of the bank's comovement coefficient to the bank's individual variance for the corresponding quarter. Government securities, RMBS, and CMBS are measured in natural logarithms and as ratios of their total outstanding amounts as reported on the bank's balance sheet to total assets. The core variable of interest, CMBS, interacts with dummies corresponding to the two exogenous shocks. $d_{2002}(d_{2004})$ is a dummy variable equal to one for every quarter after and including 2002:Q3 (2004:Q3) and zero otherwise. The dummy variables d_{2002} and d_{2004} measure the impact of CMBS holdings on a bank's CIE after the two unexpected regulatory announcements in late 2002 and 2004, respectively. The bank-specific controls include bank's size (*log total assets*), other borrowed money, bank's equity multiplier (b.v. total assets over b.v. total equity), bank's leverage ((tier 1 + tier 2)/ average total assets), return on assets (roa), bank's deposit's level, bank's cash holdings (total cash / total assets), bank's loan portfolio (loans/ total assets). All variables are measured in natural logarithms except for the leverage, roa, and the bank's deposit level. We allow for the impact of other bank characteristics (cash holdings, loans, equity multiplier, bank size, leverage, ROA) to change upon the regulatory announcements in 2002 and 2004 by interacting all the bank – specific control variables with the dummies d_{2002} and d_{2004} . The subscript of 1 attached to all explanatory variables denotes that we apply their lag values in the regression estimation. We further control for the quarter fixed effects. Robust t-statistics are reported in parentheses. ***, **, and * correspond to below 1%, 5%, and 10% significance of t-statistics, respectively. (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

	(1) P5	(2) P10	(3) P25	(4) P30	(5) P50	(6) P75	(7) P90	(8) P95
lgovsec ₋₁	1.015 (11.77)	0.889 (2.465)	-1.019 (2.365)	-1.042 (1.904)	-2.283 (2.053)	-3.633 (2.606)	5.594 (4.716)	4.605*** (1.553)
d2002	-344.5 (28,456)	-139.0 (216.9)	-243.6* (125.6)	-177.4 (165.9)	-136.8 (108.7)	-158.7 (173.4)	-209.2 (129.1)	-131.1** (64.93)
d2002 x lgovsec ₋₁	19.63 (71.89)	13.67 (12.39)	5.270 (8.728)	3.268 (7.047)	5.262 (3.764)	6.185 (12.65)	-4.570 (6.153)	-4.656 (3.384)
d2004	264.8 (28,172)	32.59 (227.7)	138.5 (127.9)	96.00 (166.8)	3.445 (112.0)	-23.04 (191.8)	-36.76 (156.6)	-147.2 (168.1)
d2004 x lgovsec ₋₁	7.226 (77.95)	-4.463 (16.36)	8.565 (9.846)	9.237 (8.482)	-3.521 (6.351)	-2.872 (14.60)	-6.499 (7.563)	-6.122 (22.55)
lrmb _{s-1}	2.353 (4.935)	2.557** (1.168)	1.964** (0.939)	1.353 (0.826)	-0.508 (0.609)	-1.590* (0.842)	-0.305 (1.305)	-0.234 (0.896)
d2002 x lrmb _{s-1}	5.804 (22.01)	6.765 (11.57)	2.092 (3.302)	1.299 (5.332)	-0.353 (2.524)	1.395 (9.247)	-6.596** (3.274)	-8.424** (3.455)
d2004 x lrmb _{s-1}	-10.45 (24.76)	-11.14 (11.78)	-3.579 (3.771)	-2.474 (5.589)	-0.338 (3.255)	-0.605 (9.613)	10.73** (4.796)	14.55** (5.804)
lcmb _{s-1}	-0.172 (0.792)	-0.308 (0.538)	-0.673 (0.457)	-0.549 (0.358)	-0.248 (0.299)	0.259 (0.501)	-0.375 (0.499)	0.434 (0.339)
d2002 x lcmb _{s-1}	5.930 (46.11)	3.394 (3.293)	3.918*** (1.452)	3.964** (1.721)	0.557 (1.470)	-1.960 (1.684)	-1.983* (1.180)	-3.171*** (1.127)
d2004 x lcmb _{s-1}	-5.191 (42.70)	-2.226 (3.367)	-1.798 (1.461)	-1.648 (1.943)	1.603 (1.624)	4.283** (1.945)	4.459*** (1.614)	5.714** (2.850)
lcash ₋₁	2.078 (14.16)	-1.096 (4.109)	0.123 (2.514)	-0.342 (1.952)	-1.952 (1.664)	1.975 (3.040)	-6.043 (5.084)	-0.207 (1.607)
d2002 x lcash ₋₁	-12.87 (583.0)	10.06 (29.53)	6.721 (8.178)	-0.628 (10.83)	-6.379 (4.862)	-31.04** (15.59)	-33.27*** (7.306)	-41.69*** (4.446)
lloans ₋₁	-21.45 (87.03)	-16.11 (11.55)	-25.90** (11.43)	-16.90** (7.204)	-8.768 (7.704)	-14.77 (9.581)	18.23* (10.71)	7.816 (5.818)
d2002 x lloans ₋₁	102.4	64.90	64.12**	51.06	28.03	28.43	-19.37	-38.52***

	(366.0)	(74.71)	(30.89)	(33.08)	(19.89)	(61.64)	(22.57)	(12.97)
d2004 x lcash ₋₁	10.08	-4.716	-10.86	-2.613	9.706	34.07**	41.25***	36.78**
	(574.8)	(29.96)	(9.059)	(11.72)	(7.184)	(17.29)	(9.832)	(15.78)
d2004 x lloans ₋₁	-48.51	-44.66	-21.45	-25.17	-19.45	12.10	7.014	43.34
	(323.5)	(81.51)	(33.93)	(36.27)	(27.93)	(65.22)	(35.82)	(48.94)
leqmultiplier ₋₁	-35.66*	-31.07***	-11.67	-5.705	-9.422	-13.70	-9.126	-11.05
	(19.28)	(10.98)	(10.37)	(11.57)	(8.090)	(11.14)	(11.63)	(6.860)
d2002 x leqmultiplier ₋₁	140.4	112.1*	79.49***	62.57	35.16	39.95	25.42	-24.76*
	(612.7)	(63.11)	(24.87)	(43.91)	(25.88)	(44.89)	(41.88)	(14.11)
lbanksiz ₋₁	-2.245	-2.516	-4.561	-3.910**	-1.407	0.300	-0.593	0.794
	(12.86)	(2.249)	(2.788)	(1.597)	(2.000)	(2.692)	(3.325)	(1.689)
d2002 x lbanksiz ₋₁	-1.824	-3.557	4.646	1.604	-0.649	-8.028	-7.233	-4.998
	(2,799)	(4.344)	(6.584)	(7.799)	(4.367)	(9.055)	(9.078)	(5.322)
leverage ₋₁	-300.3	-128.9	-221.4*	-125.7	-14.54	-89.90	-74.27	-31.53
	(666.7)	(192.5)	(118.2)	(115.8)	(86.80)	(113.8)	(154.1)	(82.34)
d2002 x leverage ₋₁	628.0	27.10	546.1*	374.6	514.1**	741.8*	752.4***	615.9***
	(6,031)	(776.6)	(308.4)	(463.6)	(259.8)	(426.9)	(264.6)	(106.5)
roa ₋₁	-341.8	-94.85	361.9**	367.7	-25.62	-615.5	-180.8	-191.0
	(14,359)	(1,309)	(178.9)	(239.8)	(626.3)	(554.4)	(1,068)	(544.2)
d2002 x roa ₋₁	1,519	1,122	60.20	344.0	620.1	2,436*	1,356	2,161***
	(75,191)	(1,528)	(670.6)	(1,015)	(795.7)	(1,317)	(1,065)	(404.8)
lotherborrowedmoney ₋₁	0.0914	-0.0894	0.341	0.367	-0.0627	0.0142	-0.843**	-0.790***
	(0.714)	(0.258)	(0.289)	(0.226)	(0.205)	(0.289)	(0.406)	(0.135)
d2002 x lotherborrowedmoney ₋₁	-1.638	-0.917	-1.520	-1.470	0.0931	0.273	2.227**	1.691***
	(42.92)	(1.324)	(1.032)	(0.936)	(0.357)	(1.071)	(0.923)	(0.431)
deplevel ₋₁	-3,683	2,559	3,361*	2,599	1,583	214.7	2,056	2,599
	(8,015)	(6,392)	(1,982)	(1,644)	(1,831)	(2,006)	(2,820)	(1,743)
d2002 x deplevel ₋₁	4,815	-2,435	-5,923	-638.5	-926.9	11,129	9,358	4,280
	(2.881e+07)	(8,963)	(5,874)	(8,296)	(4,039)	(10,203)	(7,726)	(3,382)
d2004 x leqmultiplier ₋₁	-128.0	-89.10	-80.57***	-78.49*	-22.02	-25.22	-9.265	45.00
	(682.6)	(68.37)	(26.58)	(45.03)	(28.83)	(51.56)	(48.06)	(66.93)
d2004 x lbanksiz ₋₁	8.785	9.603*	3.834	8.523	9.239*	18.77*	19.01**	15.29
	(2,792)	(5.614)	(6.862)	(7.902)	(4.881)	(9.640)	(9.079)	(13.47)

d2004 x leverage ₋₁	-641.1 (5,969)	-8.478 (841.8)	-301.5 (334.0)	-208.6 (478.7)	-452.9 (282.2)	-410.8 (515.4)	-337.4 (447.8)	-110.7 (550.0)
d2004 x roa ₋₁	515.3 (81,131)	121.5 (1,199)	484.1 (712.3)	-32.64 (1,008)	-536.0 (773.1)	-1,599 (1,568)	-302.6 (943.7)	-545.9 (955.0)
d2004 x lotherborrowedmoney ₋₁	2.282 (45.55)	0.685 (1.458)	1.786* (1.053)	1.328 (0.968)	0.0201 (0.481)	0.375 (1.134)	0.0975 (1.016)	0.372 (1.106)
d2004 x deplevel ₋₁	-4,386 (2.881e+07)	-2,753 (6,981)	-561.5 (5,961)	-6,451 (8,235)	-5,651 (4,038)	-18,210* (10,494)	-19,952*** (7,522)	-14,843 (9,065)
Constant	145.2** (63.86)	114.0* (67.09)	95.50* (51.65)	64.24 (48.13)	37.07 (37.12)	54.28 (60.14)	74.67 (71.65)	70.93** (30.34)
Observations	427	427	427	427	427	427	427	427
Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES
Robust SE	YES	YES	YES	YES	YES	YES	YES	YES

Figures

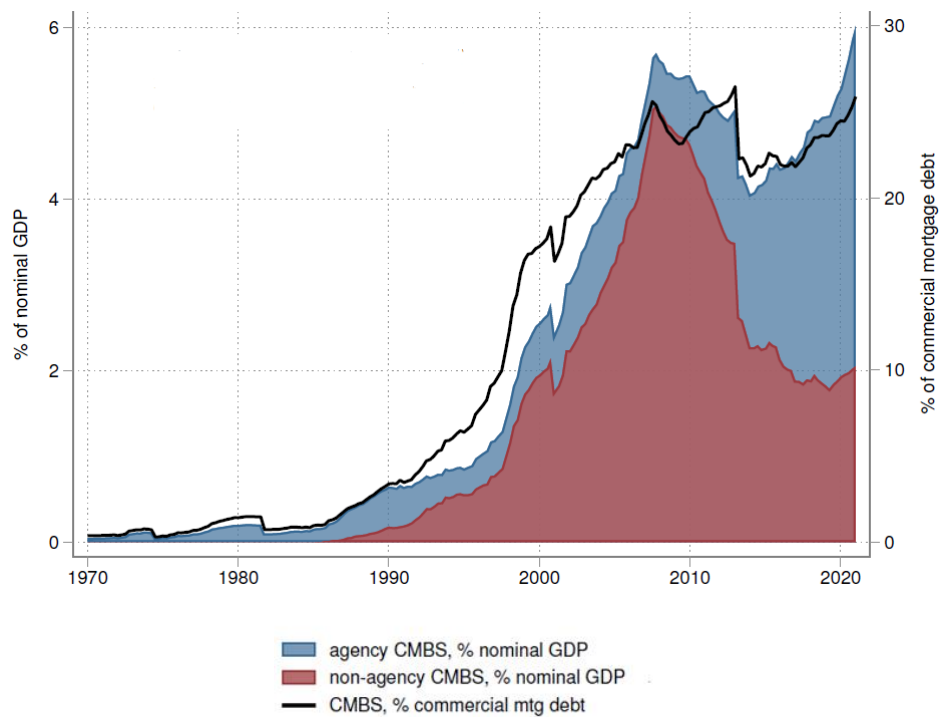
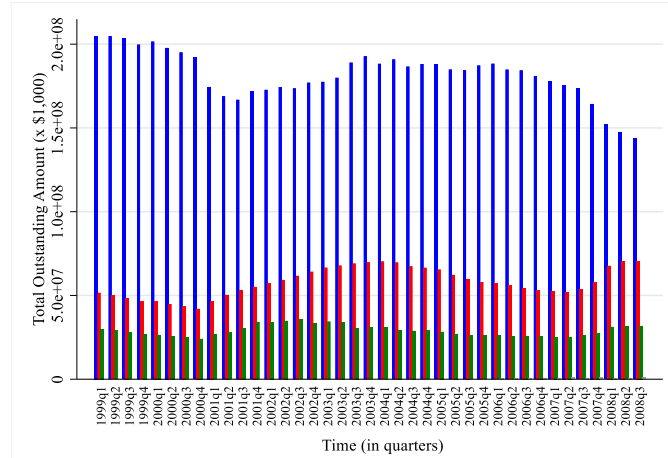
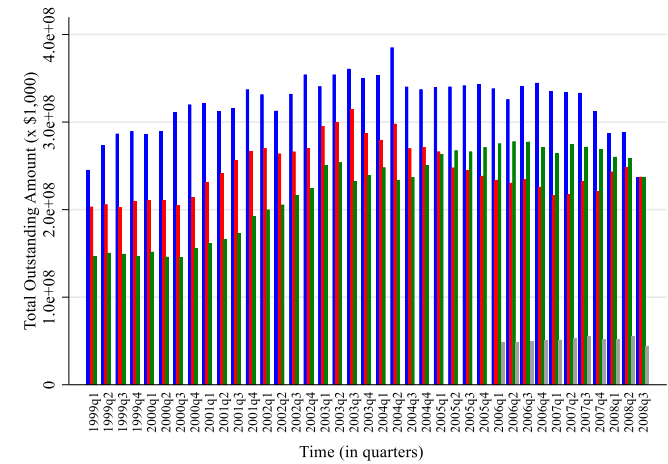


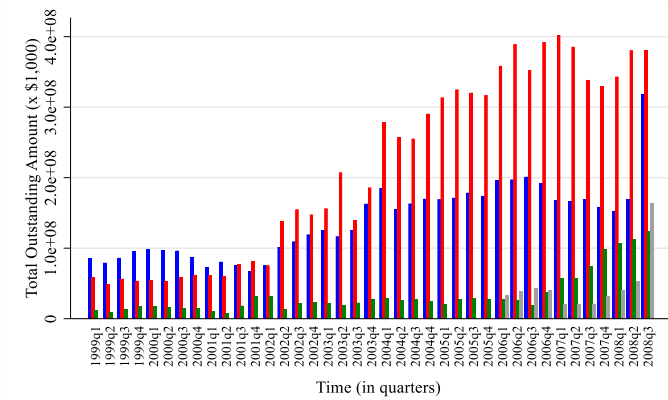
Figure 1. Commercial mortgage-backed securities, 1970 – 2020. This figure plots the evolution of the CMBS total issuance in the U.S. from 1970 to 2020. Shaded areas represent the stock of agency and nonagency CMBS as a percent of nominal GDP. The solid black line plots total CMBS scaled by the relevant stock of commercial mortgage debt. Source: Staff reports No. 1001 February 2022, FRB of New York



Panel A: Small Banks



Panel B: Midsize Banks



Panel C: Large Banks



Figure 2. Bank security holdings. This figure shows the composition of security holdings on bank balance sheets across quarters for the period 1999 – 2008. The securities included are government securities (Govsec), residential mortgage-back securities (RMBS), commercial mortgage-back securities (CMBS) and asset-back securities (ABS). They are all measured as of their total outstanding amounts on bank balance sheets and showed in 1,000 on the Y-axis. Panel A shows the composition of security holdings for the subset of small commercial banks. This subset contains all commercial banks with total assets less than \$ 1 billion. The subset includes 10,936 banks with such characteristics during this period. Panel B shows the composition of security holdings for the subset of midsize banks. Midsize banks are banks that have total assets more than \$ 1 billion and less than \$ 250 million. The midsize banks' subset includes 1,171 banks with such characteristics during this period. Panel C shows the composition of security holdings for large banks. Large banks are banks that have total assets more than \$ 250 billion. The large banks' subset includes 66 banks with such characteristics during this period.

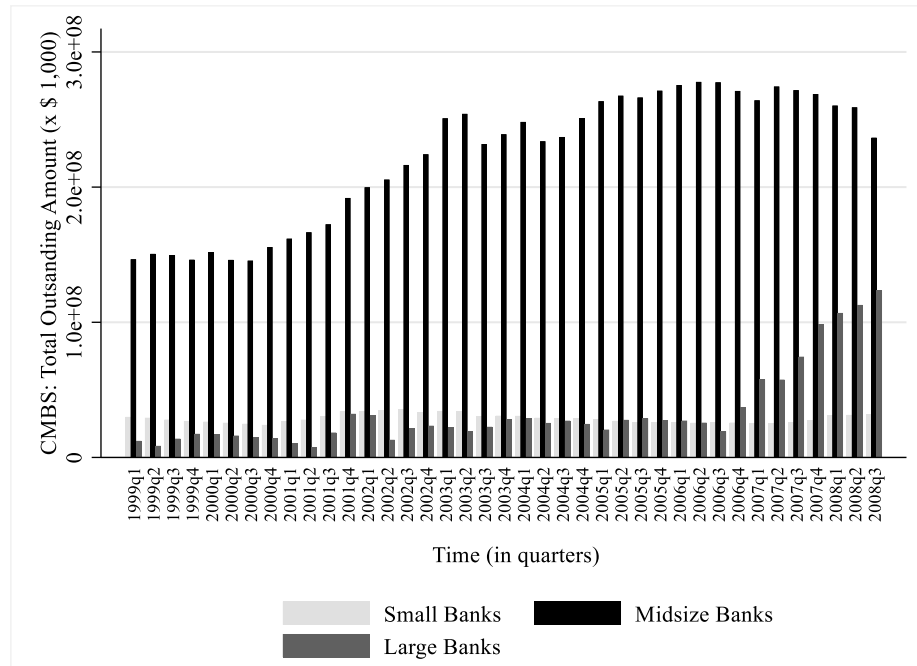


Figure 3. CMBS holdings across the three bank subsets. This figure compares the total outstanding amounts of CMBS on bank balance sheets across the three subsets of banks: small, midsize, and large banks in each quarter during the period 1999 – 2008.

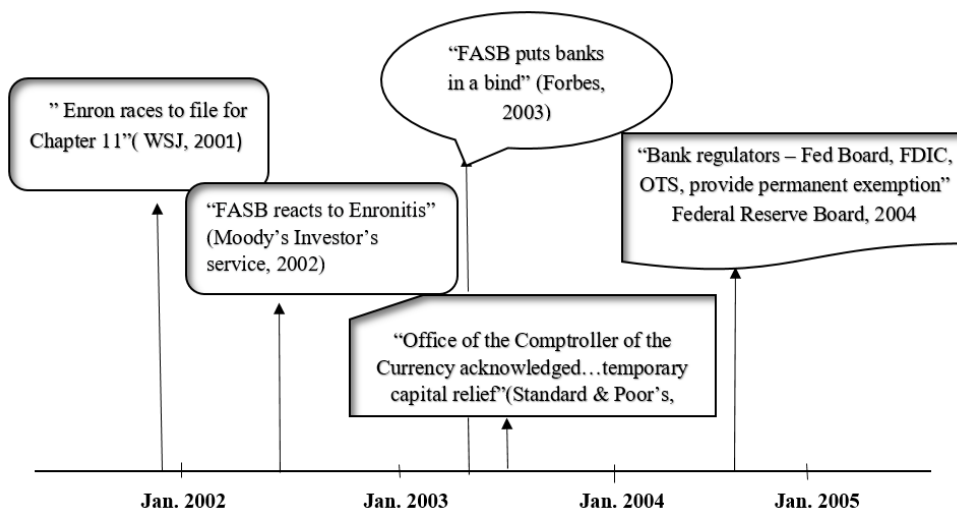
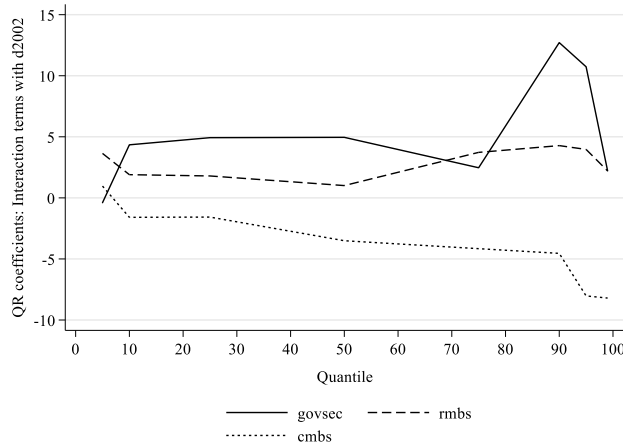
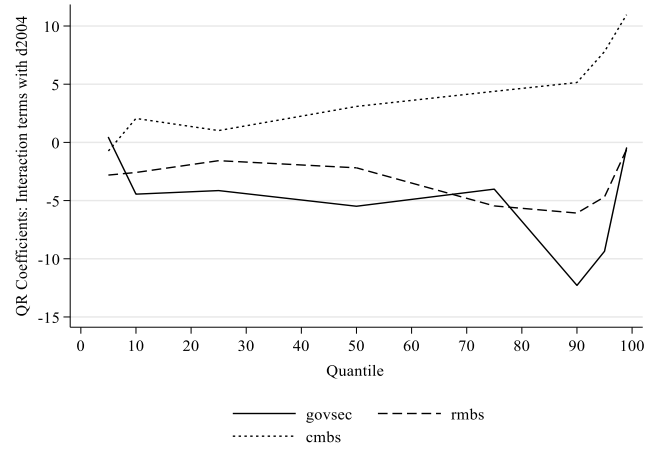


Figure 4. The timeline of the public information and regulatory announcements on the capital required for CMBS and similar securitized products on bank balance sheets. This figure shows the timeline of public information, regulatory announcements, and decisions on regulatory capital for CMBS and other securitized products between early 2002 and late 2004.

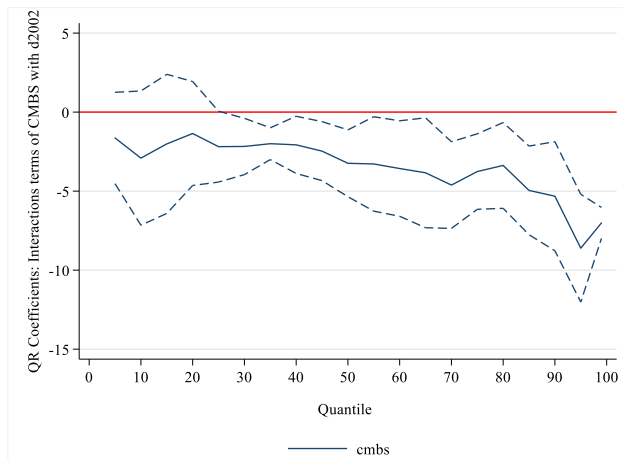


Panel A

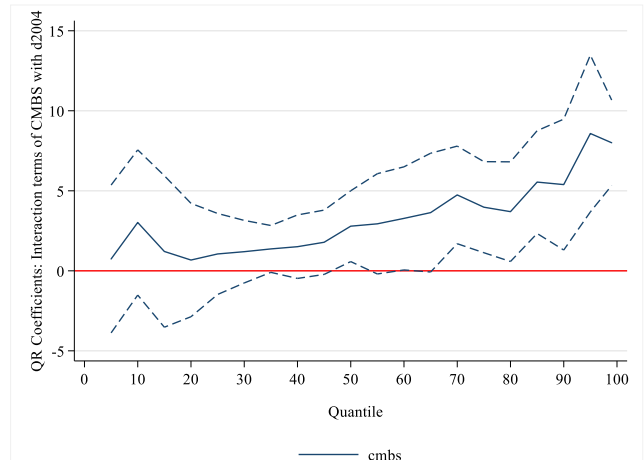


Panel B

Figure 5. Estimated coefficients of the quantile regression for the three securities: government securities, RMBS, and CMBS. Panel A shows the estimated coefficients of the quantile regression across the different percentiles following the regulatory announcement in 2002. Panel B shows the estimated coefficients of the quantile regression across the different percentiles following the regulatory announcement in 2004.



Panel A



Panel B

Figure 6. Estimated coefficients of the quantile regression for CMBS. Panel A shows estimated coefficients of CMBS across different percentiles of the CIE distribution following the 2002. Panel B shows estimated coefficients of CMBS across different percentiles of the CIE distribution following the regulatory announcement in 2004. The dotted lines mark the 95% confidence intervals.

Appendix

Table AI
Variables summary and definitions

Variable	Description	Definition
Dependent variable		
<i>cie</i>	Correlated Investment Exposure	Eq. (3)
Variable of interest		
<i>cmbs</i>	Commercial mortgage-backed securities	$\text{Ln} [(\text{securitiesothermbs_less_3y} + \text{securitiesothermbs_over_3y}) / \text{Total assets}]$
Control variables		
<i>govsec</i>	Treasury and agencies' securities	$\text{Ln} [(\text{securitiestreasury_less_3m} + \text{securitiestreasury_3m_1y} + \text{securitiestreasury_1y_3y} + \text{securitiestreasury_3y_5y} + \text{securitiestreasury_5y_15y} + \text{securitiestreasury_over_15y}) / \text{Total assets}]$
<i>rmbs</i>	Residential mortgage-backed securities	$\text{Ln} [(\text{securitiesrmbs_less_3m} + \text{securitiesrmbs_3m_1y} + \text{securitiesrmbs_1y_3y} + \text{securitiesrmbs_3y_5y} + \text{securitiesrmbs_5y_15y} + \text{securitiesrmbs_over_15y}) / \text{Total assets}]$
<i>cash</i>	Cash holdings in bank asset portfolio	$\text{ln}(\text{cash}/\text{assets})$
<i>loans</i>	Bank loan portfolio	$\text{ln}(\text{loans}/\text{assets})$
<i>assets = lbanksiz</i>	Total assets	$\text{ln}(\text{assets})$
<i>lotherborrowedmoney</i>	Other borrowed money	$\text{ln}(\text{otherborrowedmoney})$
<i>eqmultiplier</i>	Equity multiplier	$\text{ln}(\text{b.v. assets} / \text{b.v equity})$
<i>leverage</i>	Leverage	$(\text{Tier 1} + \text{Tier 2}) / \text{Average total assets}$
<i>roa</i>	Return on assets	$\text{Net income} / \text{assets}$
<i>deplevel</i>	Deposit levels	Eq. (5)

Table AII

Call Report Data Variable Key

Description	Name	Code
Total assets	assets	RCFD2170
Cash	cash	RCFD0010
		RCFD0071+RCFD0081
Transaction deposits	transdep	RCON2215
Brokered deposits	brokereddep	RCON2365
Total loans	loans	RCFD1400+RCFD2165
		RCFD1400
Securities	securities	RCFD0400+RCFD0600+RCFD0900+RCFD0950
		RCFD0390
Other borrowed money	otherborrowedmoney	RCFD2850
		RCFD3190
		RCFD1935+RCFD2861+RCFD2869
Time deposits	timedep	timedeple100k+timedepge100k
Securities with repricing maturity of less than three months	securities_less_3m	RCFDA549+RCFDA555
Securities with repricing maturity of more than three months and less than a year	securities_3m_1y	RCFDA550+RCFDA556
Securities with repricing maturity of more than one year and less than three years	securities_1y_3y	RCFDA551+RCFDA557
Securities with repricing maturity of more than three years and less than five years	securities_3y_5y	RCFDA552+RCFDA558
Securities with repricing maturity of more than five years and less than fifteen years	securities_5y_15y	RCFDA553+RCFDA559
Securities with repricing maturity of more than fifteen years	securities_over_15y	RCFDA554+RCFDA560
Non-mortgage-related securities with repricing maturity less than 3 months	securitiestreasury_less_3m	RCFDA549

Non-mortgage-related securities with repricing maturity of more than 3 months and less than a year	securitiestreasury_3m_1y	RCFDA550
Non-mortgage-related securities with repricing maturity of more than one year and less than three years	securitiestreasury_1y_3y	RCFDA551
Non-mortgage-related securities with repricing maturity of more than three years and less than five years	securitiestreasury_3y_5y	RCFDA552
Non-mortgage-related securities with repricing maturity of more than five years and less than fifteen years	securitiestreasury_5y_15y	RCFDA553
Non-mortgage-related securities with repricing maturity of more than fifteen years	securitiestreasury_over_15y	RCFDA554
Residential RMBS with repricing maturity of less than three months	securitiesrmbs_less_3m	RCFDA555
Residential RMBS with repricing maturity of more than three months and less than a year	securitiesrmbs_3m_1y	RCFDA556
Residential RMBS with repricing maturity of more than one year and less than three years	securitiesrmbs_1y_3y	RCFDA557
Residential RMBS with repricing maturity of more than three years and less than five years	securitiesrmbs_3y_5y	RCFDA558
Residential RMBS with repricing maturity of more than five years and less than fifteen years	securitiesrmbs_5y_15y	RCFDA559
Residential RMBS with repricing maturity of more than fifteen years	securitiesrmbs_over_15y	RCFDA560
Other MBS with repricing maturity of less than three years	securitiesothermbs_less_3y	RCFDA561
Other MBS with repricing maturity of more than three years	securitiesothermbs_over_3y	RCFDA562
Entity identifier	rssdid	RSSD9001
Type of entity	chartertype	RSSD9048
FDIC identifier	cert	RSSD9050
Principal holding company identifier	bhcid	RSSD9348
An abbreviated version of the legal entity name	name	RSSD9010

