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Abstract

We show that banks "extended-and-pretended" their impaired CRE mortgages in the post-pandemic period to avoid writing off their capital, leading to credit misallocation and a buildup of financial fragility. We detect this behavior using loan-level supervisory data on maturity extensions, bank assessment of credit risk, and realized defaults for loans to property owners and REITs. Extend-and-pretend crowds out new credit provision, leading to a 4.8–5.3 percent drop in CRE mortgage origination since 2022:Q1 and fuels the amount of CRE mortgages maturing in the near term. As of 2023:Q4, this "maturity wall" represents 27 percent of bank capital.

JEL classification: G21, E51, R33
Key words: commercial real estate, zombie lending, financial fragility, credit misallocation

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1 Introduction

In the post-pandemic period, commercial real estate (CRE) has experienced rapidly deteriorating property values, driven by transitory forces such as the significant monetary tightening and structural ones such as the emergence of remote work (Gupta et al., 2023). Given the high leverage typically used in CRE deals, these devaluations often appear to be large enough to deplete the equity of owners and threaten losses for the lenders that hold the underlying mortgages. The discussions about the broader impact of distress in CRE for the financial sector and the economy at large have so far mostly focused on the direct effect of these losses on banks, with little attention directed to how banks manage their distressed CRE exposure.

In this paper, using detailed supervisory data, we document that banks have "extended-and-pretended" their distressed CRE mortgages in the post-pandemic period to delay the recognition of losses.[1] Banks with weaker marked-to-market capital—largely due to losses in their securities portfolio since 2022:Q1—have *extended* the maturity of their impaired CRE mortgages coming due *and pretended* that such credit provision was not as distressed to avoid further depleting their capital.[2] The resulting limited number of loan defaults hindered the reallocation of capital, crowding out the origination of both CRE mortgages and loans to firms. The maturity extensions granted by banks also fueled the volume of CRE mortgages set to mature in the near term—a "maturity wall" with the associated risk of large losses materializing in a short period of time.

Our conceptual framework centers on banks' incentives to extend the maturity of their existing impaired loans to avoid writing off their capital. This incentive is particularly pronounced from 2022:Q1 onward as rapidly rising rates created large marked-to-market losses on securities held by banks, eroding their economic capital. While having a limited

[1]We use the term "extend-and-pretend" to describe the behavior of lenders that provide additional credit to their impaired legacy borrowers to avoid depleting their capital. This term is often used in industry reports (e.g., "Corporate Credit Concern", by Goldman Sachs on August 10, 2023) and media (e.g., "It's the Return of Extend and Pretend" by Bloomberg on June 16, 2023).

[2]CRE mortgages typically have an amortization period longer than the maturity of the loan. Hence, a sizable loan principal balance still needs to be reimbursed at maturity (balloon payment).

effect on regulatory capital, marked-to-market losses make banks more likely to be monitored by regulators and credit rating agencies and, ultimately, make them vulnerable to runs by uninsured depositors (Drechsler et al., 2024; Haddad et al., 2023).

Our empirical analysis relies on loan-level supervisory data on CRE mortgages by stress tested banks (FR Y-14Q Schedule H.2). CRE mortgages are primarily issued and held on balance sheet by banks (banks hold 50.7% of the $5.8 trillion CRE market as of 2023:Q4) and our granular data captures 26.8% of all CRE mortgages held by banks. We augment this data with supervisory loan-level C&I lending data (FR Y-14Q Schedule H.1), data for Real Estate Investment Trusts (REITs) from Capital IQ and CRSP, and bank-level information (FR Y-9C). We use the latter to measure bank marked-to-market capitalization by (i) adding unrealized gains and losses on all securities to the regulatory capital ratio and (ii) calculating the distance between this measure and the bank-specific regulatory capital threshold.

Our empirical analysis is structured in five parts. First, as motivation, we use raw bank-level data to document that credit risk in the CRE market has substantially increased in the post-pandemic period but banks—weakly capitalized ones in particular—have been sluggish in assessing the associated losses. Specifically, stock returns of REITs that invest in CRE experienced a sizable drop since January 2022, especially in the office segment of this market, likely due to the emergence of remote work. In parallel, banks suffered significant marked-to-market losses as monetary policy tightening reduced the value of their securities holdings. Nevertheless, nonperforming loans and net charge-offs have remained low by historical standards, especially for weakly capitalized banks.

Second, we use our supervisory loan-level data to provide more granular evidence of the extend-and-pretend behavior by banks in their lending to CRE owners. We label a loan as distressed if the current net operating income (NOI) of the underlying property is lower than the NOI at origination.[3] We show that undercapitalized banks disproportionately extend the maturities of these distressed loans and understate their default probabilities, leading to

[3]The net operating income is one of the most important metrics in CRE. It is defined as gross rental income minus operating expenses. According to our definition, the share of distressed loans in office CRE since 2022:Q1 is 35.1%.

fewer realized defaults.

To address the potential identification concern that undercapitalized banks might systematically lend to low-risk properties, we exploit the richness of our data to control for the profitability and location of properties. We control for profitability using (log) current NOI, (log) NOI at origination, and property occupancy. NOI acts as a near-sufficient statistic for property-level characteristics that are relevant for default risk because NOI (i) is the main ingredient used in CRE valuation and (ii) directly measures the ability of a property to generate cash flow and thus service its debt. By construction, NOI and occupancy reflect the valuation that the rental market places on property-level unobservables like building quality and exposure to trends like work-from-home. We also control for the interest rate charged by the bank, which should price in loan-level characteristics like covenants and any remaining property-level characteristics not captured by the NOI.

We control for location using zip code-property type fixed effects, which allow us to exploit variation within very narrow geographic regions.[4] The within-zip code estimation captures the unique importance of location in real estate markets: risks to future property valuations are largely location-specific, including local economic downturns, changes in local work-from-home patterns, and increases in local property taxes. To summarize, our empirical strategy effectively compares two mortgages granted by banks with different levels of capitalization; these mortgages have functionally identical lending terms and are collateralized by distressed buildings located in a narrow geographical area with similar profitability and tenant occupancy. To alleviate any remaining concerns about unobservables, we confirm our results using a within-borrower design—which we discuss later—on a smaller sample of bank loans to real estate investment trusts (REITs).

We find that weakly capitalized banks assign a 0.9 percentage point lower probability of default to similar distressed loans compared to well-capitalized banks, a sizable effect given that the mean probability of default for distressed loans is 4.8%. Banks' extend-and-pretend behavior also leads to fewer defaults: distressed CRE mortgages granted by weakly capitalized

[4]To illustrate the narrow scope of zip codes, we note that Manhattan itself has 44 zip codes (link).

banks have a 0.5 percentage point lower probability of default compared to similar mortgages granted by well-capitalized banks, relative to a mean probability of default for distressed borrowers of 1.8%. Consistent with an attempt to avoid defaults, mortgages granted by weakly capitalized banks have a 0.2 percentage point higher probability of receiving a maturity extension compared to similar mortgages granted by well-capitalized banks, relative to a mean probability of receiving an extension of 2.2% for distressed loans.

Several additional tests support the robustness and interpretation of our findings. Our results are entirely driven by the period starting from 2022:Q1, consistent with the role played by property devaluations and bank capital deterioration in our conceptual framework. We find no evidence of extend-and-pretend in 2016–19 nor in 2020–21. We also find no evidence of extend-and-pretend for loans originated after 2020:Q1—consistent with post-pandemic mortgage origination being less likely to experience large losses. Finally, we show robustness to a range of alternative modelling choices, including standard error clustering and the choice of control variables and fixed effects.

Third, we confirm that weakly capitalized banks engaged in extend-and-pretend by analyzing their *indirect* exposure to CRE through their lending to REITs that hold large portfolios of equity investments in CRE properties. We show that a loan to a CRE REIT that has experienced a large valuation decline is assigned a lower probability of default if granted by a weakly capitalized bank compared to a better capitalized one. This test complements our mortgage-level analysis in two ways. First, we rely on the forward-looking nature of market equity prices rather than measuring borrower distress using net operating income. Second, we are able to match REITs across banks using stock tickers, allowing us to compare two or more loans granted to the *same* distressed CRE REIT by banks with different levels of capitalization, similar to the methodology of Khwaja and Mian (2008).

Fourth, we show that extend-and-pretend leads to significant credit misallocation. We show that the maturity extensions granted by weakly capitalized banks to distressed borrowers result in reduced credit origination in both CRE mortgage credit and C&I credit to firms. In a counterfactual exercise that takes into account that borrowers might switch lenders, we find that extend-and-pretend leads to a contraction of 4.8–5.3% in aggregate CRE mortgage origination. We do not find a meaningful aggregate effect on C&I origination, consistent with firms being able to borrow from banks not engaging in extend-and-pretend and CRE mortgage borrowers being unable to do so, with their lenders likely affected by the high uncertainty around the future prospects of CRE.

Fifth, we document that banks' extend-and-pretend has led to an ever-expanding "maturity wall", namely a rapidly increasing volume of CRE loans set to mature in the near term. As of 2023:Q4, CRE mortgages coming due within three years represent 27% of bank marked-to-market capital, up 11 percentage points from 2020:Q4—and CRE mortgages coming due within five years represent 40% of bank marked-to-market capital. We show (i) that weakly capitalized banks drive this expansion, consistent with their extend-and-pretend behavior, and (ii) that the maturity wall represents a sizable 16% of the aggregate CRE debt held by the banking sector as of 2023:Q4.

Taken together, our results highlight the costs of banks' extend-and-pretend behavior. In the short term, the resulting credit misallocation might slow down the capital reallocation needed to sustain the transition of real estate markets to the post-pandemic equilibrium—for example supporting the conversion of office space into residential units and recreational spaces in large urban areas. In the medium term, the delayed recognition of losses exposes banks (and all other holders of CRE debt) to sudden large losses which can be exacerbated by fire sales dynamics and bankruptcy courts congestion.

Contribution to the literature. Our paper contributes to three strands of literature. First, our findings are related to the 2023 banking turmoil in the U.S. which highlighted the fragility of banks' deposits during hiking cycles (Jiang et al., 2024; Drechsler et al., 2024; Haddad et al., 2023). As rising rates reduce the market value of securities held, banks protect their book capital by cutting lending (Greenwald et al., 2024) and placing securities in non-marked-to-market portfolios (Granja et al., 2024).[5] Our results document that banks protect their capital also by extending-and-pretending their impaired credit exposures. Given

[5] Granja et al. (2024) and Hanson et al. (2024) suggest that capital raising and requiring banks to hold enough short-term government securities might help banks navigate future interest rate hikes while still holding interest rate sensitive securities.

our focus on CRE, our findings are also related to recent studies showing that banks were extremely vulnerable to CRE distress during the 2022–23 hiking cycle (Jiang et al., 2023), a fragility exacerbated by their provision of credit lines to REITs (Acharya et al., 2024b).

Second, our analysis contributes to the understanding of real estate markets in the post-pandemic period. After the initial pandemic surge, remote work has stabilized to around 20% of workdays (Han and Liang, 2022; Barrero et al., 2021), depressing real estate valuations in cities in favor of suburban areas (Gupta et al., 2022; Bloom and Ramani, 2022; Gokan et al., 2023). Van Nieuwerburgh (2023) shows that this shift also affects productivity, innovation, and local public finances. Perhaps not surprisingly, the real estate segment most exposed to the emergence of remote work is office CRE, which has suffered large drops in occupancy, lease renewals, and rents in the post-pandemic period (Gupta et al., 2023). While there is some variation across cities (Rosenthal et al., 2022), the magnitudes are dramatic. For example, Gupta et al. (2023) documents a 39% decline in the long run value of NYC office buildings. By showing banks' sluggishness in realizing losses, our results indicate that financial frictions might slow down the reallocation of capital from impaired CRE to new projects, thus affecting cities, the productive sector at large, and local public finances.[6]

Finally, the extend-and-pretend behavior by banks can be interpreted as a manifestation of zombie lending, namely the provision of subsidized credit to impaired borrowers (see Acharya et al. (2022) for a review). The literature has convincingly documented this behavior in the context of the Japanese economy in the '90s (Peek and Rosengren, 2005; Caballero et al., 2008) and the European economy after the sovereign debt crisis (Acharya et al., 2024a). As in Caballero et al. (2008), our results are consistent with weakly capitalized banks extending the maturity of their impaired loans to protect their capital. Hence, the extend-and-pretend mechanism in this paper is distinct from recent contributions suggesting that zombie lending can arise because of information asymmetries (Hu and Varas, 2021) or policy-induced risk-shifting (Acharya et al., 2024c), or from the "evergreening" notion based

[6]Consistent with our findings, Loewenstein et al. (2021) documents that debt slows down use-type redeployment-redeveloping and Glancy et al. (2024) shows that mortgage-financed properties are less likely to be subsequently redeveloped as owners anticipate redevelopment frictions.

on banks' concentrated lending (Faria-e-Castro et al., 2024). Finally, our results complement those in Favara et al. (2024) that finds no evidence of zombie lending in C&I credit by U.S. banks following the drop in the price of crude oil in 2014–15. Our setting, as discussed above, is substantially different due to the uniqueness of the CRE shock and the concurrent depletion of bank capital.

Outline. The remainder of the paper is structured as follows. Section 2 presents our data and provides descriptive evidence consistent with banks' extend-and-pretend behavior. Section 3 shows more formally that distressed borrowers are less likely to default and more likely to receive maturity extensions if the lender is undercapitalized. Section 4 shows how extend-and-pretend crowds out the credit origination in both CRE and C&I market. Section 5 shows that banks' extend-and-pretend leads to an expanding "maturity wall", where an increasing share of outstanding CRE loans mature in the near term. Section 6 concludes.

2 Banks' sluggish assessment of deteriorating CRE

We now describe our data and discuss a few findings from raw data about the post-pandemic deterioration in CRE and the sluggishness of banks in assessing their exposure to this asset class. In Section 2.1, we explain how we combine our data sources to obtain our final data and present a set of summary statistics. In Section 2.2, we document the deterioration in CRE and show that banks, especially those with a relatively weak capitalization, have been sluggish in realizing losses associated with their impaired CRE.

2.1 Data

Our empirical work combines several data sets. In our main analysis, we use (i) loan-level CRE lending data from the Federal Reserve Y-14Q Schedule H.2, (ii) loan-level C&I lending data from the Federal Reserve Y-14Q Schedule H.1, (iii) bank-level characteristics from the Federal Reserve Y-9C data, and (iv) stock prices and market segment classification for REITs from CRSP and Capital IQ, respectively.

Note that CRE mortgages are primarily issued, and held on balance sheet, by banks.

Figure 1 shows that banks hold 50.7% of the $5.8 trillion CRE market as of 2023:Q4. While our loan-level data covers only mortgages issued by stress tested banks (covering 13.6% of the total CRE market and 26.8% of the CRE mortgages held by banks), we discuss in the paper how our findings extend to the entire CRE market.

Data construction. The FR Y-14Q Schedule H.2 CRE and the FR Y-14Q Schedule H.1 C&I lending data are proprietary data sets covering all bank holding companies (henceforth "banks") subject to Dodd-Frank stress tests. Each observation is a loan-quarter. In each quarter t, we observe the balance on loan l granted by bank b to borrower j, among several other variables. Our core sample period runs at a quarterly frequency from 2020:Q1 to 2023:Q4 and only includes domestic banks (see Table B.1 for the list of our sample banks). For CRE mortgages, we mostly focus on loans originated before 2020:Q1 as our goal is to understand how banks manage their *existing* CRE portfolio. In sum, in a panel at the quarterly frequency, we observe 517,893 CRE and 153,013 C&I loans granted by 22 banks.

These two data sets share a few characteristics and variables. We observe the loan-level probability of default that lenders assign to each loan, based on internal risk ratings or advanced IRB parameter estimates depending on whether the bank is subject to the advanced approaches for regulatory capital. Banks use discretion in assigning these probability of defaults, and do so to optimize the loans' capital costs (Plosser and Santos, 2018). We also observe whether the borrower is in default or whether the maturity of an existing loan is extended. Finally, in the CRE data, we observe the zip code of the property used as collateral, its occupancy rate, its net operating income, and the type of property (e.g., office, multifamily, hotel) used as collateral.

The FR Y-9C data (Consolidated Financial Statements for Holding Companies) data is publicly available and shows a large set of bank-quarter level income statement and balance sheet characteristics. Depending on the variables, the sample period starts as early as the mid-'80s. We merge all our sample banks in the two loan-level data sets (CRE and C&I) with banks in the Y-9C. In addition to variables such as nonperforming loans ratios and net charge-offs by market (e.g., multifamily, non-farm non-residential, C&I), we observe risk-weighted assets, common equity tier 1, and the fair and book value of Held-To-Maturity

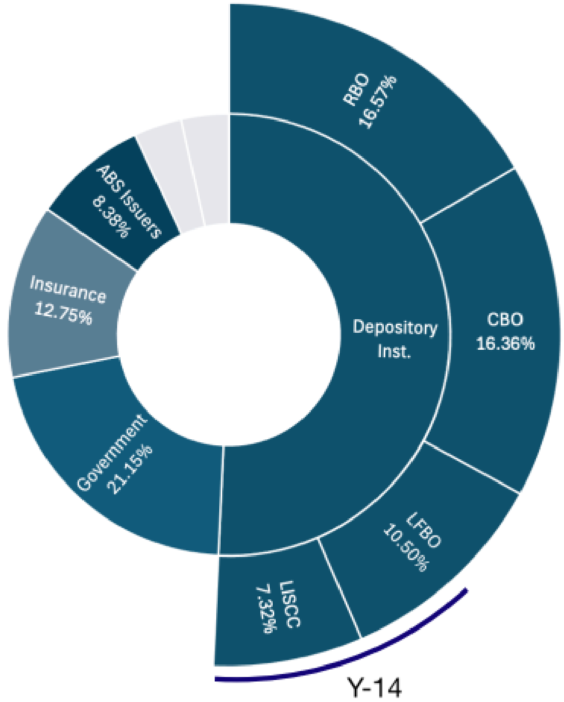

Figure 1: Holders of Commercial Real Estate debt. This figure shows the holders of CRE debt in the U.S. as of 2023:Q4. The inner part is generated using the Financial Accounts Z.1 data (sum of commercial mortgage assets by sector and multifamily residential mortgages, non-seasonally adjusted). The breakdown of the depository institution slice is sourced from the Y-9C and Call Report data. Large Institution Supervision Coordinating Committee (LISCC) are eight U.S. global systematically important banks (G-SIBs) and three Foreign Banking Organizations (FBOs). Large and Foreign Banking Organizations (LFBOs) are non-LISCC U.S. firms with total assets greater than \$100 billion and non-LISCC FBOs. Community Banking Organizations (CBOs) have total assets less than \$10 billion. Regional Banking Organizations (RBOs) have total assets between \$10 billion and \$100 million. Call Report observations are excluded if their holding company ID appears in the Y-9C to avoid double-counting. Bank size is measured using total assets. Shares are rescaled to match the Z.1 Depository Institutions slice. The two areas grayed out correspond to REITs and Other. Source: Y9-C, Financial Accounts Z.1 data.

(HTM) and Available-For-Sale (AFS) securities held, among other variables.

The stock price data for CRE REITs is from CRSP and their classification as "CRE" REITs is from Capital IQ. Each REIT is further classified based on the CRE asset class it covers, such as, for example, multifamily, office, industrial, hotel, and retail. In one part of our analysis, we merge the Y-14 Schedule H.1 C&I loan-level data with REITs' stock prices (from CRSP) and REITs' classification (from Capital IQ) to understand whether banks extend-and-pretend their C&I lending to distressed REITs. We are able to obtain stock prices and loan-level observations for our entire sample period for 76 of the 100 REITs classified in the broad CRE category in Capital IQ.

Unit of obs.: loan-quarter level | No. of obs.: 517,893 | Source: Y-14 CRE | Period: 2020:Q1 2023:Q4							
Panel A	mean	St.dev	p10	p25	p50	p75	p90
Probability of default	2.53	10.02	0.17	0.17	0.38	1.07	3.85
Default dummy	1.00	9.97	0.00	0.00	0.00	0.00	0.00
Extension dummy	2.67	16.12	0.00	0.00	0.00	0.00	0.00
Net operating income (M$)	1.09	23.74	0.11	0.18	0.33	0.79	2.15
Distress dummy	0.31	0.46	0.00	0.00	0.00	1.00	1.00
Amount outstanding (M$)	8.45	19.02	1.14	1.51	2.67	6.50	19.80
Interest rate	3.92	1.44	2.14	3.12	3.90	4.50	5.64
Underoccupancy	8.22	16.58	0.00	0.00	1.00	9.00	23.00
Time to maturity (quarters)	49.35	171.14	4.00	11.00	28.00	101.00	110.00

Unit of obs.: bank-quarter level | No. obs.: 308 | Source: Y-9C | Period: 2020:Q1 2023:Q4							
Panel B	mean	St.dev	p10	p25	p50	p75	p90
Total assets (B$)	0.89	1.05	0.16	0.19	0.34	1.21	2.74
Tier 1 capital ratio	0.11	0.02	0.09	0.10	0.11	0.13	0.14
MTM Tier 1 capital ratio	0.10	0.03	0.06	0.08	0.10	0.12	0.14
Undercapitalized	−1.31	2.73	−4.64	−3.11	−1.25	0.18	1.62
Deposits (%Assets)	69.59	16.74	29.92	64.55	75.33	79.96	83.13
CRE lending (%Assets)	0.07	0.06	0.01	0.01	0.06	0.09	0.12
C&I lending (%Assets)	0.12	0.08	0.02	0.03	0.10	0.19	0.23
Nonfarm nonresidential lending (%Assets)	0.04	0.04	0.01	0.01	0.04	0.06	0.08
Nonperforming loans CRE (%)	1.26	1.70	0.13	0.34	0.80	1.42	3.00
Nonperforming loans non-farm non-residential (%)	1.45	1.77	0.07	0.48	1.00	1.74	3.33
Nonperforming loans multifamily (%)	0.46	1.64	0.00	0.00	0.05	0.29	0.95
Nonperforming loans C&I (%)	1.13	1.53	0.18	0.44	0.71	1.16	2.07
Net charge-offs CRE (%)	0.04	0.10	−0.00	0.00	0.00	0.04	0.12
Net charge-offs nonfarm nonresidential (%)	0.06	0.16	−0.00	0.00	0.00	0.05	0.18
Net charge-offs multifamily (%)	0.02	0.17	−0.00	0.00	0.00	0.00	0.00
Net charge-offs C&I (%)	0.08	0.10	0.00	0.02	0.06	0.11	0.21

Table 1: Summary statistics. This table shows summary statistics of selected variables used in our analysis. The sample period runs at a quarterly frequency from 2020:Q1 to 2023:Q4. Panel A shows summary statistics at the loan-quarter level using Y-14 Schedule H.2 (CRE) data. Panel B shows summary statistics at the bank-quarter level using Y9-C data. The variables in Panel A are defined as follows. The probability of default is assigned by banks to each loan. The extension and default dummies take the value of one if the loan maturity is extended in quarter t or if the loan enters default in quarter t, respectively. The net operating income (NOI) is the gross rental income of the property used as collateral minus operating expenses. The distress dummy is a dummy equal to one if the current net operating income generated by the property is less than the NOI at origination. Underoccupancy is 100 minus the current occupancy share of the rentable square footage of the property. The variables in Panel B are defined as follows. Tier 1 capital ratio is the common equity tier 1 capital divided by risk weighted assets. MTM Tier 1 capital ratio is the common equity tier 1 capital adjusted for the change in market value of securities held in the HTM and AFS portfolios. The Undercapitalized variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Nonperforming loans and net charge-offs are expressed as a share of total lending (for each category of lending). Source: FR Y9-C, FR Y-14 Schedule H.2.

Summary statistics. Table 1 shows the summary statistics of our main data. Specifically, Panel A and Panel B show summary statistics for the period 2020:Q1–2023:Q4 from (i) the Y-14 Schedule H.2 CRE loan-level data and (ii) the Y-9C bank-quarter level data, respectively.

Panel A presents a set of loan-level characteristics. The first three variables are the probability of default assigned by banks to each loan, a dummy equal to one if loan l is in default at time t, and a dummy equal to one if loan l is granted a maturity extension at time t. Unlike residential mortgages, CRE mortgages typically have an amortization period much longer than the maturity of the loan, implying that most of the times there is a sizable loan balance left at maturity. In addition, 21% of mortgages in our data are interest only loans. The net operating income (NOI), a key metric in CRE markets, is defined as gross rental income minus operating expenses (which include maintenance, common charges, taxes, insurance premia, and management fees). To identify loans that are in distress, we build a distress dummy that is equal to one at time t if the time t property NOI is less than the NOI at origination.

Panel B presents a set of bank-level characteristics, including three measures of banks' capitalization. First, the tier 1 capital ratio, obtained by dividing common equity tier 1 by risk-weighted assets. Second, the marked-to-market tier 1 capital ratio (which takes into account marked-to-market gains and losses on securities held in the AFS and HTM portfolios).[7] Third, the $\text{Undercapitalization}_{bt}$ variable, defined as the distance between the regulatory capital threshold of bank b in quarter t and its time t marked-to-market tier 1 capital ratio. A positive value of the $\text{Undercapitalization}_{bt}$ variable indicates that bank b's regulatory capital with securities marked-to-market is below its regulatory threshold at time t. Bank-level regulatory thresholds are available in Table B.1. The marking-to-market of

[7]Under bank accounting rules, a bank that sells any security from its HTM portfolio—perhaps to meet unexpected liquidity demands—is typically required to mark all HTM securities to market. Note that tier 1 capital already includes unrealized gains and losses on AFS securities for 9 (AOCI Capital banks) of our 22 sample banks. The other 13 (non-AOCI-Capital banks) banks in our sample are exempted to do so. See Table B.1 for the identity of these banks and see Greenwald et al. (2024) for a detailed discussion of this different regulatory treatment. Banks do not need to adjust their regulatory capital for unrealized gains and losses on HTM securities.

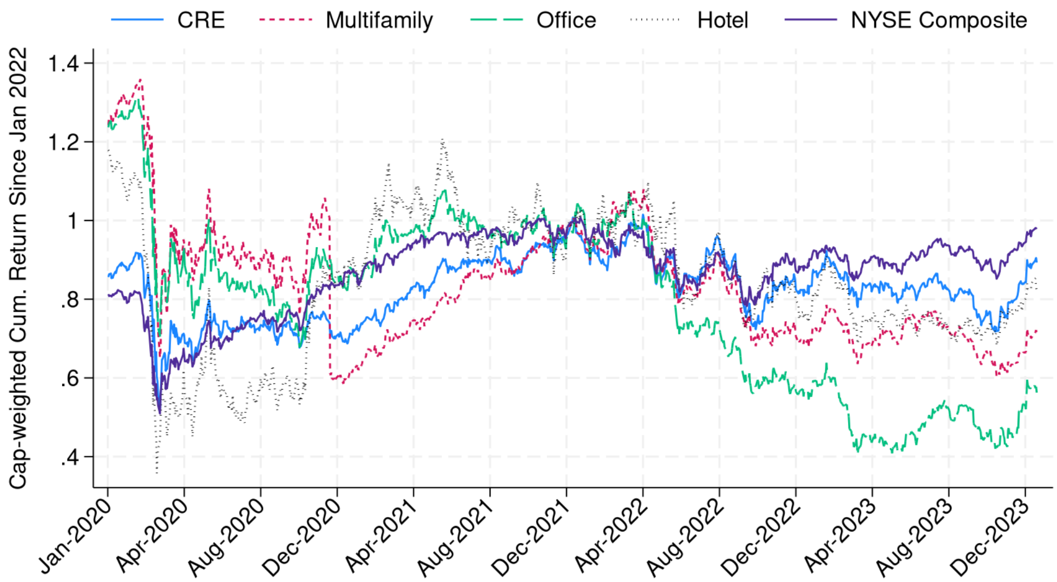

Figure 2: Decline in CRE valuations. This figure shows NYSE Composite returns, capitalization-weighted cumulative returns for aggregate REITs, and capitalization-weighted cumulative returns for REITs investing in multifamily, office, and hotel CRE segments since January 3, 2022. The lines are normalized to 1 on January 3, 2022. Sources: CRSP, Capital IQ.

securities captures the idea that banks are vulnerable to runs by uninsured depositors as interest rates increase reducing the value of securities held on balance sheet. This vulnerability is discussed in Drechsler et al. (2024) and Haddad et al. (2023).

2.2 Evidence from raw data

The raw data shows that, since 2022:Q1, the credit risk in the CRE space (especially in the office segment) has increased substantially and banks have been somewhat sluggish in assessing this deterioration—a dynamic driven by banks with a relatively weak capitalization.

Deterioration in CRE valuations. The post-pandemic period has been characterized by substantial volatility in CRE valuations, with a sizable deterioration in selected segments and a large drop in the number of transactions.

Figure 2 shows (capitalization-weighted) cumulative returns (i) for stocks of REITs investing in the aggregate CRE market as well as in the office, hotel, and multifamily segments and (ii) for the NYSE Composite index since January 2020. The lines are normalized to one on January 3, 2022, at the beginning of the Federal Reserve's hiking cycle. Measuring CRE stress using REITs' valuations, as opposed to property transaction prices, has two main advantages. First, REITs' stocks are reasonably liquid, especially compared to the CRE property market since 2022:Q1.[8] Second, transaction prices may suffer from selection as sellers might choose to sell less-devalued properties.

The figure documents the sizable deterioration of valuations since 2022:Q1, especially in the office, multifamily, and hotel segments. While the rapid rise in interest rates affected all property types, the pronounced and extended drop in office valuations is consistent with the increase in remote work. Barrero et al. (2021) estimates that 20% of workdays will be permanently supplied from home compared to just 5% before the pandemic. Panel A in Figure A.2 shows that, as of 2024:Q1, the share of work time provided at home stabilized at 28% compared to a pre-pandemic level of 6.2% (2018–19 average). Panel B shows that the subway ridership on weekdays in New York has stabilized at around 64% of the pre-pandemic level (73% of the pre-pandemic level for weekends). More generally, the figure shows that valuations sharply dropped at the onset of the pandemic, recovered during 2021, and have progressively deteriorated since 2022:Q1. By the end of 2023, office valuations are around 40% lower than their 2021:Q4 level. This collapse is consistent with anecdotal reports of office spaces being transacted at extraordinary discounts in cities like New York and San Francisco.[9]

Deterioration in bank capitalization. The deterioration in CRE since 2022:Q1 coincides with a weakening of banks' balance sheets, largely driven by the drop in value of securities held during the Federal Reserve's monetary policy tightening cycle.

[8] Figure A.1 shows the dramatic drop in the number of transactions in the CRE market in 2022 and 2023. Specifically, the figure shows, using data from Real Capital Analytics, that the number of transactions dropped by 58 percentage points in the aggregate CRE market, 39 percentage points in the office segment, 49 percentage points in the multifamily segment, and 39 percentage points in the hotel segment.

[9] See, for example, *"The Brutal Reality of Plunging Office Values Is Here"* from Bloomberg on February 13, 2024; *"Fire Sale: $300 Million San Francisco Office Tower, Mostly Empty. Open to Offers"* from the Wall Street Journal on April 27, 2023; or *"Buyers Snap Up Aging and Empty Office Building for Deep Discounts."* from the New York Times on June 12, 2024.

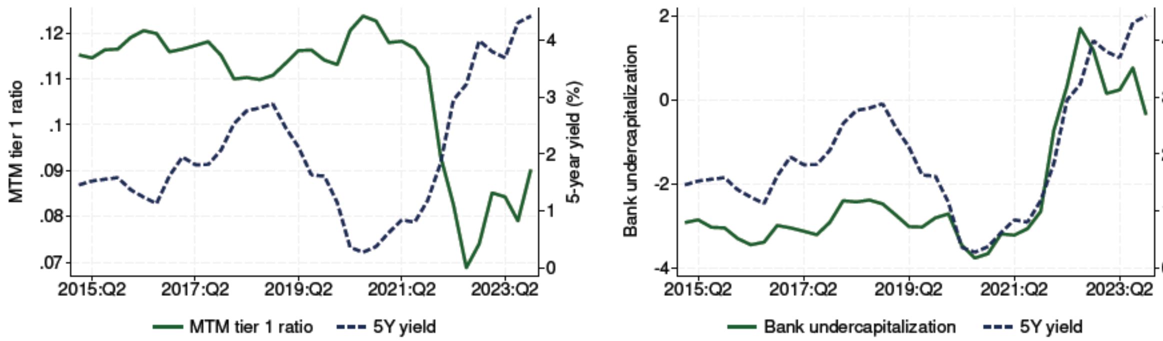

Figure 3: Weakening of banks' balance sheets as 5-year Treasury yields increase. This figure shows the time-series evolution of the 5-year Treasury yield (dashed line, secondary y-axis) and a measure of banks' capitalization (solid line, primary y-axis). The left panel shows the time-series evolution of the cross-sectional (across banks) average marked-to-market tier 1 ratio. The right panel shows the bank average Undercapitalization$_{bt}$ variable (defined in Section 2.2). We use the 5-year yield as the typical duration of banks' securities holdings is around 4 years (Greenwald et al., 2024). Source: FR Y-9C, FRED.

The left panel of Figure 3 shows the 5-year Treasury yield (dashed line) and the marked-to-market tier 1 ratio (solid line). The figure documents the sizable deterioration of banks' capitalization as the 5-year yield increased from below 1% in 2021:Q3 to 4.4% in 2023:Q4. The right panel confirms, using the Undercapitalization$_{bt}$ variable introduced in Section 2.2, that, since 2022:Q1, banks' capitalization deteriorated as the 5-year Treasury yield increased. Figure A.3 documents that the entire cross-sectional distribution of banks' undercapitalization shifted to the right (more undercapitalized banks) from 2020:Q4 to 2022:Q4.

Sluggish CRE loss recognition by weak banks. We now show that banks have been sluggish in assessing the deterioration in CRE and that such sluggishness has been particularly pronounced for weakly capitalized banks.

Figure 4 shows that the level of CRE nonperforming loans is, as of 2023:Q4, still low by historical standards. Each panel focuses on a different CRE segment and shows the median, the 25^{th} percentile, and the 75^{th} percentile of the distribution, across our sample banks, of the nonperforming loans ratio (stock of nonperforming loans divided by the stock of loans). Note that the rapid deterioration in valuations (which started in 2022:Q1) documented in Figure 2 is followed by a small increase in the nonperforming loans ratio with a two-year lag. Figure A.4 shows a similar pattern for net charge-offs.

Figure 5 shows that the sluggishness in assessing the deterioration in CRE has been driven by weakly capitalized banks. Each panel shows the nonperforming loans ratio for

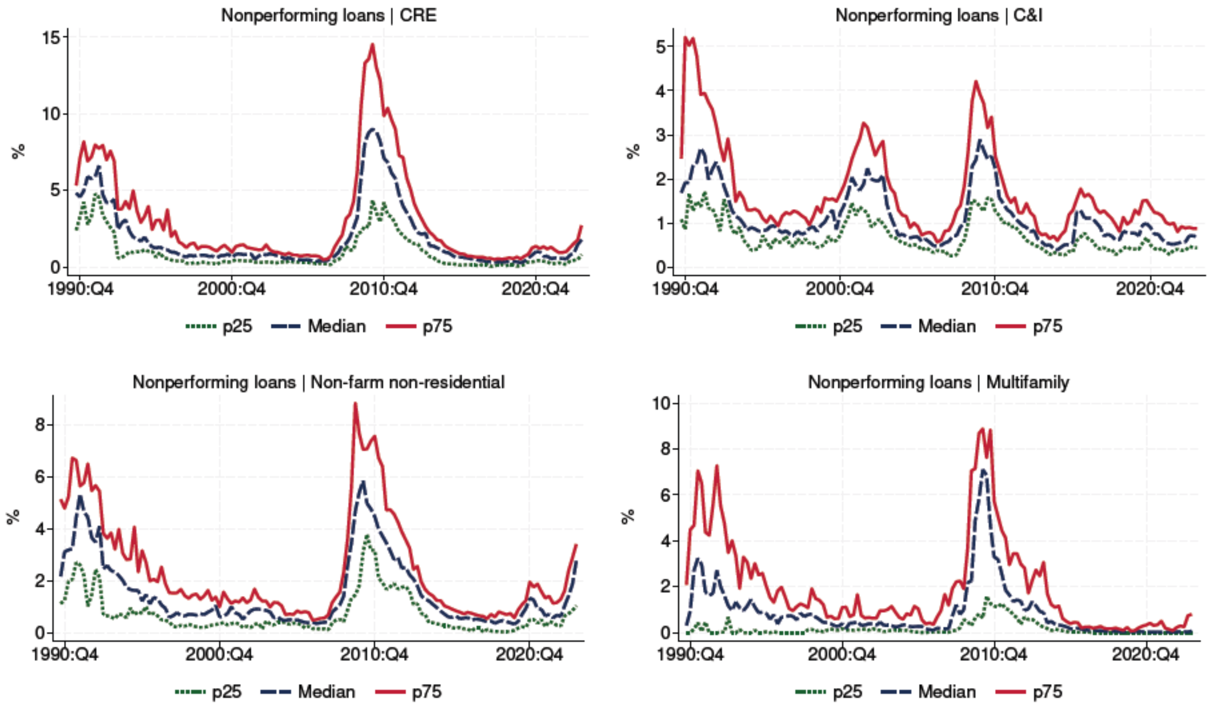

Figure 4: Nonperforming loans across asset classes. This figure shows the time-series evolution of the nonperforming loans ratio (stock of nonperforming loans divided by the stock of loans) across various asset classes (CRE, C&I, non-farm non-residential CRE, and multifamily CRE). The solid line, long dash line, and short dash line indicate the third quartile, the median, and the first quartile at any given point in time in the cross-section of our sample banks. The data runs at a quarterly frequency from 1990:Q3 to 2023:Q4. Source: FR Y-9C.

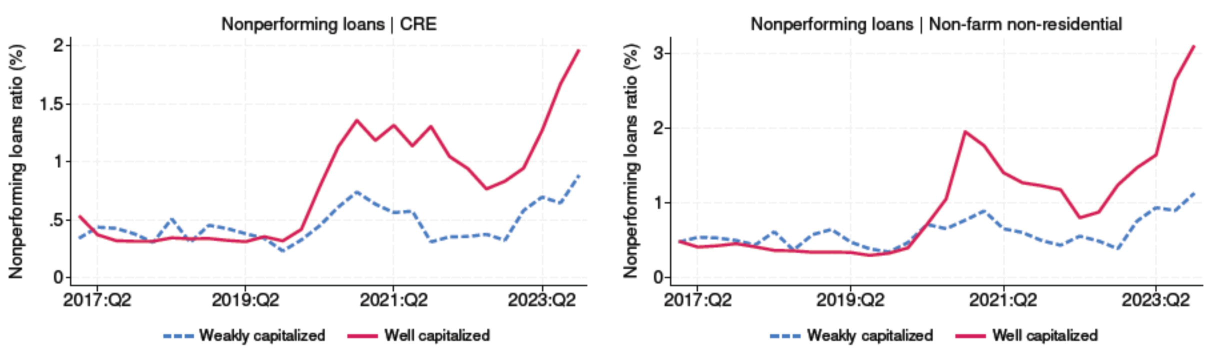

Figure 5: Nonperforming CRE loans, weakly capitalized vs. well capitalized banks. This figure shows the time-series evolution of the nonperforming loans ratio (stock of nonperforming loans divided by the stock of loans) for aggregate CRE (left panel) and non-farm non-residential CRE (right panel). Solid lines (dashed lines) indicate the median nonperforming loans ratio for well capitalized (weakly capitalized) banks. Our 22 sample banks are split in these two groups based on whether their $\text{Undercapitalization}_{bt}$ variable is above median (weakly capitalized) or below median (well capitalized) in 2022:Q4. The data runs at a quarterly frequency from 2017:Q1 to 2023:Q4. Source: FR Y-9C.

weakly capitalized banks (dashed lines) and well-capitalized banks (solid lines). The left panel focuses on all CRE loans and the right panel only focuses on non-farm non-residential CRE loans. These two graphs document that well-capitalized banks have been more active in classifying loans as nonperforming than weakly capitalized banks.

In sum, the evidence from raw data presented so far documents that, since the start of the monetary policy tightening cycle in 2022:Q1, there has been (i) a substantial deterioration in the CRE market (particularly pronounced in the office space following the surge of remote work) and (ii) a concurrent erosion of bank capital once the securities held by banks are marked to market. The evolution of nonperforming loans ratios and net charge-offs further suggests that banks have been sluggish in assessing the increase in CRE credit risk—a reluctance particularly pronounced for weakly capitalized banks.

3 Extending-and-pretending CRE credit

We now show that undercapitalized banks have been lenient in assessing their exposure to impaired CRE mortgages as their capital deteriorated since 2022:Q1. We also show that, during the same period, undercapitalized banks have extended the maturity of their impaired mortgages leading, in turn, to fewer defaults. We present this empirical evidence in Section 3.1. In Section 3.2, we present a set of additional (placebo and robustness) tests that support our interpretation. In Section 3.3, we document a similar extend-and-pretend behavior in banks' lending to REITs investing in CRE.

3.1 Evidence from CRE mortgages

We now show that weakly capitalized banks have extended-and-pretended mortgages collateralized by distressed CRE properties, especially since 2022:Q1.

Specification. We estimate the following specification in the loan-level CRE data:

$$\begin{aligned} \mathrm{Y}_{lt} = \alpha &+ \beta_1 \mathrm{Undercapitalized}_{bt} \times \mathrm{Distress}_{lt} \\ &+ \beta_2 \mathrm{Undercapitalized}_{bt} + \beta_3 \mathrm{Distress}_{lt} + \boldsymbol{\gamma'} \boldsymbol{X}_{lt} + \eta_{zpt} + \epsilon_{lt} \end{aligned} \tag{1}$$

where l is a loan, b is a bank, z is a zip code, p is a property type, and t is a quarter.[10] We use three outcome variables: (i) the default probability that bank b assigns to loan l in quarter t, (ii) a dummy equal to one if loan l is in default in quarter t, and (iii) a dummy equal to one if the maturity of loan l is extended in quarter t. The independent variable of interest is the interaction between the undercapitalization of bank b in quarter t ($\text{Undercapitalized}_{bt}$) and a variable capturing whether loan l is distressed in quarter t (Distress_{lt}). We measure distress with a dummy equal to one if the current net operating income (NOI) generated by the property is less than the NOI at origination.[11]

The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. Our sample only includes mortgages originated before 2020:Q1 to focus on loans made before the COVID-19 pandemic (and the subsequent work-from-home adaptation and rapid monetary tightening). We relax these sample restrictions (and present several additional tests) in Section 3.2. Finally, we triple cluster standard standard errors at the zip code, property type, and bank level.

Our specification addresses the concern that undercapitalized banks might systematically lend to properties with lower credit risk, thus creating a mechanical correlation between bank undercapitalization and our outcome variables. First, we extensively control for the profitability of properties, as measured by log current NOI, log NOI at origination, and property occupancy (vector $\boldsymbol{X}_{lt}$). NOI is the main component of CRE valuation models and thus acts (in tandem with occupancy) as a near-sufficient statistic for property-level characteristics that are relevant for credit risk.[12] Specifically, the most important component of NOI is the market rent. For example, a landlord will likely lower rents on an office building highly affected by local work-from-home trends, reducing its NOI and valuation,

[10] We observe 12 property types, i.e., retail; industrial (excluding warehouse/distribution); hotel/hospitality/gaming (including resorts); multi-family for rent (including low income housing); homebuilders except condo; condo/co-op; office (including medical office); mixed; land and lot development; other; healthcare (including hospitals, assisted living, memory care, and skilled nursing); warehouse/distribution.

[11] The share of loan-quarter observations corresponding to distressed loans (i.e., $\text{Distress}_{lt} = 1$) is 26.8% for loans collateralized by multifamily properties and 35.1% for loans collateralized by office properties.

[12] The NOI directly measures the ability of a property to generate cash flow and thus service its debt. CRE valuations are often calculated as a perpetuity with NOI as the flow income, discounted by an assumed capitalization rate ("cap rate") that is based on the perceived risk of the income stream.

thus increasing its default risk. Similarly, a multifamily landlord will likely increase rents on an apartment building if work-from-home leads households to demand more apartment space, increasing its NOI and valuation, thus reducing its default risk.

Second, we control for the interest rate charged by the bank (also in $\boldsymbol{X}_{lt}$). This variable allows us to control for loan-level characteristics that may be relevant for credit risk, such as loan covenants, repayment schedule, and landlord financial health. We also explicitly control for log outstanding balance and time to maturity (last two variables in $\boldsymbol{X}_{lt}$).

Third, we add zip code-property type-quarter fixed effects, effectively comparing mortgages collateralized by the same type of property (e.g., office) granted to the same zip code by banks with different levels of capital. This design allows us to control for the unique importance of location in real estate markets. Two properties located in the same area are exposed to many of the same risks to future income, including the risk of a local economic downturn and the risk of increases in work-from-home patterns, local property taxes, or even local crime rates.

Finally, in the most stringent specification, we also include bank-quarter fixed effects to control for bank-level time-varying characteristics (other than bank undercapitalization) that might affect our outcome variables, given the non-random nature of bank capitalization.

Bank-assigned probability of default. Table 2 shows the estimation results, where the outcome variable is the default probability that bank b assigns to loan l at time t. The table progressively saturates the specification with controls and fixed effects. In the most stringent specification in Column (4), we include zip code-property type-quarter fixed effects, bank-quarter fixed effects, and the loan-level controls.

The estimated coefficient on the interaction term in Column (1), which includes zip code-time fixed effects, shows that a distressed borrower tends to be classified as less risky by weakly capitalized banks compared to better capitalized banks. This effect is remarkably stable as we add zip code-property type-quarter fixed effects (Column (2)), loan-level controls (Column (3)), and bank-quarter fixed effects (Column (4)). The coefficients on the control variables suggest that these variables capture important variation in outcomes. As expected, we find that higher interest rates and lower current NOIs are associated with higher reported probabilities of default.

	Probability of Default	PD_{lt}		
	(1)	(2)	(3)	(4)
$\text{Undercapitalized}_{bt} \times \text{Distress}_{lt}$	−0.783***	−0.796***	−0.621***	−0.633***
	(0.224)	(0.232)	(0.195)	(0.166)
$\text{Undercapitalized}_{bt}$	−0.0165	−0.0577	−0.110	
	(0.114)	(0.0836)	(0.107)	
Distress_{lt}	3.560***	3.339***	0.598	0.672
	(0.526)	(0.531)	(0.522)	(0.471)
$\text{Outstanding Balance}_{lt}$			1.689***	1.626***
			(0.324)	(0.318)
$\text{Interest Rate}_{lt}$			1.264***	1.198***
			(0.276)	(0.250)
$\text{Underoccupancy}_{lt}$			0.059	0.116**
			(0.038)	(0.037)
$\text{Time to Maturity}_{lt}$			−0.013***	−0.013**
			(0.002)	(0.005)
$\text{NOI Origination}_{l}$			2.600**	2.337**
			(0.821)	(0.788)
NOI Current_{lt}			−4.419***	−4.147***
			(1.23)	(1.179)
Fixed Effects				
Zip Code-Quarter	✓			
Zip Code-Property Type-Quarter		✓	✓	✓
Bank-Quarter				✓
Observations	150,274	123,319	114,817	114,815
R^2	0.247	0.368	0.378	0.393

Table 2: Extending-and-pretending CRE credit since 2022, bank-assigned probability of default. This table shows estimation results from Specification (1). The dependent variable is the probability of default assigned by bank b to loan l at time t. Distressed_{lt} is a dummy equal to one if the net operating income (NOI) generated by the property serving as collateral is less than the NOI of the same property at origination. The $\text{Undercapitalized}_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. $\text{Outstanding Balance}_{lt}$ is the log of the outstanding amount on loan l at time t, $\text{Interest Rate}_{lt}$ is the interest rate on the loan at time t. $\text{Underoccupancy}_{lt}$ is 100 minus the current occupancy share of the rentable square footage of the property serving as collateral. $\text{Time to Maturity}_{lt}$ is the time to maturity (in quarters) of loan l at time t. $\text{NOI Origination}_{lt}$ and NOI Current_{lt} are the log of NOI at origination and current, respectively. The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. The sample only includes loans originated before 2020:Q1. Standard errors triple clustered at the zip code, property type, and bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.2.

The magnitudes are sizable. Based on the most stringent specification in Column (4), an undercapitalized bank (i.e., p75 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) assigns a 0.9 percentage point lower probability of default to similar distressed borrowers compared to a well-capitalized bank (i.e., p25 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4), relative to a mean assigned probability of default for distressed borrowers of 4.8%.

Realized defaults. We now show evidence suggesting that banks' extend-and-pretend behavior leads to fewer defaults. To this end, we estimate Specification (1) using, as outcome variable, a dummy equal to one if loan l is in default at time t. Note that this variable, unlike the bank-assigned probability of default, cannot be manipulated by banks for regulatory arbitrage reasons—for example, Plosser and Santos (2018) shows that banks manipulate the probability of defaults to reduce the risk-weights applied to risky loans, thus improving regulatory capital ratios.

Table 3 presents the estimation result, confirming that mortgages provided by undercapitalized banks are less likely to default compared to similar mortgages provided by better capitalized banks. The magnitude and significance of the estimated interaction coefficient is stable across specifications as we add stringent fixed effects and loan-level controls. The magnitude of the effect is sizable. Based on Column (4), distressed CRE mortgages granted by undercapitalized banks (i.e., p75 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) have a 0.5 percentage point lower probability of default compared to similar distressed CRE mortgages granted by well-capitalized banks (i.e., p25 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4), relative to a mean observed probability of default for distressed borrowers of 1.8%.

Maturity extensions. We now show that undercapitalized banks are more likely to extend the maturity of distressed mortgages, consistent with these mortgages experiencing fewer defaults if granted by undercapitalized banks. As in the previous analyses, we estimate Specification (1) using, as outcome variable, a dummy equal to one if the maturity of loan l is extended at time t. Note that the median length of an extension is one year while the

	Default$_{lt}$			
	(1)	(2)	(3)	(4)
Undercapitalized$_{bt}$ × Distress$_{lt}$	−0.452**	−0.466**	−0.305**	−0.328**
	(0.183)	(0.188)	(0.136)	(0.135)
Undercapitalized$_{bt}$	−0.058	−0.130***	−0.194***	
	(0.057)	(0.021)	(0.031)	
Distress$_{lt}$	1.160*	0.754	−0.520	−0.435
	(0.631)	(0.501)	(0.365)	(0.303)
Outstanding Balance$_{lt}$			0.610**	0.562*
			(0.264)	(0.262)
Interest Rate$_{lt}$			1.054**	0.981**
			(0.374)	(0.351)
Underoccupancy$_{lt}$			0.034	0.068*
			(0.029)	(0.036)
Time to Maturity$_{lt}$			−0.010**	−0.010
			(0.003)	(0.006)
NOI Origination$_{l}$			1.213**	1.067**
			(0.459)	(0.442)
NOI Current$_{lt}$			−1.864**	−1.687**
			(0.750)	(0.693)
Fixed Effects				
Zip Code-Quarter	✓			
Zip Code-Property Type-Quarter		✓	✓	✓
Bank-Quarter				✓
Observations	150,274	123,319	114,817	114,815
R^2	0.240	0.371	0.353	0.365

Table 3: Extending-and-pretending CRE credit since 2022, realized defaults. This table shows estimation results from Specification (1). The dependent variable is a dummy equal to one if loan l is in default at time t. Distressed$_{lt}$ is a dummy equal to one if the net operating income (NOI) generated by the property serving as collateral is less than the NOI of the same property at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Outstanding Balance$_{lt}$ is the log of the outstanding amount on loan l at time t. Interest Rate$_{lt}$ is the interest rate on the loan at time t. Underoccupancy$_{lt}$ is 100 minus the current occupancy share of the rentable square footage of the property serving as collateral. Time to Maturity$_{lt}$ is the time to maturity (in quarters) of loan l at time t. NOI Origination$_{lt}$ and NOI Current$_{lt}$ are the log of NOI at origination and current, respectively. The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. The sample only includes loans originated before 2020:Q1. Standard errors triple clustered at the zip code, property type, and bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.2.

	Extension$_{lt}$			
	(1)	(2)	(3)	(4)
Undercapitalized$_{bt}$ × Distress$_{lt}$	0.244***	0.199***	0.215***	0.206***
	(0.060)	(0.034)	(0.063)	(0.037)
Undercapitalized$_{bt}$	−0.354*	−0.433***	−0.442***	
	(0.179)	(0.114)	(0.136)	
Distress$_{lt}$	−0.160	−0.354	−0.626*	−0.577*
	(0.212)	(0.199)	(0.320)	(0.277)
Outstanding Balance$_{lt}$			0.259	0.177
			(0.222)	(0.215)
Interest Rate$_{lt}$			0.520**	0.412**
			(0.175)	(0.156)
Underoccupancy$_{lt}$			0.013	0.030*
			(0.013)	(0.014)
Time to Maturity$_{lt}$			0.002	0.017
			(0.012)	(0.014)
NOI Origination$_{l}$			0.475	0.265
			(0.268)	(0.277)
NOI Current$_{lt}$			−0.208	−0.059
			(0.120)	(0.124)
Fixed Effects				
Zip Code-Quarter	✓			
Zip Code-Property Type-Quarter		✓	✓	✓
Bank-Quarter				✓
Observations	150,274	123,319	114,817	114,815
R^2	0.317	0.466	0.472	0.495

Table 4: Extending-and-pretending CRE credit since 2022, maturity extensions. This table shows estimation results from Specification (1). The dependent variable is a dummy equal to one if the maturity of loan l is extended at time t. Distressed$_{lt}$ is a dummy equal to one if the net operating income (NOI) generated by the property serving as collateral is less than the NOI of the same property at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Outstanding Balance$_{lt}$ is the log of the outstanding amount on loan l at time t. Interest Rate$_{lt}$ is the interest rate on the loan at time t. Underoccupancy$_{lt}$ is 100 minus the current occupancy share of the rentable square footage of the property serving as collateral. Time to Maturity$_{lt}$ is the time to maturity (in quarters) of loan l at time t. NOI Origination$_{lt}$ and NOI Current$_{lt}$ are log of the NOI at origination and current, respectively. The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. The sample only includes loans originated before 2020:Q1. Standard errors triple clustered at the zip code, property type, and bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.2.

third quartile (p75) and the ninth decile (p90) are two and six years, respectively.

Table 4 shows the estimation results. Consistent with weakly capitalized banks using maturity extensions to prevent distressed mortgages from defaulting, we find a strong positive relationship, for distressed mortgages, between maturity extensions and bank undercapitalization. The magnitudes are, again, sizable. Based on Column (4), distressed CRE mortgages granted by an undercapitalized bank (i.e., p75 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) have a 0.2 percentage point higher probability of receiving a maturity extension compared to similar distressed CRE mortgages granted by a well-capitalized bank (i.e., p25 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4), relative to a mean observed probability of receiving a maturity extension of 2.2%.

3.2 Additional tests

We now show two sets of additional tests further suggesting that weakly capitalized banks have extended-and-pretended their distressed CRE mortgages since 2022:Q1. First, we present placebo tests showing that the results in the previous section are driven by the 2022:Q1–2023:Q4 period and by loans originated before 2020:Q1. Second, we present robustness tests confirming that our results are not reliant on specific modeling choices.

Table 5 shows the estimated coefficient of interest (β_1 in Specification (1)) and the associated standard errors in the most stringent specification, i.e., with the inclusion of all time-varying loan-level controls, zip code-property type-quarter fixed effects, and bank-quarter fixed effects. Each row corresponds to a different variation of this specification and each column corresponds to a different outcome variable (PD_{lt}, Default_{lt}, and Extension_{lt}). In each panel, the first row reports the baseline estimation results for reference.

Panel A shows the estimated coefficients and associated standard errors for three placebo tests. Specifically, Row (1) shows that our results are substantially weaker in the period before the deterioration of banks' balance sheets (2020–21), Row (2) shows that the results vanish when analyzing the period before the COVID-19 pandemic (2016–19), and Row (3) shows that the results vanish when analyzing loans originated after 2020:Q1. This final null result is consistent with post-pandemic mortgage origination being less likely to experience large losses, thus reducing the need for extend-and-pretend.

Panel A: Placebo Tests						
	PD_{lt}		$Default_{lt}$		$Extension_{lt}$	
Specification	β_1	SE	β_1	SE	β_1	SE
0. Baseline	−0.633***	(0.166)	−0.328***	(0.135)	0.206***	(0.037)
1. 2020:Q1 2021:Q4 sample	−0.240*	(0.128)	−0.101	(0.058)	−0.060	(0.060)
2. 2016:Q1 2019:Q4 sample	0.125	(0.096)	0.036	(0.061)	0.179	(0.172)
3. Post-2020:Q1 origination	−0.116	(0.137)	0.103	(0.140)	−0.606*	(0.297)

Panel B: Robustness Checks						
	PD_{lt}		$Default_{lt}$		$Extension_{lt}$	
Specification	β_1	SE	β_1	SE	β_1	SE
0. Baseline	−0.633***	(0.166)	−0.328***	(0.135)	0.206***	(0.037)
1. Lagged undercapitalization	−0.434**	(0.165)	−0.279**	(0.116)	0.275***	(0.062)
2. Cluster by bank & property type	−0.633***	(0.166)	−0.328**	(0.128)	0.206***	(0.0366)
3. Cluster by bank & zip code	−0.633**	(0.232)	−0.328*	(0.166)	0.206**	(0.0765)

Table 5: Additional tests: placebo and robustness tests. This table shows a set of estimation results, reporting the estimated coefficients β_1 from Specification (1), together with the associated standard errors, in the most stringent version of the specification (with the inclusion of all time-varying loan-level controls, zip code-property type-quarter fixed effects, and bank-quarter fixed effects). Such specification is shown in Column (4) in Table 2, Table 3, and Table 4. In the first two columns, the outcome variable is the probability of default assigned by bank b to loan l at time t. In the middle two columns, the dependent variable is a dummy equal to one if loan l is in default at time t. In the last two columns, the dependent variable is a dummy equal to one if the maturity of loan l is extended at time t. Each row corresponds to a different specification. In each panel, the first row reports the baseline specification for reference. In Panel A, the three other specifications correspond to (i) the baseline Specification (1) estimated in the 2020:Q1–2021:Q4 sample, (ii) the baseline Specification (1) estimated in the 2016:Q1–2019:Q4 sample, and (iii) the baseline Specification (1) estimated in the sample of loans originated after 2020:Q1. In Panel B, the three specifications correspond to (i) the use of lagged bank undercapitalization ($Undercapitalization_{bt-1}$) instead of contemporaneous bank undercapitalization ($Undercapitalization_{bt}$), (ii) double clustering of standard errors at the bank and property type level, and (iii) double clustering of standard errors at the bank and zip code level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Source: FR Y9-C, FR Y-14 Schedule H.2.

Panel B shows the estimated coefficients and associated standard errors for three robustness tests. Specifically, Row (1) shows that our results are robust to using bank undercapitalization lagged by one quarter ($Undercapitalization_{bt-1}$) instead of contemporaneous bank undercapitalization ($Undercapitalization_{bt}$) as outcome variable, Row (2) shows that our results are robust to double clustering standard errors at the bank and property type level, and Row (3) shows that our results are robust to double clustering standard errors at the zip code and bank level.

In sum, the specificity of our baseline results to the 2022–23 period and to pre-2020 originations is consistent with banks' extending-and-pretending existing distressed CRE mortgages to preserve capital. In addition, the robustness tests further confirm that our results are not sensitive to the timing of the bank undercapitalization variable nor to the choice of how to cluster standard errors.

3.3 Evidence from REITs

We now show that, since 2022:Q1, undercapitalized banks have extended-and-pretended their CRE exposure indirectly through their lending to REITs that invest in CRE.[13]

The analysis of banks' lending behavior to REITs has two advantages compared with the previous analyses on CRE mortgages. First, instead of relying on properties' NOI, we can measure distress using market equity prices which are inherently forward looking. For example, the market capitalization of a REIT holding *temporarily* distressed properties would not drop as much if the future outlook for those properties is positive. Second, we can match the same *borrower* across different banks using the stock ticker of each REIT. We can then compare the lending behavior of two banks with different levels of capital lending to the *same* borrower—and check how this potentially different behavior varies based on whether the borrowing REIT is distressed. This within-borrower estimation also addresses the possibility that our previous analysis was driven by healthy sponsors systematically holding distressed CRE mortgages issued by undercapitalized banks.

We run the following specification using the loan-level Y-14Q Schedule H.1 C&I data:

$$\text{PD}_{lbjt} = \alpha + \beta_1 \text{Undercapitalized}_{bt} \times \text{Distress}_{jt} + \beta_2 \text{Undercapitalized}_{bt} + \boldsymbol{\gamma}' \boldsymbol{X}_{lt} + \eta_{jt} + \epsilon_{lbjt} \quad (2)$$

where l is a loan (term loan or credit line) outstanding in quarter t granted by bank b to REIT j. The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4 and, as in the previous mortgage CRE analyses, only includes loans originated before 2020:Q1. The

[13] Acharya et al. (2024b) shows that the indirect exposure of banks to CRE through REITs is especially pronounced for large banks and that, once this exposure is accounted for, banks' CRE exposure is substantially less concentrated among small banks.

	Probability of Default		PD_{lbjt}
	(1)	(2)	(3)
$\text{Undercapitalized}_{bt} \times \text{Distress}_{jt}$	−0.104***	−0.132***	−0.148***
	(0.026)	(0.016)	(0.040)
$\text{Undercapitalized}_{bt}$	−0.093*	−0.091	
	(0.049)	(0.053)	
$\text{Outstanding Balance}_{lt}$		0.063	0.026
		(0.088)	(0.093)
$\text{Interest Rate}_{lt}$		0.103	0.056
		(0.082)	(0.062)
$\text{Time to Maturity}_{lt}$		−0.030**	−0.015
		(0.013)	(0.011)
Fixed Effects			
Borrower-Quarter	✓	✓	✓
Bank-Quarter			✓
Observations	2,765	2,461	2,440
R^2	0.577	0.582	0.645

Table 6: Extending-and-pretending since 2022, evidence from REITs. This table shows estimation results from Specification (2). The dependent variable is the probability of default assigned by bank b to REIT j at time t. Distress_{jt} is the change in market capitalization of REIT j from 2020:Q1 to quarter t (positive values indicate a drop in market capitalization). The $\text{Undercapitalized}_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. The following control variables are included in the estimation but omitted from this table for brevity: $\text{Outstanding Balance}_{lt}$ is the log of the outstanding amount on loan l at time t; $\text{Interest Rate}_{lt}$ is the interest rate on the loan at time t; $\text{Time to Maturity}_{lt}$ is the time to maturity (in quarters) of loan l at time t. The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. The sample only includes loans originated before 2020:Q1. Standard errors double clustered at the borrower and bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: CRSP, Capital IQ, FR Y9-C, FR Y-14 Schedule H.1.

outcome variable is the probability of default that bank b assigns to loan l at time t. The variable Distress_{jt} is the change in market capitalization of REIT j from 2020:Q1 to quarter t—where large positive values indicate a sizable drop in market capitalization. The vector $\boldsymbol{X}_{lt}$ is a collection of loan-level controls, namely the log of the outstanding amount on loan l in quarter t, the interest rate on the loan at time t (in basis points), and the time to maturity (in quarters) of loan l in quarter t. As discussed, the regression also includes borrower-time fixed effects to control for unobserved characteristics of borrowers (Khwaja and Mian, 2008). Finally, we double cluster standard errors at the borrower and bank level. Table B.2 shows the summary statistics of the variables used in this analysis.

Table 6 shows the estimation results. Column (1) includes borrower-quarter fixed effects but no loan-level controls. Column (2) includes the loan-level controls and Column (3) also includes bank-quarter fixed effects. The estimated coefficient on the interaction term is negative, significant, and remarkably stable across specifications, documenting that the same borrower is assigned a systematically lower probability of default by an undercapitalized bank compared to a well capitalized bank. Based on Column (3), an undercapitalized bank (i.e., p75 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) assigns a 0.1 percentage point lower probability of default to the same distressed REIT (50% drop in market capitalization) compared to a well-capitalized bank (i.e., p25 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4), relative to a mean assigned probability of default for distressed borrowers of 0.8%. Consistent with the results presented in the previous section, Table B.3 shows that these results disappear in 2020–21.

4 Crowding-out of new credit origination

In this section, we show that banks' extend-and-pretend behavior leads to significant misallocation in CRE markets by crowding out the origination of new credit. At a conceptual level, banks that saw their capital being eroded by the rapid rise in interest rates have an incentive to extend-and-pretend their existing distressed CRE credit to avoid further depleting their capital. A weak capitalization also forces these banks to forego new lending opportunities as extend-and-pretend mechanically leads to a reduced balance sheet capacity to fund them.[14]

In Section 4.1 and in Section 4.2, we show that banks that engage in extend-and-pretend behavior reduce markedly their origination in the CRE mortgage market and in the C&I lending market. In Section 4.3, we calculate that extend-and-pretend leads to a contraction of 4.8–5.3% in aggregate CRE mortgage origination without having a sizable effect on C&I credit origination.

[14]The crowding-out of new projects is consistent with the "congestion externalities" documented in the context of "zombie lending" (Caballero et al., 2008).

4.1 Crowding-out new CRE credit

We now show that banks' extend-and-pretend behavior shifts the composition of total outstanding CRE credit away from new origination and toward extensions of distressed loans.

To this end, we collapse our data at the zip code-bank-quarter level and define the following variables:

$$\text{Distressed Extensions}_{bt} = \frac{\sum_l \text{Committed Bal}_{blt} \times \mathbb{I}(\text{Extension})_{blt} \times \mathbb{I}(\text{Distress})_{lt}}{\text{Total CRE}_{bt}} \tag{3a}$$

$$\text{New Origination}_{bzt} = \frac{\sum_l \text{Committed Bal}_{blzt} \times \mathbb{I}(\text{New Orig})_{blzt}}{\sum_l \text{Committed Bal}_{blzt}} \tag{3b}$$

The first variable is the dollar value of all CRE loans extended to distressed borrowers (based on the drop in property NOI as in the previous section) by bank b in quarter t, expressed as a share of total outstanding CRE lending by bank b in quarter t. This variable measures the extent of banks' *nationwide* distressed maturity extension. The second variable is the dollar value of new credit granted by bank b in zip code z in quarter t, expressed as a share of all outstanding CRE loans granted by bank b in zip code z as of quarter t. This variable captures the composition of bank lending, in a given zip code, between new origination and preexisting exposure.

Using these variables, we estimate the following specification:

$$\begin{aligned}\text{New Origination}_{bzt} = \alpha + \beta \text{Distressed Extensions}_{bt} \times \text{Undercapitalized}_{bt} \\ + \boldsymbol{\omega}' \boldsymbol{Z}_{bt} + \mu_b + \eta_{zt} + \epsilon_{bzt}\end{aligned} \tag{4}$$

where b is a bank, z is a zip code, and t is a quarter. As discussed, the outcome variable is the share of new origination by bank b in zip code z in quarter t. The independent variable of interest is the interaction between the share of all CRE loans extended to distressed borrowers and bank undercapitalization. We double cluster standard errors at the zip code and bank level. Table B.2 shows the summary statistics.

Our specification addresses two identification concerns. First, by including zip code-quarter fixed effects (η_{zt}), we effectively compare two or more banks with different levels of nationwide maturity extensions lending to the same zip code, thus controlling for the possibility that

	New Origination$_{bzt}$			
	(1)	(2)	(3)	(4)
Distressed Extensions$_{bt}$ × Undercapitalized$_{bt}$	−0.602**	−0.606**	−0.582**	−0.432**
	(0.248)	(0.242)	(0.217)	(0.161)
Distressed Extensions$_{bt}$	1.028*	1.075**	1.252**	1.126**
	(0.511)	(0.492)	(0.496)	(0.400)
Undercapitalized$_{bt}$	0.006***	0.006***	0.062***	0.039*
	(0.002)	(0.002)	(0.020)	(0.019)
Bank-Level Controls		✓	✓	✓
Bank-Level Controls (interacted with Undercapitalized$_{bt}$)			✓	✓
Fixed Effects				
Zip Code-Time	✓	✓	✓	✓
Bank	✓	✓	✓	
Zip Code-Bank				✓
Observations	140,134	140,134	140,134	135,486
R^2	0.313	0.313	0.313	0.469

Table 7: Crowding-out new CRE credit. This table shows estimation results from Specification (4). The dependent variable, defined in (3b), is the dollar value of new CRE credit granted by bank b in zip code z in quarter t, expressed as a share of total outstanding CRE credit granted by bank b in zip code z as of quarter t. Distressed Extensions$_{bt}$, defined in (3a), is the dollar value of all CRE credit granted to distressed borrowers by bank b in quarter t, expressed as a share of total outstanding CRE credit granted by bank b as of quarter t. We measure distress with a dummy equal to one if the current net operating income (NOI) generated by the property is less than the NOI at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Uninteracted bank-level controls are included in Columns (2)-(4). Bank-level controls interacted with Undercapitalized$_{bt}$ are included in Columns (3)-(4). The bank-level controls are bank size (measured as log of total assets) and the sum of CRE and C&I lending (as a share of total assets). The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. Standard errors double clustered at the bank and zip code level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR 9-C, FR Y-14 Schedule H.2.

banks that engage in maturity extensions to distressed borrowers systematically lend to zip codes with lower demand for credit. Second, the inclusion of bank fixed effects (μ_b) and bank time-varying characteristics (vector $\boldsymbol{Z}_{bt}$) controls for the possibility that the bank propensity to engage in maturity extensions might be driven by some bank characteristics correlated with our outcome variable. In addition to the uninteracted Undercapitalized$_{bt}$ and Distressed Extensions$_{bt}$ variables, the bank-level control variables are bank size (log assets) and the sum of CRE and C&I lending (as a share of total assets), and the interaction of these two variables with the bank-level undercapitalization variable.

The estimation results in Table 7 suggest that banks' extend-and-pretend behavior (maturity extensions granted by undercapitalized banks to distressed loans) leads to crowding-out of new CRE origination. Specifically, the interaction term in Columns (1)–(3) is negative, statistically significant, and stable as we add time-varying bank-level controls and the same controls interacted with the $\text{Undercapitalized}_{bt}$ variable. In Column (4), we add the stringent zip code-bank fixed effects to exploit the variation within the same zip code-bank pair over time, thereby controlling for time-invariant zip code-bank characteristics. While somewhat smaller in magnitude, the coefficient of interest is still statistically significant.

These magnitudes are economically significant. Based on Columns (3) and (4), an undercapitalized bank (i.e., p75 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) that provides maturity extensions to a large portion of its distressed CRE portfolio ($\text{Distressed Extensions}_{bt}$ equal to 1%) has a share of new CRE credit 0.6–0.8 percentage points smaller than a well-capitalized bank (i.e., p25 of the cross-sectional distribution of $\text{Undercapitalized}_{bt}$ as of 2022:Q4) that engages in a similar distressed maturity extension. This effect is sizable given a 6.3% mean share of new CRE credit. Table B.4 shows, in a placebo test, that the extent of banks' nationwide *non-distressed* maturity extensions is not associated with a reduction in the origination of new CRE credit.

4.2 Crowding-out new C&I credit

We now show that banks extending-and-pretending their impaired CRE mortgages reduce their origination of C&I loans. To this end, we adapt our empirical strategy to the C&I context and define the following outcome variable at the industry-state-bank-quarter level:

$$\text{New Origination}_{bist} = \frac{\sum_l \text{Committed Bal}_{blist} \times \mathbb{I}(\text{New Orig})_{blist}}{\sum_l \text{Committed Bal}_{blist}} \quad (5)$$

where b is a bank, i is an industry (2-digit NAICS), s is a state, and t is a quarter. As in the analysis of the CRE market, this variable captures the composition of bank lending between new origination and preexisting exposure within an industry and state. Specifically, the variable is defined as the dollar value of new credit granted by bank b to industry i in state s in quarter t, expressed as a share of all outstanding C&I credit granted by bank b to industry i in state s as of quarter t.

	New Origination$_{bist}$			
	(1)	(2)	(3)	(4)
Distressed Extensions$_{bt}$ × Undercapitalized$_{bt}$	−0.628**	−0.709**	−0.637**	−0.599**
	(0.252)	(0.253)	(0.233)	(0.232)
Distressed Extensions$_{bt}$	0.807	0.857	1.085	1.107
	(0.639)	(0.669)	(0.841)	(0.746)
Undercapitalized$_{bt}$	0.005**	0.005**	0.055***	0.051***
	(0.002)	(0.002)	(0.007)	(0.007)
Bank-Level Controls		✓	✓	✓
Bank-Level Controls (interacted with Undercapitalized$_{bt}$)			✓	✓
Fixed Effects				
Industry-State-Quarter	✓	✓	✓	✓
Bank	✓	✓	✓	
Industry-Bank				✓
State-Bank				✓
Observations	79,104	79,104	79,104	79,093
R^2	0.199	0.199	0.199	0.215

Table 8: Crowding-out new C&I credit. This table shows estimation results from Specification (6). The dependent variable, defined in (5), is the dollar value of new C&I credit granted by bank b to industry i in state s in quarter t, expressed as a share of total outstanding C&I credit granted by bank b to industry i in state s as of quarter t. Distressed Extensions$_{bt}$, defined in (3a), is the dollar value of all CRE credit extended to distressed borrowers by bank b in quarter t, expressed as a share of total outstanding CRE credit granted by bank b as of quarter t. We measure distress with a dummy equal to one if the current net operating income (NOI) generated by the property is less than the NOI at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Uninteracted bank-level controls are included in Columns (2)-(4). Bank-level controls interacted with Undercapitalized$_{bt}$ are included in Columns (3)-(4). The bank-level controls are bank size (measured as log of total assets) and the sum of CRE and C&I lending (as a share of total assets). The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. Standard errors triple clustered at the bank, industry, and state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.1.

We adapt our specification to the C&I setting as follows:

$$\begin{aligned}\text{New Origination}_{bist} = \alpha + \beta_1 \text{Distressed Extensions}_{bt} \times \text{Undercapitalized}_{bt} \\ + \boldsymbol{\omega' Z}_{bt} + \mu_b + \eta_{ist} + \epsilon_{bist} \qquad (6)\end{aligned}$$

where we use industry-state-quarter fixed effects (η_{ist}) to capture the time-varying demand for credit in an industry-state pair. The outcome variable is the share of new origination granted by bank b to industry i in state s in quarter t. The variable of interest is the interaction between the share of all CRE loans granted to distressed borrowers (Distressed Extensions$_{bt}$) interacted with bank undercapitalization (Undercapitalized$_{bt}$). As in the previous section, we include bank fixed effects (μ_b), bank time-varying characteristics ($\boldsymbol{Z}_{bt}$) (which include the Undercapitalized$_{bt}$ and the Distressed Extensions$_{bt}$ variables), and the interaction of these bank time-varying characteristics with the bank undercapitalization variable. We triple cluster standard errors at the industry, state, and bank level. Summary statistics are available, again, in Table B.2.

The estimation results in Table 8 document a sizable negative effect of banks' extend-and-pretend behavior on C&I origination. Similar to the case of CRE, the coefficient of interest is negative, statistically significant, and stable as we add controls and stringent fixed effects, including industry-bank and state-bank fixed effects in Column (4). Based on Columns (3) and (4), an undercapitalized bank (i.e., p75 of the cross-sectional distribution of Undercapitalized$_{bt}$ as of 2022:Q4) that provides distressed maturity extensions to a large portion of its CRE portfolio (Distressed Extension$_{bt}$ equal to 1%) has a share of new C&I credit around a 0.9 percentage point smaller than a well-capitalized bank (i.e., p25 of the cross-sectional distribution of Undercapitalized$_{bt}$ as of 2022:Q4) that engages in a similar distressed maturity extension. As in the case of CRE, this effect is sizable given a 9.5% mean share of new C&I credit. Table B.5 shows, in a placebo test, that the extent of banks' nationwide *non-distressed* maturity extensions is not associated with a reduction in the origination of new C&I credit.

4.3 Aggregate effects of banks' extend-and-pretend

We now use the estimation results in the previous two sections to calculate the aggregate effects of banks' extend-and-pretend behavior on new CRE and new C&I credit.

First, our empirical strategy gets rid of the bank-level unit of observation, collapsing the data (i) at the zip code-quarter level for the CRE analysis and (ii) at the industry-state-quarter level for the C&I analysis. We then estimate the following regressions:

$$\begin{aligned}\text{New Origination}^{CRE}_{zt} &= \beta_1 \widetilde{\text{Distressed Extensions}}_{zt} \times \widetilde{\text{Undercapitalized}}_{zt} \\ &+ \beta_2 \widetilde{\text{Distressed Extensions}}_{zt} + \boldsymbol{\omega}' \boldsymbol{Z}_{zt} + \widehat{\eta_{zt}} + \mu_t + \nu_z + \epsilon_{zt} \qquad (7a)\\ \text{New Origination}^{C\&I}_{sit} &= \beta_1 \widetilde{\text{Distressed Extensions}}_{sit} \times \widetilde{\text{Undercapitalized}}_{sit} \\ &+ \beta_2 \widetilde{\text{Distressed Extensions}}_{sit} + \boldsymbol{\omega}' \boldsymbol{Z}_{sit} + \widehat{\eta_{sit}} + \mu_t + \nu_{si} + \epsilon_{sit} \qquad (7b)\end{aligned}$$

where the outcome variables are the share of new CRE (C&I) origination over preexisting CRE (C&I) exposures within a zip code (within a state-industry). The main independent variables are (i) $\widetilde{\text{Distressed Extensions}}_{zt}$ ($\widetilde{\text{Distressed Extensions}}_{sit}$), namely the extent of banks' *nationwide* distressed maturity extensions in quarter t and zip code z (state-industry si); and (ii) $\widetilde{\text{Undercapitalized}}_{zt}$ ($\widetilde{\text{Undercapitalized}}_{sit}$), namely the extent of banks' undercapitalization in quarter t and zip code z (state-industry si). Similarly, $\boldsymbol{Z}_{zt}$ and $\boldsymbol{Z}_{sit}$ are the indirect exposures of zip codes (or state-industry pairs) to the bank-level controls.[15] The two specifications also include the fixed effects $\widehat{\eta_{zt}}$ and $\widehat{\eta_{sit}}$ estimated in specifications (4) and (6). These fixed effects capture all the time-varying heterogeneity at the zip code and state-industry level, respectively, thus capturing borrowers' credit demand.

Second, we use the estimated coefficients from (7a) and (7b) to predict the share of new CRE (C&I) origination within a zip code (within a state-industry). We perform two predictions: one prediction using the actual values of the $\widetilde{\text{Undercapitalized}}_{zt}$ ($\widetilde{\text{Undercapitalized}}_{sit}$) variable and one prediction setting, in the $\widetilde{\text{Undercapitalized}}_{zt}$ $\times$

[15]The formal definitions of these variables are as follows. New $\text{Origination}^{CRE}_{zt}$ (New $\text{Origination}^{C\&I}_{zt}$) is the dollar value of new credit granted in zip code z in quarter t (industry-state si in quarter t), expressed as a share of all outstanding CRE loans granted in zip code z as of quarter t (industry-state si in quarter t). $\widetilde{\text{Distressed Extensions}}_{zt}$ ($\widetilde{\text{Distressed Extensions}}_{sit}$) is the dollar value of all CRE loans extended to distressed borrowers (based on the drop in property NOI) in zip code z in quarter t (industry-state si in quarter t), expressed as a share of total outstanding CRE lending in zip code z in quarter t (industry-state si in quarter t). $\widetilde{\text{Undercapitalized}}_{zt}$ ($\widetilde{\text{Undercapitalized}}_{sit}$) is the weighted average of bank-time level $Undercapitalization_{bt}$ at the zip code-quarter (industry-state-quarter) level, where the weights are the value of credit granted by bank b in quarter t to zip code z (industry-state si). Finally, this same weighted average applies to the other variables in the vector $\boldsymbol{Z}_{zt}$ ($\boldsymbol{Z}_{sit}$).

$\widetilde{\text{Distressed Extensions}}_{zt}$ ($\widetilde{\text{Undercapitalized}}_{sit} \times \widetilde{\text{Distressed Extensions}}_{sit}$) interaction term, the values of $\widetilde{\text{Undercapitalized}}_{zt}$ ($\widetilde{\text{Undercapitalized}}_{sit}$) equal to zero whenever this variable is strictly greater than zero. This second case allows us to effectively isolate the effect of extend-and-pretend by weakly capitalized banks. We then aggregate these two predictions from the zip code-quarter level (industry-state-quarter level) to the quarter level using a weighted average of zip code-level (state-industry level) new origination shares, where the weights are given by zip code-level (state-industry level) granted CRE (C&I) credit.

Our results suggest that our sample banks' extend-and-pretend behavior led to a 4.8–5.3% reduction in the dollar value of new CRE origination.[16] We do not find a meaningful aggregate effect for C&I origination, consistent with corporate borrowers affected by the credit contraction being able to borrow from banks not engaging in extend-and-pretend. The dichotomy between the CRE and C&I markets suggests that well-capitalized banks might be more willing to lend in the C&I market compared to the CRE market, consistent with the high uncertainty surrounding the future prospects of several CRE segments.

5 Implications for financial stability

The results so far show that weakly capitalized banks have extended-and-pretended their impaired CRE mortgages since 2022:Q1 and that this behavior has crowded out the origination of new CRE and new C&I credit. In this section, we show that this extend-and-pretend behavior has also led to an ever-expanding "maturity wall", namely an increasing volume of CRE loans set to mature in the near term—which, as we later argue, represents a meaningful financial stability risk.

Figure 6 documents, using our loan-level CRE data, the rapid expansion of the maturity wall from 2020 to 2023. Each line shows, for a given year, the balance (dollar values) of CRE mortgages maturing in each year in the future. For example, to produce the 2022:Q4 line, we

[16] The exact estimate of the effect depends on the stringency of the specification used to estimate the fixed effects $\widehat{\eta_{zt}}$ and $\widehat{\eta_{sit}}$ in Specification (4). Specifically, the lower and upper bounds of the aggregate effect are based on Column (4) and Column (3) in Table 7, respectively.

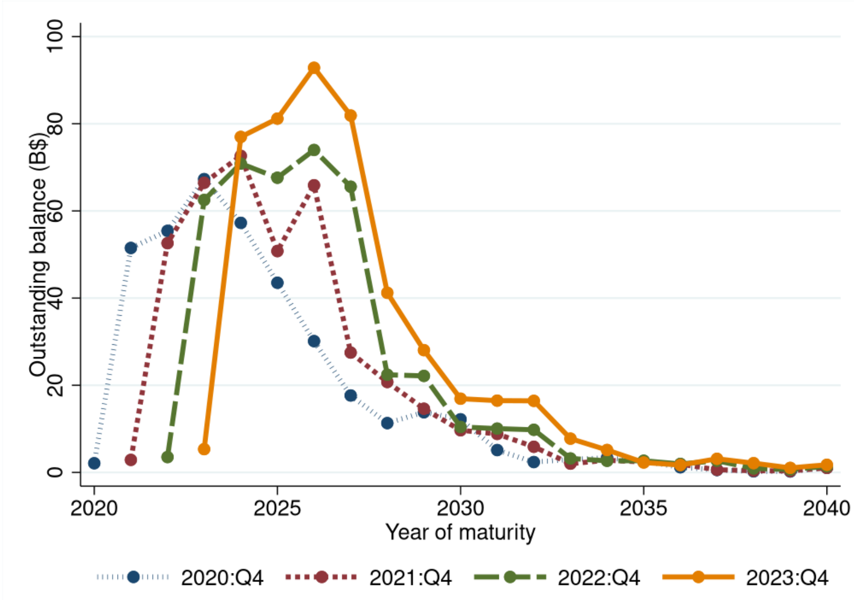

Figure 6: A rapidly expanding maturity wall. This figure shows the maturity wall faced by our sample banks as of 2020:Q4, 2021:Q4, 2022:Q4, and 2023:Q4. Each line shows, as of one of these four dates, the dollar value of CRE mortgages expiring in each year in the future (x-axis). Mortgages maturing after 2040 are cut off for exposition purposes. Source: FR Y-14Q Schedule H.2.

subset the stock of mortgages outstanding as of this date to find the balances expiring in 2023, 2024, 2025, and so on. This line shows that, as of 2022:Q4, there were $63 billion in CRE mortgages maturing in 2023, $71 billion maturing in 2024, $68 maturing in 2025 and so on. The graph clearly shows that banks have increasingly front-loaded the maturity structure of their CRE portfolios. As time goes by, the lines are getting taller and steeper (resembling a "wall") and their distribution is becoming more thin tailed.

The size of the maturity wall is substantial when compared to the stock of bank capital. The left panel of Figure 7 shows the dollar value of maturing CRE mortgages as a share of current period marked-to-market regulatory capital. For example, for the line corresponding to 2023:Q4, all loan balances are divided by aggregate marked-to-market capital as of 2023:Q4. This figure documents that, as of 2020:Q4, loans maturing within three years only represented 16% of capital. By 2023:Q4, this figure rose to 27%. Using a five-year horizon, the maturity wall expanded from 24% to 40% of capital. Figure A.5 shows that this rapid expansion of the maturity wall is driven by undercapitalized banks, consistent with our previous analyses documenting their higher propensity to extend-and-pretend existing impaired CRE mortgages.

The expansion of the maturity wall represents a financial stability risk as a sizable, and

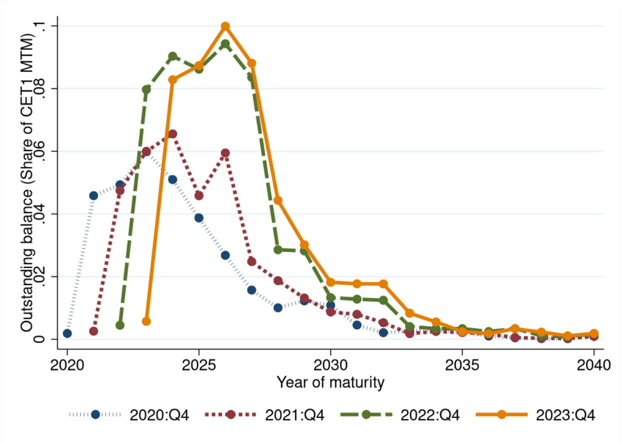

Figure 7: The maturity wall is large compared to both bank capital and the entire CRE market. This figure shows the maturity wall faced by our sample banks as of 2020:Q4, 2021:Q4, 2022:Q4, and 2023:Q4. Each line shows, as of one of these four dates, the dollar value of CRE mortgages expiring in each year in the future normalized by aggregate marked-to-market tier 1 capital in the left panel and by total value of the CRE market in the right panel. Mortgages maturing after 2040 are cut off for exposition purposes. Source: FR Y-14Q Schedule H.2, Financial Accounts Z.1.

increasing, portion of bank regulatory capital is at risk should these CRE loans default. The possibility of a large and sudden capital hit for banks becomes more likely as the maturity wall becomes taller. For example, regulators, credit rating agencies, and providers of funding might scrutinize bank maturity extensions more closely, thus forcing banks to accept defaults rather than granting more maturity extensions. This hit to capital has two risks. First, it might trigger a run by depositors (or by liquidity providers more in general), due to solvency concerns, especially if banks sit on large existing marked-to-market losses in their holdings of securities (Drechsler et al., 2024). Second, it might trigger a wave of foreclosures or sales of CRE loans in secondary markets, imposing fire-sale externalities on other intermediaries by depressing the market valuations of CRE debt and underlying CRE properties (Duarte and Eisenbach, 2021).

A sharp repricing of CRE debt would likely affect other leveraged intermediaries with exposure to CRE, including non-bank financial intermediaries. The possibility of such contagion is supported by the observation that the maturity wall documented above represents a sizable fraction of the *entire* CRE market. In the right panel of Figure 7, we extrapolate the dollar values of CRE loans expiring in the near term from our sample to the entire banking sector.[17] We find that, as of 2023:Q4, 16% of aggregate CRE debt held by the banking sector is near-maturity (within three years), an increase from 13% in 2020:Q4. These magnitudes suggest that selling pressures by banks could impose spillover effects on nonbank intermediaries.

6 Conclusion

The post-pandemic period is characterized by a deterioration of CRE valuations and monetary tightening. In this environment, banks have to manage their CRE loan portfolio while seeing their marked-to-market capital being eroded by losses on securities. We document that, since 2022:Q1, banks have extended the maturity of their distressed CRE mortgages coming due and pretended that such credit provision was not as risky to avoid further depleting their capital. Consistent with this interpretation, we find that this extend-and-pretend behavior is driven by banks with weak marked-to-market capitalization, is absent before 2022:Q1, and is also present in bank lending to REITs that hold large CRE portfolios.

The effects of this behavior open up several research avenues. On the one hand, the resulting crowding-out of new credit provision slows down the efficient reallocation of CRE credit, likely hindering the downsizing of office districts in urban areas, also affecting cities' tax revenues. On the other hand, maturity extensions somewhat mechanically fuel a rising wave of impaired loans in the future. The materialization of this financial fragility depends on whether banks will be able to deal with rising defaults in an orderly fashion or whether widespread defaults will lead to sudden and extensive losses.

[17] Our key assumption is that the dollar value of CRE loans expiring in the near term for banks outside of the supervisory loan-level CRE sample is proportional to their share of the entire CRE bank lending market. For example, as of 2023:Q4, our sample banks have $100 billion in near-maturity loans. Since our banks hold about one fourth of the CRE debt held by the banking sector, we assume that the aggregate banking sector has $400 billion in near-maturity CRE loans. If the banking sector has $x of near-maturity CRE loans in quarter t, we divide x by the total debt outstanding in the CRE market in quarter t to obtain the size of the banking sector maturity wall relative to the CRE market.

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Appendix

This appendix is structured as follows. Appendix A presents additional figures. Appendix B presents additional tables.

A Additional Figures

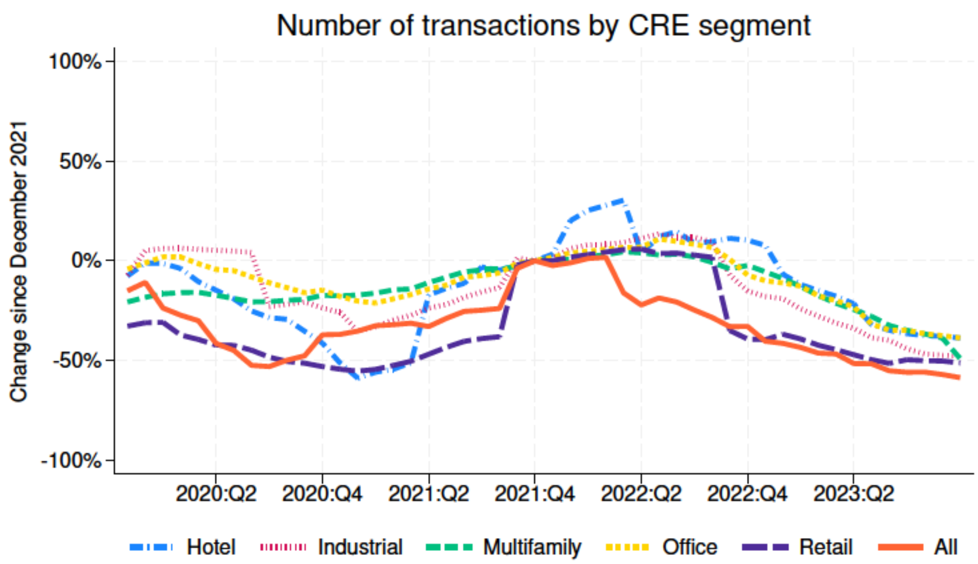

Figure A.1: Decline in CRE transactions in 2022 and 2023. This figure shows the evolution of the total number of CRE transactions for hotel, industrial, multifamily, office, retail, and for the aggregate CRE market since January 2020. We use a 12-month rolling average calculated using the underlying monthly data. The changes are measured since December 2021. Source: Real Capital Analytics.

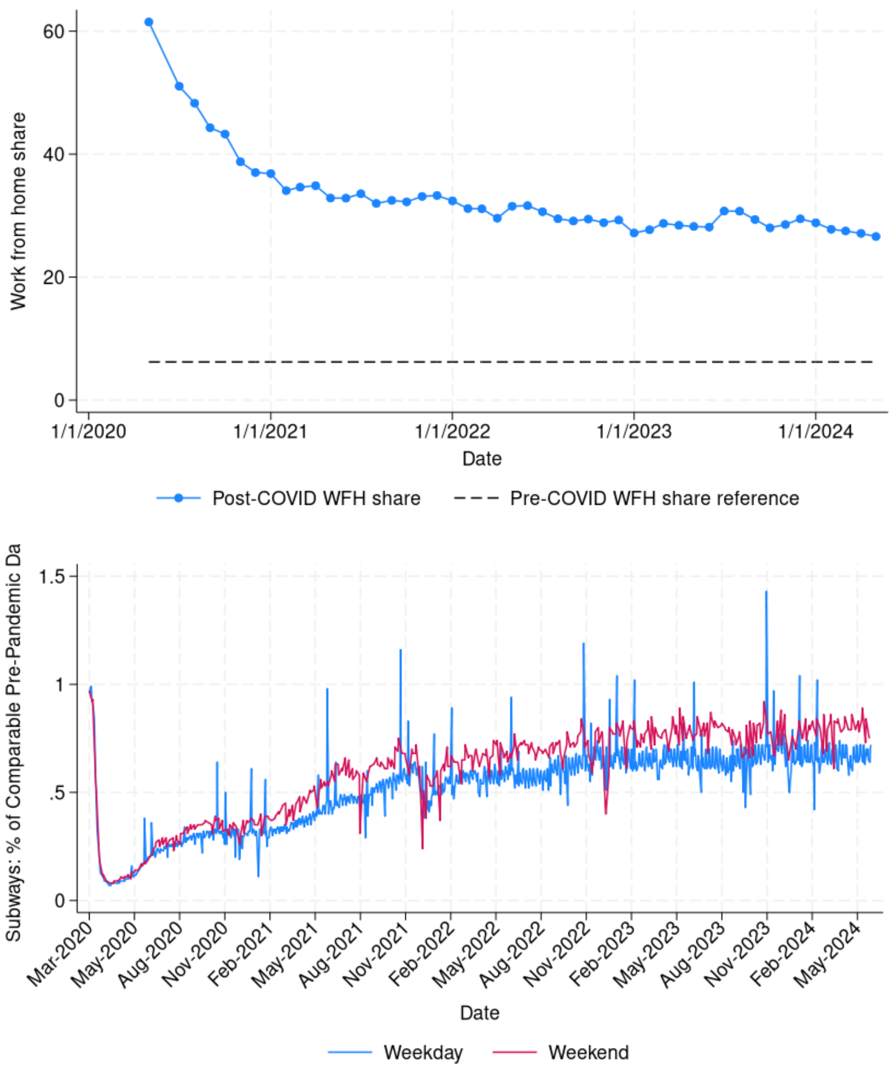

Figure A.2: Work from home and NYC subway ridership since March 2020. This figure shows the sharp changes and subsequent plateau of the share of work provided from home and MTA subway ridership starting in March 2020. The post-COVID work-from-home data is taken from the U.S. Survey of Working Arrangements and Attitudes (SWAA) which is at a monthly frequency. The grey dotted line is the average of the 2018 and 2019 American Time Use Survey work-from-home share as calculated in the SWAA data file. Subway ridership is reported by the New York City Metropolitan Transportation Authority (MTA) at a daily frequency as a percentage of ridership on a comparable pre-COVID day. Sources: U.S. Survey of Working Arrangements and Attitudes (SWAA), New York City Metropolitan Transportation Authority (MTA).

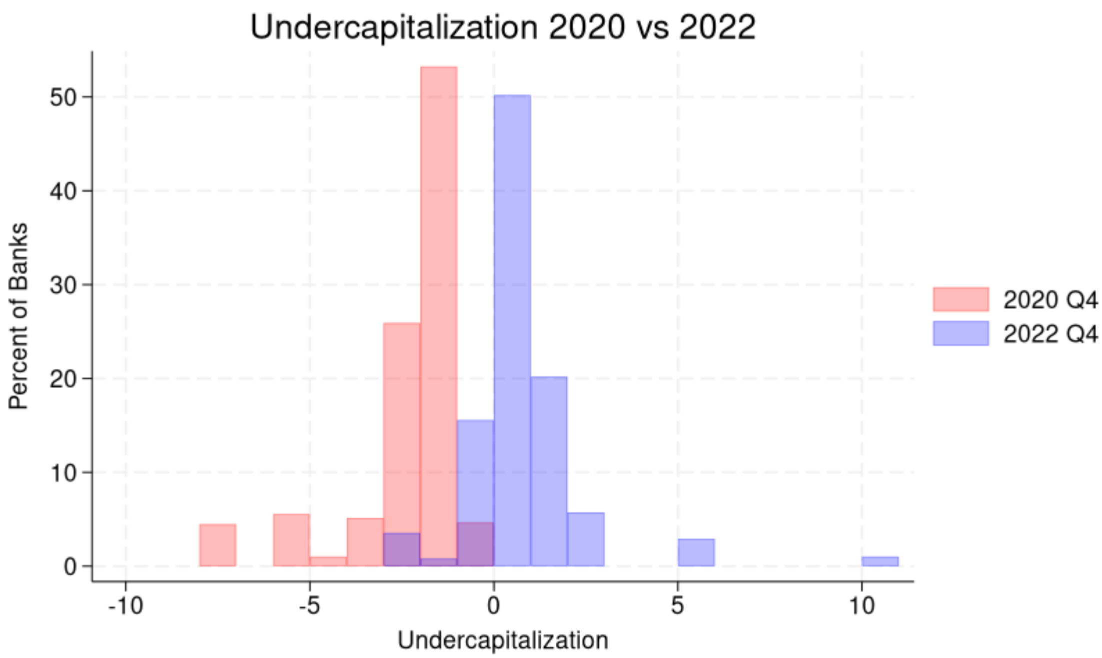

Figure A.3: Weaker banks' capitalization in 2022:Q4 compared with 2020:Q4. This figure shows the cross-sectional distribution of the undercapitalization variable (defined in Section 2.2) as of 2020:Q4 (red bars) and 2022:Q4 (blue bars). Source: FR Y9-C.

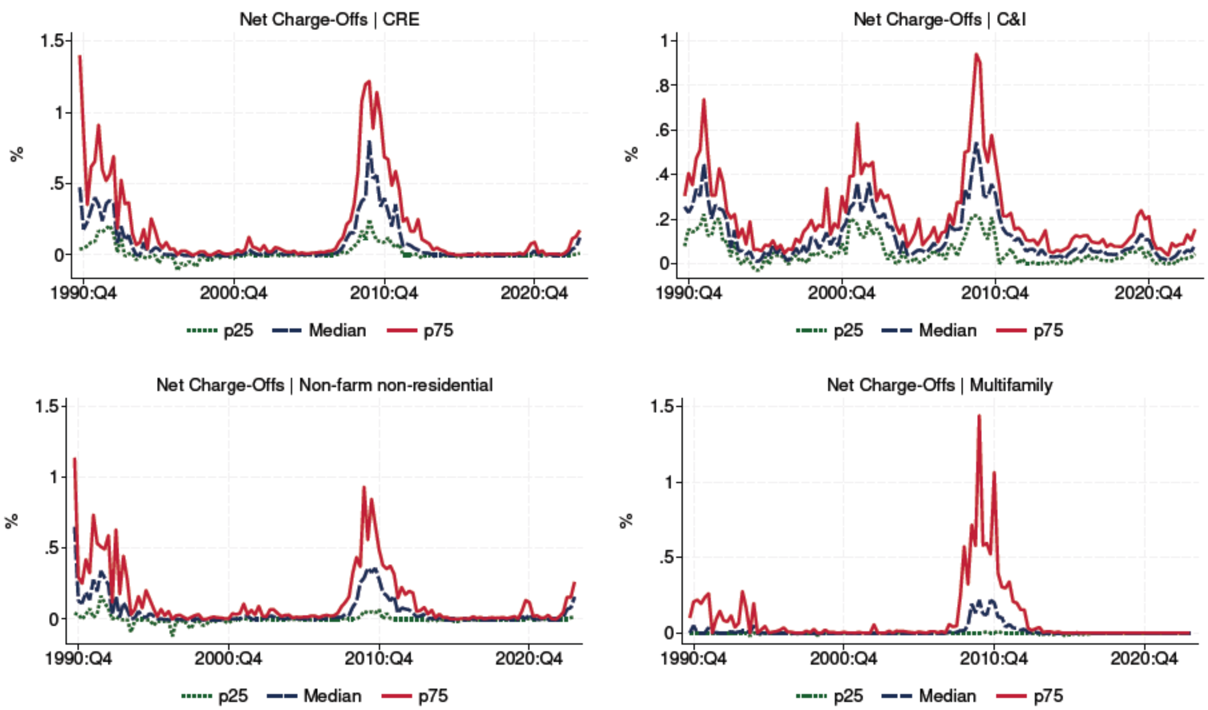

Figure A.4: Net charge-offs across asset classes. This figure shows the time-series evolution of the net charge-off ratio across various asset classes (CRE, C&I, non-farm non-residential CRE, and multifamily CRE). The solid line, long dash line, and short dash line indicate the third quartile, the median, and the first quartile at any given point in time in the cross-section of our sample banks. The data runs at a quarterly frequency from 1990:Q3 to 2023:Q4. Source: FR Y-9C.

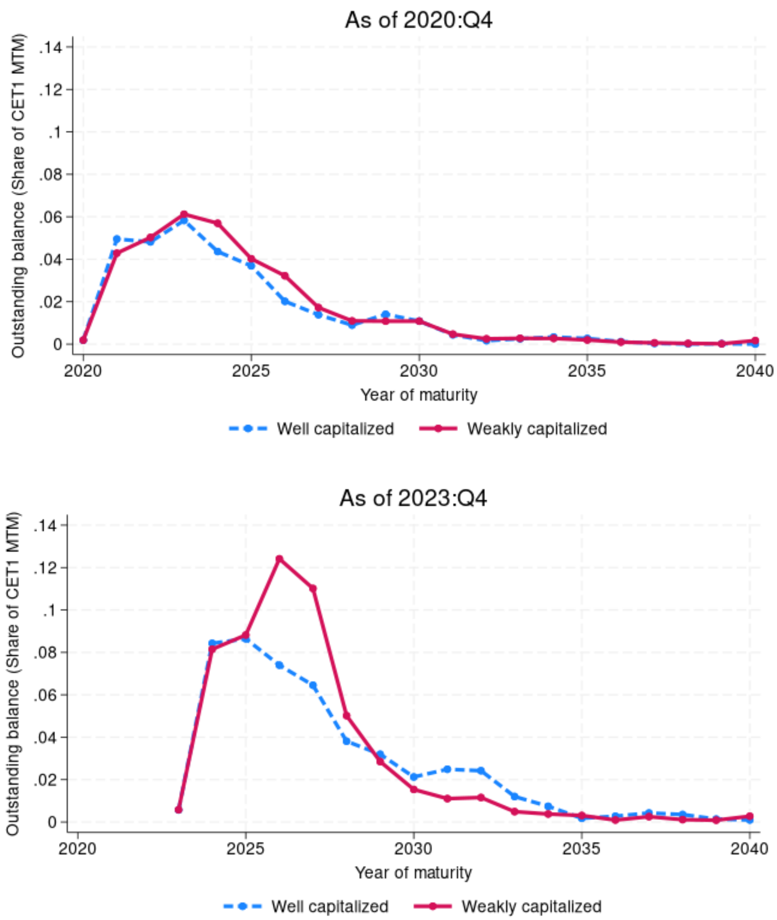

Figure A.5: Maturity wall normalized by bank capital, well-capitalized vs. undercapitalized banks. This figure shows the maturity wall faced by our sample banks as of 2020:Q4 (top panel) and 2023:Q4 (bottom panel). Each line shows, as of one of these two dates, the dollar value of CRE mortgages expiring in each year in the future normalized by aggregate marked-to-market tier 1 capital. Our 22 sample banks are split in two groups, well capitalized and weakly capitalized, based on whether their $\text{Undercapitalization}_{bt}$ variable is above median (weakly capitalized) or below median (well capitalized) in 2022:Q4. Mortgages maturing after 2040 are cut off for exposition purposes. Source: FR Y-14Q Schedule H.2.

B Additional Tables

IDRSSD	Name	Period	AC/NC	CET1 Threshold
1031449	SVB FNCL GRP	2021:Q3 2022:Q4	NC	7
1037003	M&T BK CORP	2020:Q1 2023:Q4	NC	9.2
1039502	JPMORGAN CHASE & CO	2020:Q1 2023:Q4	AC	12
1068025	KEYCORP	2020:Q1 2023:Q4	NC	7
1068191	HUNTINGTON BSHRS	2020:Q1 2023:Q4	NC	7.8
1069778	PNC FNCL SVC GROUP	2020:Q1 2023:Q4	NC	7.4
1070345	FIFTH THIRD BC	2020:Q1 2023:Q4	NC	7
1073757	BANK OF AMER CORP	2020:Q1 2023:Q4	AC	10.4
1074156	BB&T CORP	2020:Q1 2023:Q4	NC	7
1075612	FIRST CITIZENS BSHRS	2023:Q1 2023:Q4	NC	7
1111435	STATE STREET CORP	2020:Q1 2023:Q4	AC	8
1120754	WELLS FARGO & CO	2020:Q1 2023:Q4	AC	9.2
1132449	CITIZENS FNCL GRP	2020:Q1 2023:Q4	NC	7.9
1199611	NORTHERN TR CORP	2020:Q1 2023:Q4	AC	7
1562859	ALLY FNCL	2020:Q1 2023:Q4	NC	7
1951350	CITIGROUP	2020:Q1 2023:Q4	AC	11.5
2132932	NEW YORK CMNTY BC	2023:Q4	NC	7
2162966	MORGAN STANLEY	2020:Q1 2023:Q4	AC	13.3
2277860	CAPITAL ONE FC	2020:Q1 2023:Q4	NC	7.6
2380443	GOLDMAN SACHS GROUP THE	2020:Q1 2023:Q4	AC	13.3
3242838	REGIONS FC	2020:Q1 2023:Q4	NC	7
3587146	BANK OF NY MELLON CORP	2020:Q1 2023:Q4	AC	8.5

Table B.1: Sample banks. This table reports the sample of domestic banks in our CRE loan-level analysis. The table shows the bank identifier (idrssd), the bank name, the period where loans by each bank are populated in the Y-14 Schedule H.2 data, whether the bank is an AOCI Capital (AC) bank or a non-AOCI-Capital (NC) bank, and the CET1 regulatory threshold of each bank. Banks in the first group need to include unrealized gains and losses on AFS securities in their tier 1 capital. Banks in the second group do not need to make such adjustment. See Greenwald et al. (2024) for a detailed discussion of this differential regulatory capital treatment. Source: FR Y9-C, FR Y-14 Schedule H.2 data.

Unit obs.: loan-quarter level | Source: Y-14 C&I | 2020:Q1 2023:Q4							
Panel A: REITs	mean	St.dev	p10	p25	p50	p75	p90
Probability of default	1.31	3.68	0.07	0.12	0.20	0.61	2.78
Distress	−0.10	0.46	−0.62	−0.23	0.00	0.17	0.35
Outstanding amount (M$)	51.49	49.20	9.97	19.29	36.00	70.00	105.00
Interest rate	2.45	2.00	0.00	1.15	1.85	3.20	5.93
Time to maturity (quarter)	11.15	5.41	5.00	7.00	11.00	15.00	18.00

Unit obs.: zip code-bank-quarter level | Source: Y-14 CRE | 2020:Q1 2023:Q4							
Panel B: CRE crowding-out	mean	St.dev	p10	p25	p50	p75	p90
New origination	0.08	0.25	0.00	0.00	0.00	0.00	0.15

Unit obs.: bank-quarter level | Source: Y-14 CRE | 2020:Q1 2023:Q4							
Panel C: CRE crowding-out	mean	St.dev	p10	p25	p50	p75	p90
Distressed extensions	0.01	0.01	0.00	0.00	0.00	0.01	0.02
Non-distressed extensions	0.01	0.02	0.00	0.00	0.01	0.02	0.02

Unit obs.: bank-industry-state-quarter level | Source: Y-14 C&I | 2020:Q1 2023:Q4							
Panel D: C&I crowding-out	mean	St.dev	p10	p25	p50	p75	p90
New origination	0.08	0.20	0.00	0.00	0.00	0.05	0.27

Table B.2: Additional summary statistics. This table presents additional summary statistics. Panel A shows summary statistics at the loan-quarter level for our analysis of banks lending to distressed REITs. Panel B and Panel C show summary statistics for our analysis of crowding-out of CRE origination at the zip code-bank-quarter level and bank-quarter level, respectively. Panel D shows summary statistics at the bank-industry-state-quarter level for our analysis of crowding-out of C&I origination. Source: FR Y9-C, FR Y-14 Schedule H.1, FR Y-14 Schedule H.2.

2020:Q1 2021:Q4 Period	Prob. of Default (1)	(2)	PD_{lbjt} (3)
$\text{Undercapitalized}_{bt} \times \text{Distress}_{jt}$	0.471	0.502	0.567
	(0.387)	(0.410)	(0.434)
$\text{Undercapitalized}_{bt}$	0.221	0.226	
	(0.131)	(0.135)	
Bank-Level Controls		✓	✓
Fixed Effects			
Borrower-Quarter	✓	✓	✓
Bank-Quarter			✓
Observations	5,984	5,577	5,552
R^2	0.556	0.550	0.635

Table B.3: Extending-and-pretending since 2022, placebo evidence from REITs. This table shows estimation results from Specification (2). The dependent variable is the probability of default assigned by bank b to loan l at time t. The sample period is 2020:Q1–2021:Q4. Distress_{jt} is the change in market capitalization of REIT j from 2020:Q1 to quarter t (positive values indicate a drop in market capitalization). The $\text{Undercapitalized}_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. The following control variables are included in the estimation but omitted from this table for brevity: Outstanding Balance_{lt} is the log of the outstanding amount on loan l at time t; Interest Rate_{lt} is the interest rate on the loan at time t; Time to Maturity_{lt} is the time to maturity (in quarters) of loan l at time t. Standard errors double clustered at the borrower and bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: CRSP, Capital IQ, FR Y9-C, FR Y-14 Schedule H.1.

	New Origination$_{bzt}$			
	(1)	(2)	(3)	(4)
Non-Distressed Extensions$_{bt}$ × Undercapitalized$_{bt}$	−0.200	−0.194	−0.204	−0.106
	(0.125)	(0.125)	(0.126)	(0.074)
Non-Distressed Extensions$_{bt}$	−0.0161	−0.021	−0.043	−0.059
	(0.107)	(0.114)	(0.116)	(0.099)
Undercapitalized$_{bt}$	0.005**	0.005**	0.041**	0.022
	(0.002)	(0.002)	(0.018)	(0.018)
Bank-Level Controls		✓	✓	✓
Bank-Level Controls (interacted with Undercapitalized$_{bt}$)			✓	✓
Fixed Effects				
Zip Code-Time	✓	✓	✓	✓
Bank	✓	✓	✓	
Zip Code-Bank				✓
Observations	140,134	140,134	140,134	135,486
R^2	0.313	0.313	0.313	0.469

Table B.4: Crowding-out new CRE credit, placebo test. This table shows estimation results from Specification (4). The dependent variable, defined in (3b), is the dollar value of new CRE credit granted by bank b in zip code z in quarter t, expressed as a share of total outstanding CRE credit granted by bank b in zip code z as of quarter t. Non-Distressed Extensions$_{bt}$ is the dollar value of all CRE credit granted to non-distressed borrowers by bank b in quarter t, expressed as a share of total outstanding CRE credit granted by bank b as of quarter t. We measure non-distress with a dummy equal to one if the current net operating income (NOI) generated by the property is more than the NOI at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Uninteracted bank-level controls are included in Columns (2)-(4). Bank-level controls interacted with Undercapitalized$_{bt}$ are included in Columns (3)-(4). The bank-level controls are bank size (measured as log of total assets) and the sum of CRE and C&I lending (as a share of total assets). The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. Standard errors double clustered at the bank and zip code level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.2.

	New Origination$_{bist}$			
	(1)	(2)	(3)	(4)
Non-Distressed Extensions$_{bt}$ × Undercapitalized$_{bt}$	−0.337	−0.347	−0.389	−0.361
	(0.256)	(0.257)	(0.257)	(0.266)
Non-Distressed Extensions$_{bt}$	−0.117	−0.114	−0.135	−0.128
	(0.076)	(0.084)	(0.134)	(0.107)
Undercapitalized$_{bt}$	0.005**	0.005**	0.051***	0.048***
	(0.002)	(0.002)	(0.007)	(0.008)
Bank-Level Controls		✓	✓	✓
Bank-Level Controls (interacted with Undercapitalized$_{bt}$)			✓	✓
Fixed Effects				
Industry-State-Quarter	✓	✓	✓	✓
Bank	✓	✓	✓	
Industry-Bank				✓
State-Bank				✓
Observations	79,104	79,104	79,104	79,093
R^2	0.199	0.199	0.199	0.215

Table B.5: Crowding-out new C&I credit, placebo test. This table shows estimation results from Specification (6). The dependent variable, defined in (5), is the dollar value of new C&I credit granted by bank b to industry i in state s in quarter t, expressed as a share of total outstanding C&I credit granted by bank b to industry i in state s as of quarter t. Non-Distressed Extensions$_{bt}$ is the dollar value of all CRE credit extended to non-distressed borrowers by bank b in quarter t, expressed as a share of total outstanding CRE credit granted by bank b as of quarter t. We measure non-distress with a dummy equal to one if the current net operating income (NOI) generated by the property is more than the NOI at origination. The Undercapitalized$_{bt}$ variable, defined in Section 2.2, is the time-varying difference between bank-level regulatory capital (once marked-to-market gains and losses on securities held are taken into account) and the bank-specific regulatory threshold. Uninteracted bank-level controls are included in Columns (2)-(4). Bank-level controls interacted with Undercapitalized$_{bt}$ are included in Columns (3)-(4). The bank-level controls are bank size (measured as log of total assets) and the sum of CRE and C&I lending (as a share of total assets). The sample period runs at a quarterly frequency from 2022:Q1 to 2023:Q4. Standard errors triple clustered at the bank, industry, and state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: FR Y9-C, FR Y-14 Schedule H.1.