Does Mortgage Rate Lock-in Dampen Commercial Real Estate Busts?*

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Abstract

We show that mortgage lock-in effects play a significant role in the commercial real estate market. We develop a bargaining model in which owners with low interest rates have a high reservation value and thus sell at higher prices. In the general case with many buyers and sellers, the model has the additional implication that lock-in effects exist for non-locked in properties and are stronger if the market has more rate locked properties. Consistent with the model's predictions, we find a 17% reduction in sale probabilities and a 4% increase in prices for locked-in commercial properties when market interest rates are 100bp above the fixed rate on the mortgage. Additionally, exploiting cross-market exposure to lock-in, we find evidence of a market-wide price premium for non-locked-in properties in more lock-in-exposed markets. These effects are not driven by financially distressed properties, differences in liquidity across markets, or differences in owner types.

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1. INTRODUCTION

In this paper we examine whether fixed rate mortgage lock-in can dampen commercial real estate (CRE) busts. Our research question is motivated by two simple yet consequential observations. First, CRE prices have fallen significantly during the recent bust. Specifically, the Green Street CPPI price index shows a roughly 20% decline between June 2022 and December 2024, compared to a roughly 30% decline between August 2007 and March 2010. The work of Gupta et al. (2025) suggests even larger potential declines in certain markets.

Second, the rapid rise in interest rates has generated a lock-in effect that is having wide-ranging impacts on *residential* housing markets. In particular, recent work has shown that lock-in significantly reduces supply and increases prices due to borrowers being hesitant to give up very low interest rates.

We hypothesize that CRE mortgage lock-in has prevented values from falling as much as they otherwise would have, effectively dampening the decline. We develop this hypothesis in the context of a bargaining model in which some property owners have a fixed mortgage rate lower than the current market rate (locked-in owners), whereas others have a mortgage rate that is higher than the market rate. The model predicts that locked-in owners have a higher reservation value due to the fact that they have an interest rate advantage. This translates into a lower sale probability and higher average sale price for their properties. Additionally, the model predicts that the lock-in effect translates into higher prices for *all* properties because it reduces supply, and that these effects should be stronger when more properties are rate locked.

We take the model predictions to the data using properties financed with securitized mortgages (commercial mortgage backed securities (CMBS) loans). Studying securitized loans is advantageous for our question because, in the time period we study, most are fixed rate and approximately 10 years to maturity at issue. This is important because the lock-in effect should be the most salient for longer-term fixed rate debt.[1]

[1] In contrast, most bank portfolio CRE loans are floating rate and shorter term (see, e.g., Glancy, Kurtzman, and Loewenstein 2025 or Glancy, Krainer, Kurtzman, and Nichols 2021), which would make bank loans a less ideal setting in which to study our questions.

Our key empirical variable of interest, *interest rate advantage*, is based on the difference between the origination interest rate on loan *i* and the current average rate on loans of the same property type as *i* (the "market rate"). Because the rate lock-in effect should only be salient when the current market rate *exceeds* the rate on loan *i*, we set *interest rate advantage* equal to the difference between the market rate and the rate on loan *i* when the rate on loan *i* is less than or equal to the market rate, whereas we set it equal to 0 when the rate on loan *i* is above the market rate. Thus, this variable captures the fundamental asymmetry in how fixed-rate borrowers should respond to changes in mortgage rates: when rates rise, borrowers become locked into their low rate, and the degree of lock-in is increasing in the gap between their rate and the current market rate. However, when rates fall, borrowers are not subject to lock-in because they have no interest rate advantage relative to the current market.

In our empirical analysis, we estimate the likelihood of a property sale as a function of *interest rate advantage* and other observables. Consistent with the model, we find that, for the average locked-in property, a 1 percentage point larger interest rate advantage is associated with a roughly 0.054*120=6.5 p.p. lower probability of transacting over a ten-year period (which is the average term of a securitized mortgage in our sample). Because the unconditional probability of sale is .0032*120=38.4 p.p over a ten-year period, this represents a decline of about 17% of the unconditional mean. Additionally, we find a price impact commensurate with a reduction in sale likelihood. Specifically, a 1 percentage point larger interest rate advantage is associated with a roughly 4% increase in sales price for locked-in properties (that is, properties with an interest rate below the current market rate). To put this into perspective, consider the fact that between December 2023 and December 2024, the average monthly gap between origination and current interest rates is roughly -2 percentage points. This implies over 8% higher prices for locked-in properties, on average, during this period of time.

To address concerns about omitted variables and alternative explanations, we include a wide range of controls and fixed effects, including property-type-by-month, geography-by-month, and property owner type fixed effects.[2] We also directly address the possibility that our results are driven by owners of financially

[2] Our empirical strategy isolates variation in mortgage lock-in arising from differences in the vintage of fixed-rate mortgages across properties. Identification comes from comparisons of properties that face the same contemporaneous market conditions and sector-specific trends, but differ in the interest rate on their existing loan due to origination at different points in the interest-

distressed properties that delay sale in hopes of obtaining a higher price. Specifically, we show that our main results are not driven by properties secured by high loan-to-value (LTV) or low debt service coverage ratio (DSCR) loans, or loans secured by distressed properties.

After establishing the impact of lock-in on properties with an interest rate advantage, we then study the effect of lock-in on CRE prices in aggregate. An important implication of the model, when generalized to multiple buyers and sellers, is that observed transaction prices need not reflect only the financing position of the transacting property. When a large share of owners are locked into low fixed rates and rates rise, aggregate supply is reduced, raising equilibrium prices even for properties that do not benefit from a rate advantage. In the final section of the paper, we quantify the extent of market-level exposure to rate lock-in during 2022–2024 and show that a substantial fraction of transactions involved non-locked-in properties operating in markets where supply was nonetheless constrained by locked-in owners. As a result, prices for non-locked-in properties embed an indirect lock-in premium through market-wide supply effects, implying that mortgage rate lock-in can dampen aggregate CRE price declines through both direct property-level effects and broader market-wide supply channels.

Our paper is the first to study and document the impact of fixed-rate mortgage lock-in in commercial real estate. By showing the price impact of lock-in, we contribute to recent work that studies the long-run impacts of the remote work shift on CRE values (see, e.g., Gupta, Mittal, and Van Nieuwerburgh (2025)) by documenting that values would have likely declined further absent the lock-in effect. Our results also suggest that assumability, which is a standard feature of CMBS loans, may not mitigate lock-in effects and increase mobility for locked-in borrowers.[3]

rate cycle. We absorb local demand and financing conditions using market-by-time fixed effects, and national sectoral dynamics using property-type-by-time fixed effects. Within these cells, we further condition on a rich set of observable property and loan characteristics—including size, age, leverage, debt service coverage, amortization structure, and loan balance—that account for systematic differences in baseline sale propensities and pricing behavior, as well as owner type. After conditioning on these fixed effects and controls, remaining variation reflects differences in mortgage-rate vintages across otherwise similar properties within the same market, property type, and time period. This variation determines the extent to which a property's existing fixed-rate loan is below prevailing market rates and thus captures the intensity of mortgage lock-in, rather than differences in asset quality, local demand, or sectoral cycles.

[3] Berndt, Zheng, and Zhu (2025) show that mortgage assumability can dampen lock-in effects in residential markets. Unlike conventional residential mortgage markets, where Berndt, Zheng, and Zhu (2025) show that only about 20% of loans are assumable (due to the fact that assumable mortgages are mainly issued by the FHA and VA, which make up a minority of the U.S. residential housing market), assumability is an extremely common feature of CMBS loans. However, as we show in Figure 1, assumptions appear rare enough in practice that they do not substantially mitigate aggregate lock-in effects in the CMBS

The remainder of the paper is structured as follows. In Section 2 we review related literature and describe the key institutional details of our setting. Section 3 presents the model, Section 4 describes our data and empirical methodology. Section 5 presents the main empirical results. Section 6 evaluates spillovers to non-locked-in properties. Section 7 concludes.

2. RELATED LITERATURE AND INSTITUTIONAL DETAIL

2.1. Related Literature

Our paper is related to a growing literature that studies the impact of mortgage lock-in on supply and prices in residential markets. Fonseca and Liu (2024) and Fonseca, Liu, and Mabille (2025) show that lock-in reduces time on market and increases prices. Similarly, Aladangady, Krimmel, and Scharlemann (2024) show that lock-in reduces listings and results in greater house price growth, Batzer, Coste, Doerner, and Seiler (2024) show that lock-in reduces supply and increases price, and Katz and Minton (2024) show that lock-in reduces sales and discourages moves from owning to renting. Liebersohn and Rothstein (2025) focus on the mobility effects of lock-in. De la Roca, Giacolette, and Liu (2025) document that the supply reduction and price increase associated with lock-in spills over to the rental market, resulting in higher asking rents in supply-constrained markets. Berndt, Zheng, and Zhu (2025) show that mortgage assumability can dampen lock-in effects in residential markets.

Another set of recent papers studies residential lock-in effects using structural models. These include Abel (2024), who focuses on the dynamics of home sales, Fonseca, Liu, and Mabille (2025), who focus on mobility and prices, and Gerardi, Qian, and Zhang (2025), who focus on welfare effects of lock-in for younger households and households in lower-income areas. Additionally, Amronin and Eberly (2023) use a structural model to illustrate how lock-in can subvert monetary policy transmission.

market.

2.2. *Institutional Detail*

The U.S. CRE market is dominated by a few large lender types—including banks, CMBS, and insurance companies—that significantly vary in the loan terms they offer. Glancy, Krainer, Kurtzman, and Nichols (2021) provide a comprehensive analysis of the differences in terms of average interest rate, LTV, size, property type, and term. In this paper we focus on CMBS loans. Like most residential mortgages, most CMBS loans are fixed rate, which leads to the potential for the lock-in effect that is the focus of this paper. Despite this and a few other similarities, the standard CMBS loan contains many features that are distinct from the residential mortgages that are the focus of the existing literature. First, most CMBS loans are less than or equal to ten years to maturity.[4] Additionally, they are often either non- or partially-amortizing, which necessitates either a property sale or refinancing at the end of the holding period in order to pay the balloon balance. CMBS loans are also often assumable, which allows a new owner to assume the existing mortgage on the property when it is sold.

Unlike residential mortgages which, post-GFC, are generally prepayable without penalty, all CMBS loans feature prepayment lock-out periods that are followed by defeasance or yield maintenance provisions that penalize prepayment.[5] Thus, CMBS loans may not prepay as quickly as residential mortgages after rates drop. Despite this, CMBS borrowers still face strong refinance incentives when rates drop significantly.

An additional feature of CMBS loans is that they are typically assumable. In contrast, most conventional residential mortgages are not assumable. Because assumability allows the purchaser to assume the existing mortgage on the property at the time of sale, this feature can be particularly advantageous after rates have risen.

Assumability may dampen fixed-rate lock-in because sellers can purchase a new property by assum-

[4]Recent evidence from An, Cordell, and Smith (2023) suggest that, post-GFC, the CMBS market is shifting away from 10-year, fixed rate loans and into shorter-term floating rate loans. We restrict our sample to fixed rate CMBS only, and as shown in Table 1, the loans in our sample are primarily 10-year loans.

[5]Defeasance is the most common type of prepayment clause used in CMBS. With defeasance, if a borrower prepays, they are required to supply a portfolio of risk-free securities (typically U.S. Treasuries) to the investor that can replicate the payments of the loan through its maturity date.

ing existing debt at a lower rate. However, assumption is not costless and requires the approval of the lender.

To assess the likelihood of CMBS loan assumptions, Figure 1 plots fixed-rate CMBS loan assumptions over our sample period using data from Trepp.Specifically, it plots the fraction (in percentage points) of total outstanding loan balance that is assumed in a given month. The figure indicates that assumptions are extremely rare on a loan balance-weighted basis. Less than 0.5% of outstanding loans are assumed in any given month in the sample.[6]

3. THEORETICAL FRAMEWORK

In this section, we model the effect of mortgage lock-in on the sales and prices of commercial real estate properties. We start our analysis with a one-period model of bilateral bargaining between one buyer and one seller with a mortgage. We then generalize our setting to one with multiple buyers and sellers and an endogenous buyer to seller ratio.

3.1. Bilateral Bargaining

There are two agents: a seller and a buyer. The seller owns a property that is used as collateral for a fixed-rate mortgage with M dollars of principal balance and an interest rate of r^{orig}. The timing works as follows: the mortgage is originated prior to $t = 0$, the seller can offer her property for sale (or choose not to sell) at $t = 0$, and at $t = 1$ the mortgage balance of M matures. If the property is not sold at $t = 0$, then at $t = 1$ the seller earns value S from owning the property and pays $(1 + r^{\text{orig}})M$ to the lender. This implies that her total payoff is $S - (1 + r^{\text{orig}})M$ at $t = 1$.

Our main focus is on mortgage lock-in effects, and to simplify our analysis we assume that all agents are risk-neutral and mortgages are risk-free, i.e., the mortgage is always paid off in full by the current owner.

[6] Residential loan assumptions during the recent period of interest rate hikes also appear relatively infrequent. For example, in their sample of transactions from October 2023 to March 2024, Berndt et al. (2025) document that less than 4% of sales are assumable sales. Industry commentary such as Mendoza (2024) also suggests that assumptions of FHA and VA loans are relatively low in recent years. The infrequency of assumptions in residential real estate is likely due to different reasons compared to CRE, though. For example, residential sellers may not be aware of the potential price implications of holding an assumable mortgage.

At $t = 0$, the current market interest rate on mortgages is r_0. We assume it is possible for $r^{\text{orig}} \neq r_0$ because the seller's mortgage was originated prior to $t = 0$.

If the property is sold at $t = 0$, then it sells for P dollars and the seller repays the mortgage and reinvests the net proceeds $(P - M)$ at the current market rate r_0, which results in a payoff of $(1 + r_0)(P - M)$ at $t = 1$. The lowest price the seller is willing to accept is

$$P^S = \frac{S - (r^{\text{orig}} - r_0)M}{1 + r_0}, \tag{1}$$

which is the seller's reservation value. The seller is indifferent between selling and keeping the property when $P = P^S$, and the seller strictly prefers to sell the property when $P > P^S$.

To simplify notation, based on Fonseca and Liu (2024) we define

$$\Delta \equiv r^{\text{orig}} - r_0$$

to denote the difference between the market interest rate at mortgage origination and the interest rate at the time of property sale. Then, equation (1) becomes

$$P^S = \frac{S - \Delta M}{1 + r_0}. \tag{2}$$

We note that the lower the value of Δ, the higher the seller's reservation value. Intuitively, when Δ is low (negative), the seller benefits from an interest rate advantage due to the low interest rate on the existing mortgage, which translates into the higher reservation value.

At time $t = 0$, the seller is matched with a buyer. If the transaction takes place, the buyer expects to extract value u from the property at time $t = 1$. If the transaction does not take place, then the buyer earns return r_0 on their capital. Thus, the highest price the buyer is willing to pay for the property is given by

$$P^B = \frac{u}{1 + r_0}, \tag{3}$$

which represents the buyer's reservation value.

We assume that negotiations between the seller and buyer lead to the Nash bargaining solution. If $P^B < P^S$, then the property is not sold. If $P^B \geq P^S$, the seller and buyer agree on the sale price $P^* = \left(P^B + P^S\right)/2$, or

$$P^* = \frac{u + S - \Delta M}{2(1 + r_0)}. \tag{4}$$

3.1.1. Assumptions on the Buyer's Utility Value

We assume that the buyer's value u is randomly distributed with

$$u = B - x,$$

where the constant B represents the upper bound on the buyer's valuation, with $B > S$. Random variable $x \geq 0$ is exponentially distributed with parameter λ, i.e., its probability density function $f(x, \lambda)$ and cumulative distribution function $F(x, \lambda)$ are given by

$$f(x,\lambda) = \lambda e^{-\lambda x} \quad x \geq 0, \tag{5}$$

$$F(x,\lambda) = 1 - e^{-\lambda x} \quad x \geq 0. \tag{6}$$

The exponential distribution allows an analytically tractable transition to the setup with multiple buyers.

3.1.2. Deriving the Probability of Sale

Next, we derive the probability of the property being sold, $\pi(\Delta, \lambda)$=Pr$(P^B \geq P^S)$, the expected sale price, $\bar{P}(\Delta, \lambda)$, and analyze how $\pi(\Delta, \lambda)$ and $\bar{P}(\Delta, \lambda)$ depend on the key model parameters Δ and λ.

Proposition 1. *The sale probability is given by*

$$\pi(\Delta, \lambda) = 1 - e^{-\lambda(B - S + \Delta M)}, \tag{7}$$

and is increasing in Δ and λ.

Conditional on the property being sold, its expected price is equal to

$$\bar{P}(\Delta, \lambda) = \frac{1}{2(1+r_0)} \left(B + S - \Delta M - \frac{1}{\lambda} + \frac{B - S + \Delta M}{e^{\lambda(B-S+\Delta M)} - 1} \right). \tag{8}$$

$\bar{P}(\Delta, \lambda)$ is decreasing in Δ and increasing λ.

Proof. See Appendix A.2.

Proposition 1 says that the more negative Δ is, the lower the sale probability and the higher the average sale price, a result of the seller with a negative Δ benefiting from paying a mortgage rate r below the current market rate. This benefit results in a higher seller's reservation value. The buyer's reservation value is not affected by the past interest rate r^{orig}. As a result, the gains from trade are lower, and the seller and the buyer are less likely to agree on the mutually acceptable price. However, when they agree to trade, the average price is going to be higher to compensate the seller for the mortgage rate benefits associated with negative Δ.

Proposition 1 also says that both the sale probability and the average sale price is increasing in λ. This is because a higher λ is associated with a higher expected buyer's value u. In other words, the buyer's reservation value is increasing in λ, which translates into higher sale probabilities and sale prices

3.2. Multiple Buyers and Sellers in Equilibrium

We now move beyond the setting with two agents to consider multiple buyers and sellers. Assume at time $t = 0$, the CRE market is populated with N_S sellers and N_B buyers. Each seller expects to earn value S from owning the property until time $t = 1$. A fraction α of the sellers owe a fixed-rate mortgage with M dollars of the principal balance and interest rate r that matures at time $t = 1$. As a result, their reservation value is given by (2).

The fraction $(1-\alpha)$ of the sellers do not have a locked-in mortgage. This could be due to multiple factors, including adjustable rate mortgages, fixed rate mortgages maturing at time $t=0$, or no mortgage debt. Without rate lock, the seller's reservation value is equal to $\frac{S}{1+r_0}$. Let $l=1$ if a seller is locked in, and $l=0$ if a seller is not locked in. Then the seller's reservation value as a function of l can be written as follows:

$$P^S(l\Delta) = \frac{S - l\Delta M}{1+r_0}. \tag{9}$$

At time $t=0$, each seller is randomly matched with $k=\frac{N_B}{N_S}$ buyers[7]. As in Section 3.1, buyers' values u are independently distributed random variables, and buyers' reservation values are given by (3). The seller negotiates a deal with a buyer with the highest valuation using the Nash bargaining procedure as in Section 3.1. If $P^B < P^S(l)$, then the property is not sold. If $P^B \geq P^S(l)$, the seller and buyer agree on the sale price $P^* = \left(P^B + P^S(l)\right)/2$.

Notably, we do not assume that sellers necessarily become buyers subsequently.[8] This differs from what would typically be assumed in a residential real estate setting, in which, because properties are owned for shelter services, a household that sells must subsequently become a buyer, or at least choose to rent. In contrast, CRE properties are owned for income production. Therefore, a seller is not necessarily going to become a buyer subsequently. Consistent with sellers not necessarily becoming buyers, we see only about 11% of sellers of a property becoming buyers within the next two years in our transaction data.[9] Additionally, the literature does not suggest that this is an overwhelming occurrence. Indeed, certain sellers are economically motivated to become buyers. For example, closed-end real estate funds or asset managers with a target portfolio allocation in real estate assets are likely to roll the equity from a property sale into a new property. There can be important tax advantages to doing this, namely, 1031 exchanges in

[7] In practice, the number of buyers k is an integer that can be different for different properties. Since we focus on the averages across the entire CRE market, we treat k as a continuous variable.

[8] If we were to assume some share of sellers become buyers, our results would be altered by that share that we assume and it would represent an additional parameter in the model.

[9] This is based on the full sample of sales transactions with non-missing buyer and seller IDs, and minimal data cleaning—just dropping properties without a square footage or CBSA code, properties that have missing property type or hotels or development sites, and transaction prices that are missing or less than $1, from 2001 through 2022 (as opposed to ending in 2024 so there is the potential for a repurchase within 24 months). We show a figure with time variation in the annual average of this measure in Figure 2; the rate never reaches above 15%.

which sellers can avoid paying immediate capital gains tax by rolling the proceeds from sale into a new property within a specified amount of time. However, Ling and Petrova (2020) show that only a small share (5-6%) of sales in their sample of CoStar data are 1031 exchanges.

We note that among k buyers, the buyer with the highest valuation, $u = B - x$, is the one with the smallest x. The minimum of k independent exponential random variables is an exponentially distributed random variable with parameter $k\lambda$. Hence, the analytical results of Proposition 1 can be applied to the partial equilibrium setting by replacing λ with $k\lambda$, and Δ with $l\Delta$. In particular, the expected price is given by

$$\bar{P}(l\Delta, k\lambda) = \frac{1}{2(1+r_0)}\left(B + S - l\Delta M - \frac{1}{k\lambda} + \frac{B - S + l\Delta M}{e^{k\lambda(B-S+l\Delta M)} - 1}\right). \quad (10)$$

According to Proposition 1, $\bar{P}(l\Delta, k\lambda)$ is increasing in $(k\lambda)$ and decreasing in $(l\Delta)$. Since parameter λ is fixed and l is either 0 or 1, we can say that $\bar{P}(l\Delta, k\lambda)$ is increasing in k and weakly decreasing Δ.

We now endogenize the buyer-to-seller ratio k, by assuming that locked-in property owners are less likely to list their properties. In particular, let Q be the total number of identical CRE properties. Owners that are not locked in list their properties with probability γ, while locked-in owners offer their properties for sale with probability $\gamma(1 - \phi(\Delta))$, where $\phi(\Delta)$ is a decreasing function of Δ, with $\phi(0) = 0$. When Δ is negative, an owner with an interest rate advantage is less likely to try to sell the property. Thus, $\phi(\Delta)$ represents the reduction in property listings due to locked-in properties.

We can express the total number of sellers as follows

$$\begin{aligned} N_S &= Q(\alpha\gamma(1 - \phi(\Delta)) + (1 - \alpha)\gamma) \\ &= \gamma Q(1 - \alpha\phi(\Delta)). \end{aligned}$$

Then, the buyer-to-seller ratio $k(\Delta)$ becomes

$$k(\Delta) = \frac{N_B}{\gamma Q(1 - \alpha\phi(\Delta))}. \quad (11)$$

We note that $k(\Delta)$ is a decreasing function of Δ. The more negative Δ is, the fewer properties are listed for sale and the higher the buyer-to-seller ratio is.

Recall that the average price $\bar{P}(l\Delta, k(\Delta)\lambda)$ is increasing in $k(\Delta)$ and weakly decreasing Δ. Because $k(\Delta)$ is decreasing in Δ, $\bar{P}(l\Delta, k(\Delta)\lambda)$ is a decreasing function of Δ. Plugging (11) into (10), we can rewrite the expected price $\hat{P}(\Delta, l)$ as a function of Δ and l. Thus, we have the following proposition.

Proposition 2. *The sale probability is given by*

$$\hat{\pi}(\Delta, l) = 1 - e^{-k(\Delta)\lambda(B-S+l\Delta M)}, \tag{12}$$

and is increasing in Δ and λ.

Conditional on the property being sold, its expected price is given by

$$\hat{P}(\Delta, l) = \frac{1}{2(1+r_0)} \left(B + S - l\Delta M - \frac{1}{k(\Delta)\lambda} + \frac{B-S+l\Delta M}{e^{k(\Delta)\lambda(B-S+l\Delta M)} - 1} \right). \tag{13}$$

$\hat{P}(\Delta, l)$ is decreasing in Δ for all l.

Proposition 1 established that properties with more negative Δ are sold at higher prices. Proposition 2 highlights the second effect of rate lock (negative Δ) on CRE prices. By reducing CRE supply to the market, rate lock has an additional positive effect on *all* CRE prices, including properties without rate lock.

3.3. Empirical Implications

Hypothesis 1: Properties with more negative Δ are less likely to be sold.

Hypothesis 2: Properties with more negative Δ are sold at higher prices.

A final empirical implication of the model is that lock-in results in higher prices for all properties, not just properties with more negative Δ, because lock-in reduces supply. These finding should be stronger when more buyers finance their properties with a fixed rate mortgage (higher α), all else equal.

Hypothesis 3: The reduction in supply results in higher prices for all properties, not only properties with more negative Δ. These effects should be most pronounced in areas with a higher share of rate locked properties.

4. DATA AND EMPIRICAL METHODOLOGY

This section describes the data and methodology used to test the predictions of the model.

4.1. Data

Our primary dataset is based on transaction-level data from MSCI Real Capital Analytics (RCA), which is comprehensive for transactions above $2.5 million in value in the U.S. We begin with the information on all sales and refinancings that are associated with CMBS loans since 2001.[10] Because RCA provides point-in-time data at the time of a transaction, rather than a time series for each property such that we have a panel, we construct a panel after cleaning the data.

In building the loan panel, cleaning the RCA data proceeds in several steps. First, we drop transactions that have missing values for any of the following: interest rate, interest rate type (necessary for identifying fixed rate loans), origination date, maturity date, loan amount, debt service coverage ratio (DSCR), transaction value, property type, property geography, and lender type. We also drop hotel loans given there are very few in our sample and we are thus not confident in our ability to properly construct market rates for these properties. Additionally, we require that loans have at least 12 months of data.

After cleaning the transaction-level data, we create a loan panel at the monthly frequency by carrying forward observations between the most recent transaction and the date of the next transaction. For observations without a second transaction, we carry forward the information to the maturity date of the loan.

[10] We start with the transactions with non-missing RCA markets and non-missing property types with values at time of sale or refinancing that are non-missing and above $1; we also do not include "development sites" in our analysis.

We drop any observations that occur before loan origination or after loan maturity. For loans with a transaction date greater than the last date in RCA, we only keep through the last date in RCA. The loan panel thus spans from 2001 through December 2024.

After constructing the loan-month panel, we undertake some additional cleaning for our regressions.[11] Specifically, we drop properties without RCA property quality (Q)-scores,[12] age (or loans with building ages below 0 at the time of transaction), or size, as these variables are necessary for the empirical analysis.

The first cleaning step before constructing the loan panel reduces the sample of transactions with a fixed rate CMBS loan from 169,782 to 140,918. Most of these dropped transactions have missing loan terms and are thus not amenable to an analysis on rate lock effects. When we then construct the loan panel, the sample falls further to 88,599 loans (see Table 1), mostly because of our restriction that transactions include the building square footage, building age, and the RCA quality score.[13]

4.2. Empirical Methodology

To construct our key independent variable of interest, we first calculate the difference between the interest rate on a CMBS loan at origination and the prevailing market interest rate for similar CMBS loans in a given month. This is our proxy for Δ in the model:[14]

$$\Delta_{i,p,t} = r_{i,p,orig} - R_{p,t}, \tag{14}$$

[11] We still want these loans to be included in constructing our property-market-level rates, which is why we drop them after constructing the panel.

[12] Q-score is a measure created by RCA to measure the relative quality of the property as compared with other properties in a locality. See Glancy, Kurtzman, and Loewenstein (2024) for further details on this measure.

[13] We see these as important controls to include in our baseline results and thus limit the sample to their inclusion; in unreported regressions, we see that—consistent with our baseline results—there are lower sales and higher prices for loans with a higher interest rate advantage, and that these effects are statistically significant and stronger than in our baseline regression. Note that we construct our panel with the same cleaning criteria except including floating rate loans when we examine how the fixed vs. floating shares change in Section 5.2.

[14] Although the RCA data is at the property-level, we construct our panel dataset using the loan associated with each particular property. Therefore, our key variable of interest is at the loan level, rather than the property level.

where $r_{i,p,orig}$ is the interest rate associated with loan i on property type p originated in month $orig$ and $R_{p,t}$ is the average interest rate for fixed-rate CMBS loans of property type p originated in month t.[15]

A key aspect of our empirical design is that the mortgage rate differential captured by $\Delta_{i,p,t}$ should only impact sales when it is negative. This is because when $\Delta_{i,p,t} \geq 0$ the property owner can sell the existing property and buy a new property using a mortgage with a rate lower than the rate they have on the existing property. In this environment we do not expect the lock-in effect to be strong after controlling for other determinants of sale. In contrast, when $\Delta_{i,p,t} < 0$, if the property owner sells and puts their equity into a new property, they will be forced to borrow at a rate that is higher than the rate they have on the existing property. In this environment, we expect a lock-in effect to exist after controlling for other determinants of sale.

We capture this asymmetry by defining our key independent variable of interest, $Interest\,Rate\,Advantage$, in the following way:

$$Interest\,Rate\,Advantage_{i,p,t} = \begin{cases} 0 & \text{if } \Delta_{i,p,t} \geq 0, \\ -\Delta_{i,p,t} & \text{if } \Delta_{i,p,t} < 0. \end{cases}$$

This variable incorporates the idea that the lock-in effect should not be relevant unless the current market rate is higher than the fixed rate on the property associated with loan i, which gives the borrower an interest rate advantage relative to other owners borrowing at current market rates.

We then test Hypothesis 1 by estimating

$$\text{Sale}_{i,p,t} = \beta Interest\,Rate\,Advantage_{i,p,t-1} + \eta_1 X_i + \eta_2 Z_{i,t-1} + \zeta_{i,t} + \varepsilon_i, \tag{15}$$

where $\text{Sale}_{i,p,t}$ is an indicator equal to 1 when the property associated with loan i is sold in month t, and 0 otherwise.

[15] Other papers, such as De la Roca et al. (2025), use alternative measures such as the ratio of monthly payments, rather than the difference in interest rates, to measure rate lock-in. The loans used in this analysis are cleaned following our first cleaning step described in the previous subsection but not the second.

Controls that do not vary with the time (X_i) include the log of the previous transaction price of the property in 2017 dollars, an indicator for whether origination LTV is greater than 75%, an indicator for whether the origination DSCR is less than 1.25, the Q-score of the property, the square footage of the property, and whether the property is located in a central business district (CBD). Time-varying controls ($Z_{i,t-1}$, which are lagged one month) are property age and age-squared, remaining term to maturity indicators, and an indicator for a transaction associated with the property being distressed property as marked by RCA.[16] In the most saturated specification, fixed effects ($\zeta_{i,t}$) include property type×year-quarter FEs, owner type FEs[17], geographic market×year-quarter FEs[18], an indicator as to whether the loan is an Agency CMBS loan (i.e., a multfamily loan issued by Fannie Mae or Freddie Mac), and whether the loan is associated with a refinancing. Standard errors are clustered at the market×property type level.

Identification therefore comes from differences in mortgage-rate vintages across otherwise similar properties within the same market, property type, and time period, holding constant local demand (market-by-time fixed effects), national property-type trends (property-type-by-time fixed effects), and observable property and loan characteristics that account for baseline heterogeneity (controls), as well as owner type.

To estimate the impact the relative rate has on sale price (Hypothesis 2), we reestimate a version of equation 15 in which the dependent variable is the log transaction price. For this regression, we collapse the panel to a dataset of repeat transactions in which each property is observed at least twice. In this dataset, the timing of observables is such that t is the month of sale, $t-1$ is the month before the sale, and $t=0$ is the date of loan origination or previous transaction, whichever is later. Our price equation has the following form:

$$\text{LnPrice}_{i,p,t} = \beta Interest\,Rate\,Advantage_{i,p,t-1} + \eta_1 Z_{i,t-1} + \eta_2 Z_{i,t=0} + \zeta_{i,t} + \varepsilon_i. \tag{16}$$

[16]We define this measure based on RCA's *DistressedStatus* field, which indicates whether a property is distressed at the time of transaction. Specifically, any loan with a status that is not marked as "Resolved" and that is non-missing is included in this indicator variable.

[17]We group owner types in a manner similar to the groupings in Ghent (2021).

[18]We use the RCA market definition which is designed to be tailored to CRE markets, as opposed to a Census-defined geographic market definition; the RCA market measure is closest to a CBSA or city-level geographic measure. There are 158 markets in the dataset used in our baseline regression.

Here, controls at the time of origination ($t = 0$) are an indicator for whether origination LTV is greater than 75%, an indicator for whether the origination DSCR is less than 1.25, and the origination term to maturity. The controls as of month $t-1$ (many of which are fixed through the term of the loan) are property size, age, age-squared, Q-score, remaining term to maturity indicators, a CBD indicator, and an indicator for a distressed sale. Fixed effects ($\zeta_{i,t}$) are as in (15). Standard errors are clustered at the market×property type level.

5. MAIN RESULTS

Table 1 summarizes our sample at the loan level, while Table 2 summarizes it at the loan-month level. Panel A of Table 1 summarizes all loans in our sample. Because the focus of our study is on transaction likelihood and prices, we also break our sample into two parts, which are summarized in Panels B and C. In Panel B we summarize loans associated with properties that are sold before or at maturity. For these loans, we observe at least one sale in the sample period. In contrast, in Panel C we summarize loans associated with properties that are not sold before or at maturity in our sample. For these loans the dependent variable is always 0 in the regressions of sales probability and always missing in the regressions of prices.

Table 3 tabulates property type counts for all transactions in our sample. Because RCA has very few hospitality property transactions, we drop all hospitality properties from the sample. Table 4 tabulates the owner types in RCA in a manner similar to Ghent (2021).

Figure 3 plots the number of loans outstanding in our loan panel each month. The counts level off in the aftermath of the GFC and decline around 2016 when the CMBS "wall of maturities" began to refinance before rising thereafter, with much of this growth driven by agency CMBS. Figure 4 plots the number of property sales for the loans in our sample. There are noticeable declines in sales volume following the GFC, during COVID, and during the 2022-2024 period of rising interest rates. Figure 5 plots sales counts by remaining term to maturity at the time of sale. Because the standard CMBS loan term is 10 years, we group loans into ten 1-year remaining term buckets and plot the sales counts by bucket. Sales frequency is highest in the 1-year remaining bucket, consistent with property owners being more likely to sell when they need funds to repay the maturing balloon balance.[19] Sales frequency is relatively stable in the 2-year to 9-year buckets, and then drops again for loans with more than 9 years remaining to maturity.

Figure 6 shows a time series of loans with an interest rate advantage, while Figure 7 plots the average interest rate differential $\Delta_{i,p,t}$ over time. We present the series both unweighted and weighted by property value.Large shares of loans have an interest rate advantage: the majority of months have over half of loans with an interest rate advantage. However, the shares are much lower in most periods looking at loans with a high interest rate differential (in the figure, we condition on the differential being above 1%). Looking at Figure 7, the interest rate differential declines and is persistently negative at two points in the sample: during the aftermath of the GFC, and during the 2022-2024 rate increases. The latter period is notable due to the magnitude of the negative differential, and the fact that nearly all loans have an interest rate advantage of over 1%.

5.1. Main regression results

Columns 1 through 3 of Table 5 report the results of estimating equation 15. The dependent variable is equal to 1 if the property associated with loan i is sold in month t and 0 otherwise, and we multiply the dependent variable by 100 to ease in interpretation of the results. We layer in various levels of fixed effects across columns. The property type×year-quarter fixed effects account for time-varying national trends in property types, such as the sharp decline in office property value that followed the remote work shift. The market×year-quarter fixed effects account for time-varying local market conditions and capture differences in liquidity across markets at a point in time.

Finally, the owner type fixed effects account for differences in owner types. Certain types of investors, such as private equity funds, may have incentives to sell that are related to investment time horizons. If the investment horizon incentive is correlated with the interest rate advantage, then this may drive our results since sales and price dynamics may be related to investment horizon and not solely the interest rate advantage. Alternatively, as shown in Ghent (2021), delegated investors select into more liquid markets. If market liquidity is correlated with the interest rate advantage, then we might observe different sales and

[19] CMBS loans within 3 months of maturity can usually be paid off without defeasance or yield maintenance penalties.

price dynamics for delegated investors that are unrelated to the interest rate advantage.

Across specifications in columns 1 through 3, the sign on *Interest Rate Advantage* is negative and significant, indicating that as the interest rate differential becomes *more negative*, the likelihood of sale decreases. This is consistent with Hypothesis 1: locked-in properties are less likely to be sold compared to properties that are not locked in. The coefficient can be interpreted as follows. In column 3, the most saturated specification, when the rate differential is negative, a 100bp further reduction in the rate differential is associated with a 0.054 percentage point lower probability of a sale. Because the data are monthly, this specification implies a roughly 0.65 percentage point lower probability of a sale over the year ($0.054 \times 12 = 0.648$), or roughly 6.5 percentage points over the life of the loan ($0.054 \times 120 = 6.48$).

To further interpret this coefficient, consider the fact that, as Table 2 shows, the unconditional mean of *Sale* at a monthly level is 0.32%. This implies that, over a ten-year period, the average sale likelihood is $0.32\% \times 120 = 38.4\%$. A 6.5 percentage point reduction in sale probability over a ten-year period is therefore about 17% of the unconditional mean.

In addition to investigating sales probability, in columns 4 through 6 of Table 5 we report the results of estimating equation 16, in which the log of sales price is the dependent variable. The sign on *Interest Rate Advantage* is positive and significant across specifications, which indicates that as the interest rate differential becomes more negative and hence exposes the owner to more rate lock-in, the sales price increases. This is consistent with Hypothesis 2. The coefficient on our most saturated specification in column 6 indicates that a 100bp reduction in the rate differential is associated with an approximately 4% higher sales price for locked-in properties.

To put the price impact in column 6 into further context, consider that the interest rate differential was -200bps (or more) during the 2022-2024 time period (see Figure 7). A rate differential of -200bps would imply an increase in sales price of $2 \times 4 = 8\%$ for locked-in properties relative to what their price would have been absent the interest rate advantage.

5.2. How much of the CRE Market was likely rate locked in 2022–2024?

In this section, we provide evidence that at least half the CRE market was likely locked in between 2022-2024. For this analysis, it is useful to start by looking at shares of mortgage debt for the different investors in multifamily and commercial debt in the Financial Accounts of the United States. In Table 6, we use data from the Financial Accounts of the U.S. to show that in 2023, 26.8% of the CRE mortgage debt was securitized, while 52.2% was held by banks, 12.5% was held by insurers, and 8.5% was held by other sectors and intermediaries. We focus on the first three groups and then discuss the other sectors and intermediaries, as well as the all cash transactions in the market.

In terms of CMBS, Figure 6 shows that nearly 100% of fixed-rate CMBS were rate locked during the 2022 to 2024 period. The top panel shows the share of total CMBS outstanding with any interest rate advantage ($\Delta < 0$), and the bottom panel shows the share with a large interest rate advantage ($\Delta < -1$) In terms of banks and insurance companies, we rely on Glancy et al. (2021), who examine microdata with the loan terms for the loans held by these lender types. They show that although the incidence of longer-term, fixed rate loans is lower for bank lending than in CMBS, for 2012 to 2017 originations, about 34% of bank loans are fixed rate and the average term for bank loans is over 6.5 years. They also show that nearly all (97%) insurance company loans are fixed rate and have an average term of more than 13 years during that time period. Altogether, if we assume 94.5% of CMBS debt, 34% of bank loans, and 97% of insurer loans are fixed rate, we can approximate that about 55% of the CRE debt market would have been exposed to rate lock between 2022 and 2024. [20]

Beyond properties financed with mortgages, all cash transactions are common in CRE. For example, in our raw RCA sample, about 30% of transactions are not financed with a mortgage.[21] As shown in Glancy et al. (2024), many of these buyers are REITs or other borrowers that likely have unsecured debt that is

[20]The "Other" category reported in Table 6 is made up of a heterogeneous set of holders. Nonfinancial corporates and noncorporates likely issue debt directly or via private placements, with corporates likely having a higher fixed rate share than noncorporates. The federal government and state and local governments overwhelmingly hold fixed rate loans and bonds, while private pensions and state and local government retirement funds also tend to prefer fixed rate holdings. Lastly, finance companies and mortgage REITs tend to fund themselves with short-term liabilities and therefore their holdings tend to be more fixed rate.

[21]This number is lower than the 50% share of cash transactions reported in Glancy et al. (2024), as they only consider investment properties for sale and also include development sites as a property type in their analysis.

fixed rate. In turn, we expect that at least 50% of this unsecured debt is also fixed rate, though there is much more uncertainty on this margin. That said, given the all cash share in our sample, in the case where 50% of other debt is rate locked, we would only require 19% or more of the unsecured CRE debt market to be fixed rate for half of the market to be rate locked.

5.3. Robustness

In this section we report the results of several robustness checks for our main results. First, we examine whether the results are driven by borrowers that are financially distressed. Second, we reestimate our results using a market rate derived from monthly Trepp CMBS data. Third, we reestimate our results excluding agency CMBS loans. Finally, we examine the results when we recalculate our main independent variable including loans with positive rate differentials.

5.3.1. Financial distress

If financially distressed borrowers delay sale in hopes of curing distress and obtaining a better price, this may drive our results. We proxy for potential distress using three loan characteristics. The first is an indicator equal to 1 if the origination LTV is great than 75%, and 0 otherwise. The average origination LTV in our sample is 67%; therefore the 75% cutoff should capture loans that are riskier at origination. Similarly, we define a second indicator equal to 1 for loans with origination DSCR below 1.25 and 0 otherwise. With the mean origination DSCR being 1.56, this cutoff should also capture riskier loans. Third, we use the indicator for whether a loan is marked as *Distressed* prior to sale by RCA, described in Section 4.2, that appears in the main specifications in equations 15 and 16. We then reestimate equations 15 and 16 using an interaction between these indicators and *Interest Rate Advantage*. The interaction terms capture the impact of rate lock-in for potentially distressed loans relative to non-distressed loans.

The results are reported in Tables 7 (for sales) and 8 (for prices). We only show the results for the specification with owner type fixed effects to show all the results on one table.

The coefficient on *Interest Rate Advantage* remains negative and highly significant for sales across specifications, and positive and mostly significant for prices. As in our baseline regressions, we see a lower probability of sale across distress measures. However, the interaction terms are all statistically insignificant and the baseline coefficient is in the same range as in Table 5. For our pricing regressions, the results are similar for the high LTV and low DSCR indicators. Additionally, in Columns (5) and (6), we do see a positive and highly significant coefficient on distress, as in our baseline specification. However, you can also see that the coefficient on *Interest Rate Advantage* has reduced significance while the interaction is highly significant, which is consistent with rate lock effects mattering more for distressed loans. Altogether, it is unlikely that distressed sellers delaying sale in hopes of a higher price is driving the results for sales. If anything, our results are consistent with distressed sellers being more likely to be affected by rate lock effects.

5.3.2. Alternative data for Interest Rate Advantage

As a robustness test of our sales and prices results, we reestimate our baseline regressions but with our main independent variable of interest recalculated using Trepp CMBS data. Because Trepp does not contain transaction prices or indicate whether properties are ultimately sold, we are unable to use it for our primary analysis. However, like RCA, Trepp contains comprehensive information on interest rates for CMBS loans. We use Trepp to construct the market rate by month and property type $R_{p,t}$ and then recalculate the interest rate differential for our RCA loan sample using the Trepp market rate. We then recalculate *Interest Rate Advantage* and reestimate equations 15 and 16 and report the results in Tables 9. The results are similar to those in our main analysis.

5.3.3. Excluding agency loans

Our main results in Table 5 include private-label and agency CMBS. However, agency CMBS are exclusive to multifamily properties and our hypothesis that rate lock affects all property types is not unique to any given property type. We therefore test whether our results are sensitive to the inclusion of agency loans by dropping agency loans in the sample and reestimate equations 15 and 16.

The results are reported in Table 10. The number of observations is significantly smaller compared to the main analysis given the large number of agency CMBS loans. Overall, the results for sales likelihood in columns 1 through 3 are similar to those in the main analysis. The size of the coefficient on *Interest Rate Advantage* for the pricing regressions in columns 4 through 6 is much larger, indicating that the lock-in effect is stronger for private-label CMBS, though the coefficient is insignificant due to the much smaller sample size with such a large number of fixed effects.

5.3.4. Including loans with positive rates

Our main specification takes the interest rate differential defined in (14), $\Delta_{i,p,t}$, and constructs the variable *Interest Rate Advantage* that is $\Delta_{i,p,t}$ times -1 if rates are negative and is 0 otherwise. This approach is motivated by the incentives in the space, i.e. that loans are subject to rate lock effects when the market rate is above their origination rate. When market rates are below origination rates, we expect that there is a higher refinancing incentive that should increase as the gap between market rates and the origination rate widens, especially given that CMBS loans are typically subject to significant prepayment penalties. Therefore, we expect that that the relationship between sales probability or prices and $\Delta_{i,p,t}$ will be less pronounced when we include loans with positive rates in our main specification than when *Interest Rate Advantage* is the main independent variable of interest.

In Table 11, we test this hypothesis; we show the results for the full interest rate differential, noting that we do not multiply $\Delta_{i,p,t}$ by -1, so the results have the opposite signs of those in Table 5. The results confirm our hypothesis, as the coefficients on $\Delta_{i,t}$ for both sales and prices are about one-third relative to the coefficients on *Interest Rate Advantage* in our main specification.

6. EVALUATING THE IMPACT ON NON-LOCKED-IN PROPERTIES

While the previous section shows that mortgage lock-in operates at the property level, its market-level implications depend on how reduced turnover affects market-wide prices. According to Hypothesis 3, lock-in should also result in higher prices for properties that are not locked in, due to the reduction in supply from locked-in owners, all else equal. In this section, we test this hypothesis by exploiting cross-sectional variation in the exposure of non-locked-in properties to lock-in effects.

We begin by constructing a proxy for market-level exposure to lock-in effects. We do so by measuring the share of mortgage-financed properties with fixed rate debt in each market each quarter. The time-varying fixed-rate share captures exposure to lock-in because fixed-rate mortgages are more likely to be locked in when market rates rise (see, for example, the share of fixed-rate CMBS that were locked in as illustrated in Figure 6). Thus, markets with higher fixed-rate shares are likely to have more properties locked-in compared to markets with lower fixed-rate shares.

We define an indicator equal to one if a market's fixed rate share is above the seventy-fifth percentile of the fixed rate share across markets over time.[22] Importantly, the average fixed rate share across markets trends down over time, as shown in Figure 9. This is because CMBS and insurer loans become a smaller share of transactions relative to banks and because more CMBS loans are floating rate later in the sample.

Our specifications for this exercise are similar to those in equations (15) and (16), but additionally incorporate the high fixed market share indicator and an interaction between it and an indicator for whether the *Interest Rate Advantage* is positive.[23] By including the interaction, the coefficient on the high fixed-rate-share indicator identifies the effect of market-level lock-in exposure on non-locked-in properties.

This exercise is necessarily less precise than our tests of Hypotheses 1 and 2 because market-level fixed-rate exposure must be approximated rather than directly observed. The main source of imprecision is that most non-CMBS property transactions do not report a maturity date in the RCA data. As a result, we approximate maturities using lender-type averages from Glancy et al. (2021): 10 year terms for insurers and 5 year terms for banks.[24] Additionally, we must make assumptions about interest rate type for bank and insurer loans as this term is typically missing in for these lender types. While nearly all insurer loans are fixed rate, bank loans exhibit greater heterogeneity; in the absence of comprehensive data, we conservatively classify bank loans as variable rate.[25] Importantly, this induces measurement

[22] We note that when we use a continuous fixed rate share variable we obtain qualitatively similar results.

[23] The regressions do not include market-by-time fixed effects because the fixed share indicator is at the market-by-time level.

[24] If there is a maturity date, we use it, but most insurer and bank loans do not have a maturity date in our sample.

[25] The most comprehensive source of information on these loan terms that we are aware of comes from Glancy et al. (2021). In Table 1 of their paper, they show that insurers are 97% fixed rate, and we round up as we believe those few non-fixed rate loans are potentially anomalous. Bank loans are one-third fixed rate in Table 1 of Glancy et al. (2021), but their sample only includes loans for the large stress test banks, and so without further information we conservatively classify all bank loans as variable rate.

error in market-level exposure, reducing effective cross-market-over-time variation and attenuating estimated effects rather than generating spurious amplification. Absent a mechanism linking this error to contemporaneous demand shocks after conditioning on market and property-type-by-time fixed effects, this measurement error induces attenuation bias, making our estimates conservative rather than biasing them upward.

The results are shown in Table 12. The key variable of interest, *High fixed rt. shr. in mkt. ind.*, is positive and significant for prices, with non-locked properties in high lock-in markets selling for 9-11% more than non-locked properties in low lock-in markets (columns 3-4). Because all specifications include rich property-type-by-time and market fixed effects, these patterns are unlikely to reflect time-varying differences in local liquidity or demand conditions. These findings for prices are consistent with Proposition 2, whereby rate lock-in raises equilibrium prices through reduced market-wide supply. The findings in the first two columns show that non-locked properties in high lock-in markets have 0.06-0.08 percentage point lower monthly sales probabilities than those in low lock-in markets, which contradicts the model's prediction that there are more sales of non-locked in properties in more rate locked markets. The model result is a function of there being a fixed share of buyers in the market; the empirical results suggest additional channels such as endogenous buyer exit may be operative in areas with more rate lock. Altogether, given the empirical findings are consistent with higher prices on non-locked in properties, we interpret them as providing further evidence of spillover effects further dampening busts beyond those effects on rate locked properties."

7. CONCLUSION

We document the existence of a significant fixed-rate mortgage lock-in effect for CMBS loans. For a 100bp increase in market interest rates relative to the fixed mortgage rate on the average property, our results suggest a significantly lower sales probability (about 17% of the unconditional mean) and higher price (around 4%) conditional on sale. These results are consistent with a simple bargaining model between a locked-in seller and a buyer. We also find evidence that non-locked-in properties transact at higher prices, consistent with the model's prediction when generalized to multiple buyers and sellers. Given that rate differentials averaged around -2 percentage points in the post-pandemic period, these findings suggest that rate lock-in effects likely contributed to dampening the post-COVID decline in CRE values by constraining supply during a period of rising interest rates.

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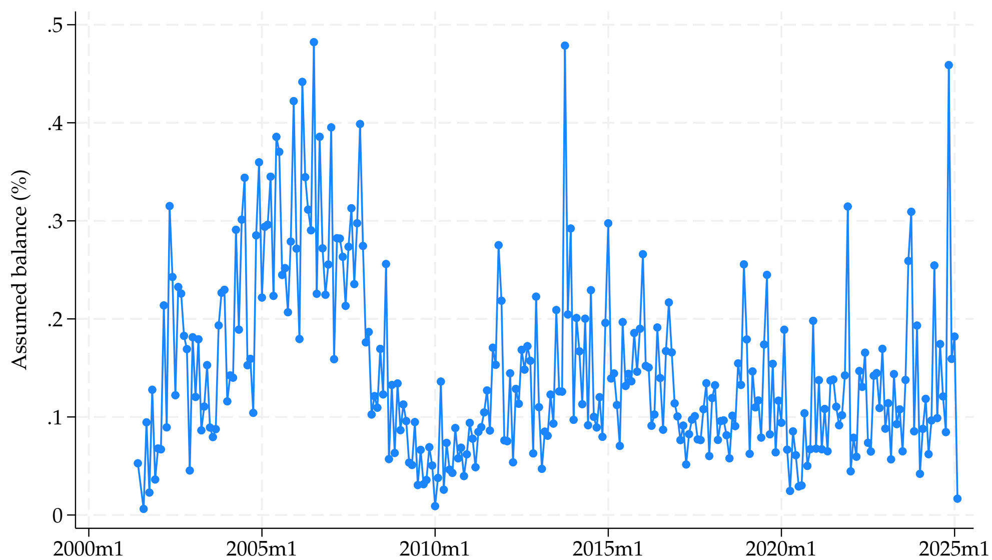
FIGURES

Figure 1: Loan Assumptions over Time

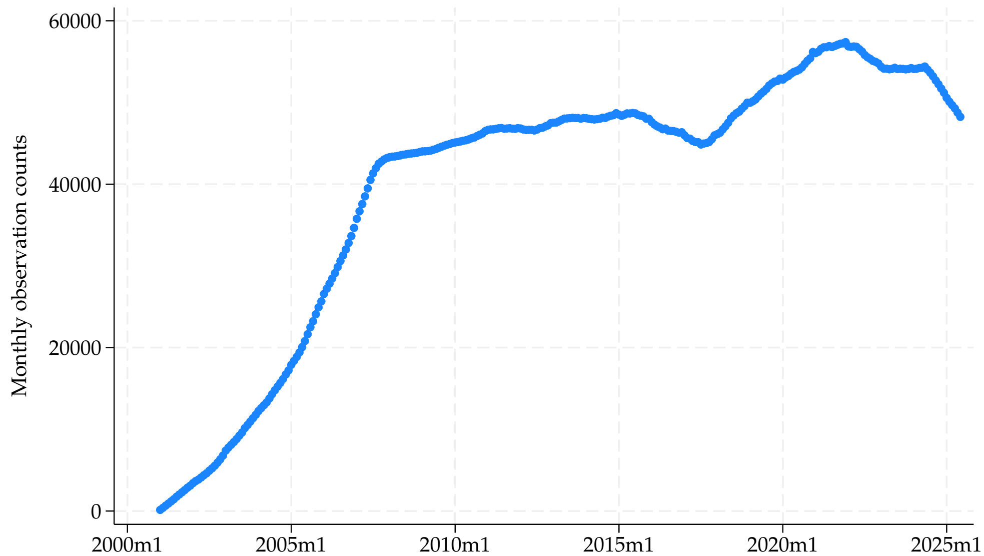


Note: The figure plots the fraction (expressed in percentage terms) of total outstanding CMBS fixed-rate loan balance that is assumed in a given month.
Source: Authors' calculations using data from Trepp.

Figure 2: Investor Repurchase Rate over Time

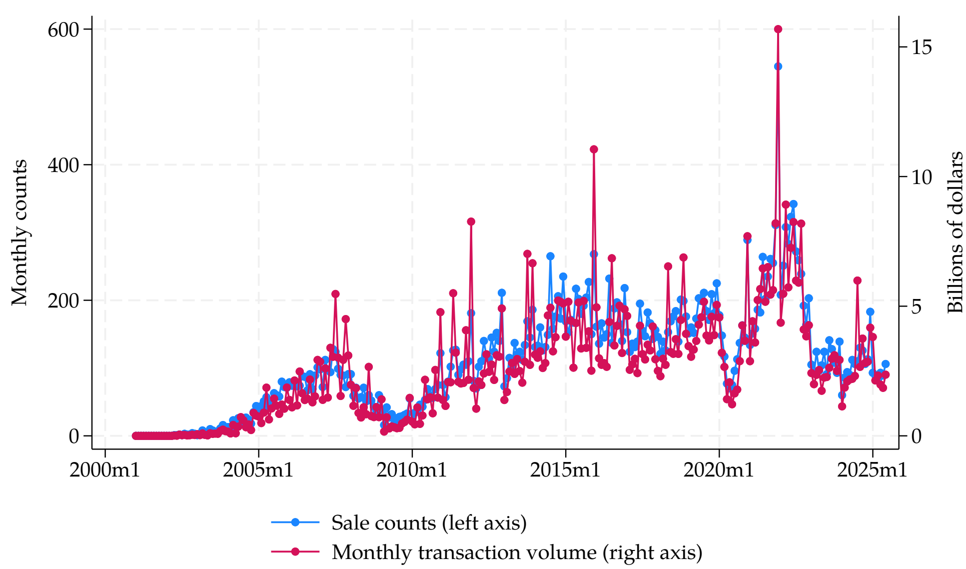
Note: The figure plots the annual average share (expressed in percentage terms) of sales transactions that are followed by a repurchase by that same seller within two years for the sample ending in 2022.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 3: Counts of Loan Panel Observations over Time



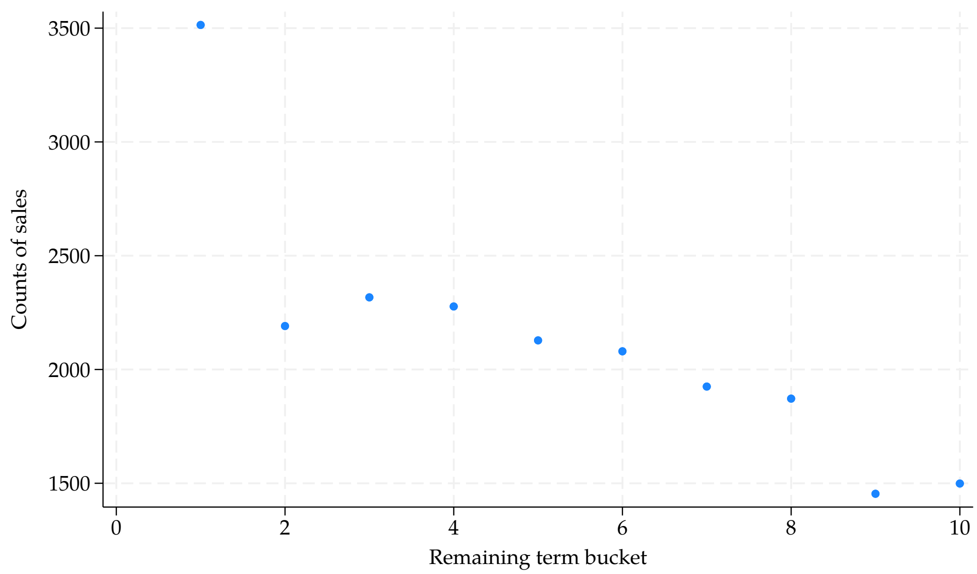
Note: The figure plots counts of observations in our loan panel by month in the sample of data used in our analysis.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 4: Repeat Sales over Time in the RCA Sample of Loans



Note: The figure plots monthly "repeat" sales counts (left axis) and the sum of "repeat" sale values in billions of dollars (right axis).
Source: Authors' calculations using data from MSCI Real Capital Analytics.

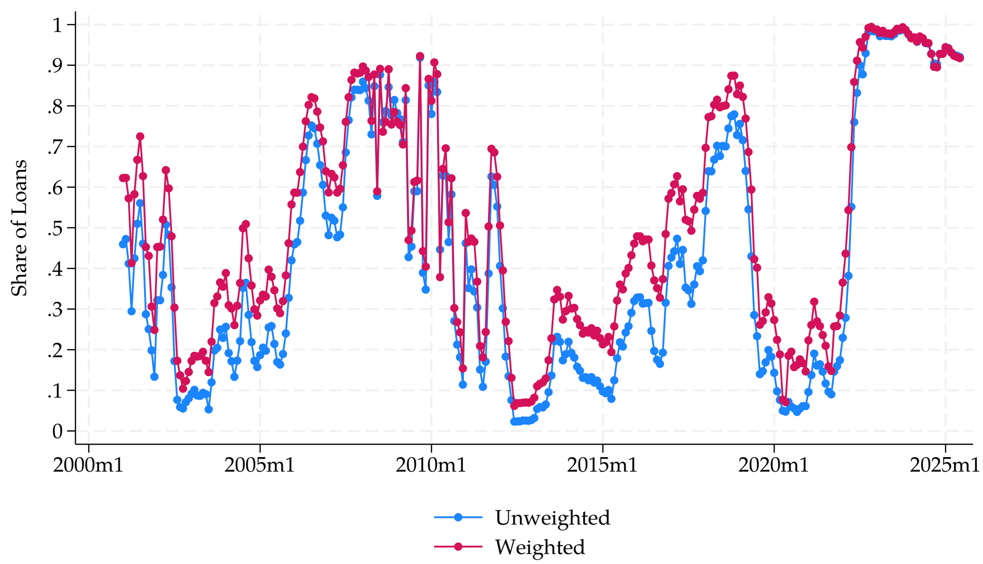
Figure 5: Sales by Term Remaining Bucket



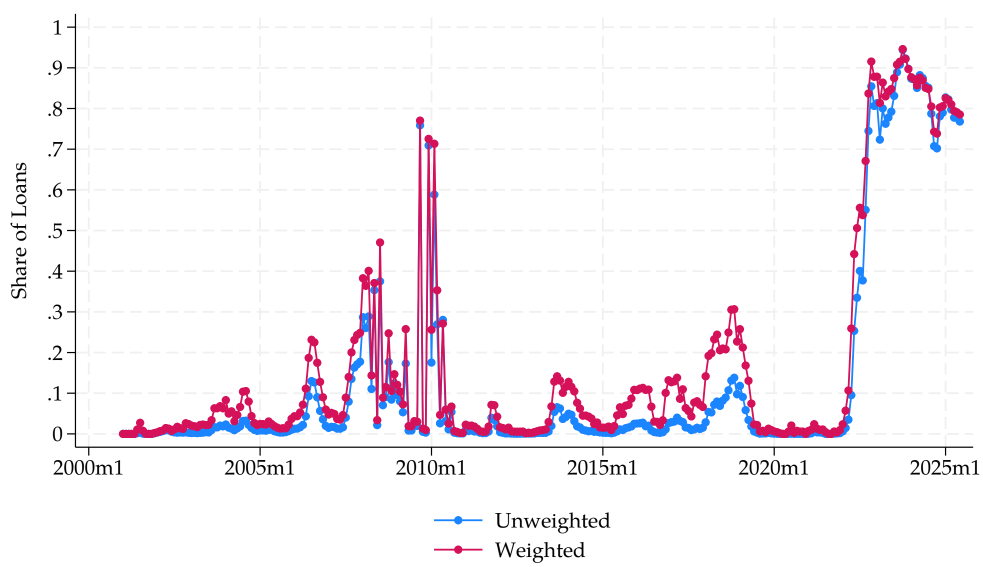
Note: The figure plots a scatter of counts of the sales out of existing transactions ("repeat sales") by term remaining year bucket (0-1 years, 1-2 years, ..., 9+ years).
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 6: Shares of CMBS Loans with an Interest Rate Advantage Over Time

(a) CMBS with any Interest Rate Advantage

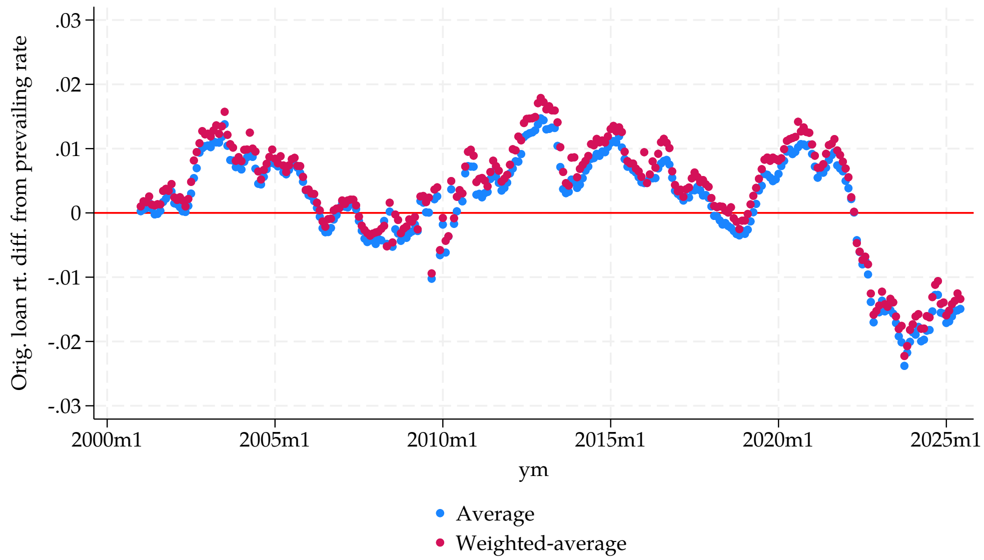


(b) CMBS with a High Interest Rate Advantage ($\geq 1\%$)



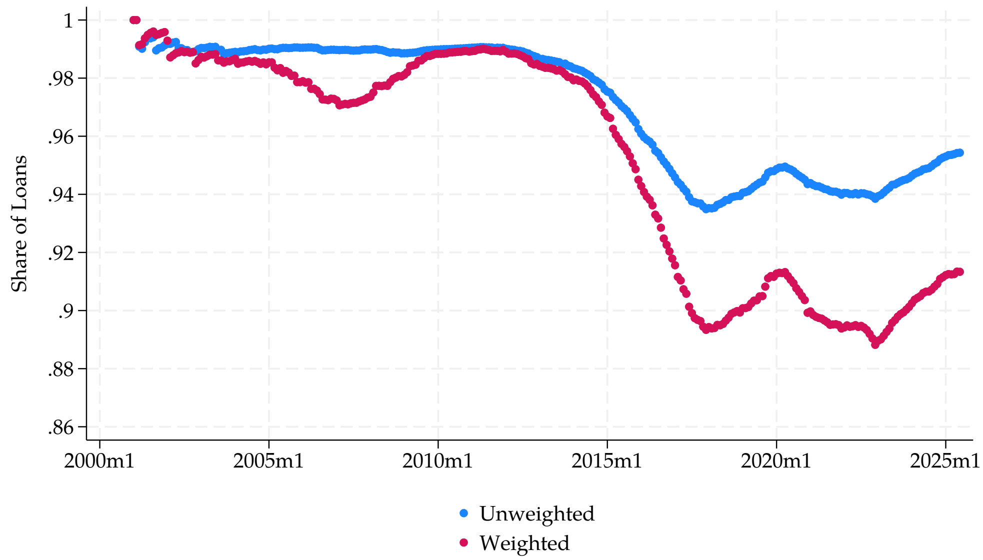
Note: The figures plot the unweighted and weighted (by property value) share of fixed rate CMBS loans with an interest rate advantage, i.e. a negative interest rate differential (defined in (14)), over time. The top panel shows the unconditional shares, while the bottom panel conditions on the interest rate differential being above 1%.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 7: Average Interest Rate Differential over Time



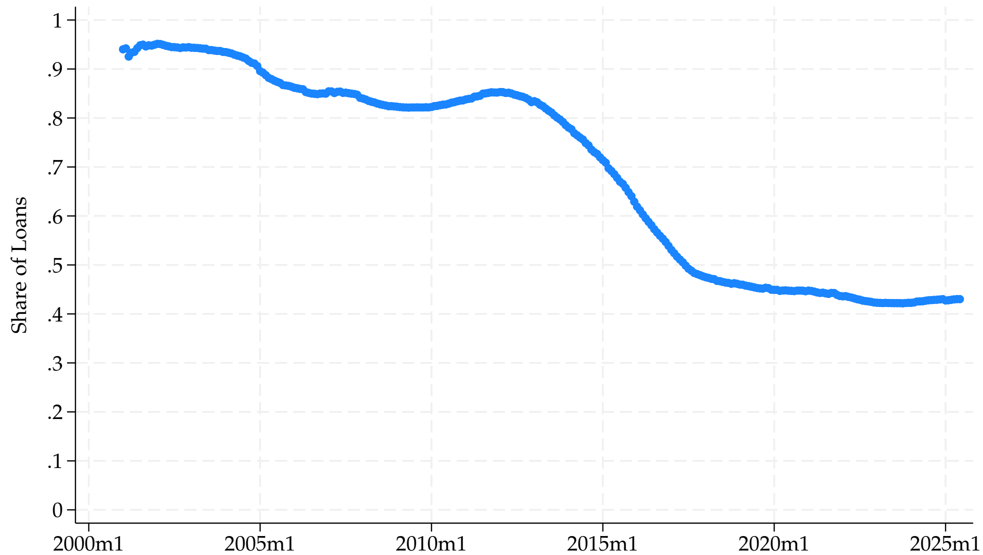
Note: The figure plots the simple average and weighted (by property value) average of the interest rate differential (defined in (14)) over time.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 8: Fixed Rate Share of CMBS Loans over Time



Note: The figure plots the simple average and weighted (by property value) share of loans with a fixed rate if we expand the sample to also include those with floating rates while meeting the other cleaning criteria described in the paper.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

Figure 9: Average Fixed Rate Share of CMBS, Insurer, and Bank Loans over Time



Note: The figure shows the average fixed rate share of loans across lender types in the sample over time.
Source: Authors' calculations using data from MSCI Real Capital Analytics.

TABLES

Panel A: Statistics for all loans

Variable	Count	Mean	Median	SD	Min	Max
Interest rate at origination (%)	88,599	0.05	0.05	0.01	0.02	0.09
Term remaining as of 1st obs. (years)	88,599	10.33	10.00	4.09	0.25	40.08
Term remaining at time of transaction (years)	88,599	3.69	2.17	4.75	0	34.92
Term at origination (years)	88,599	10.60	10.01	3.95	1.05	40.03
LTV at origination	88,599	0.6704	0.6970	0.1140	0.0850	0.8050
DSCR at origination (%)	88,599	1.5782	1.4000	0.5768	1	7.5500
Distressed loan indicator	88,599	0.05	0	0.22	0	1
Property quality score	88,599	0.52	0.52	0.27	0.01	1
Transaction price (millions of dollars)	88,599	25	11	81	0	5700
Loan size at origination (millions of dollars)	88,599	16	7	40	0	3002
CBD indicator	88,599	0.10	0	0.29	0	1
Agency loan indicator	88,599	0.42	0	0.49	0	1
Building age at time of transaction (years)	88,599	37	32	26	0	283
Building size in square feet (1,000s) at time of transaction	88,599	136	82	184	0	10247

Panel B: Statistics for loans on properties that are sold before or at maturity

Variable	Count	Mean	Median	SD	Min	Max
Interest rate at origination (%)	21,756	0.05	0.05	0.01	0.02	0.09
Term remaining as of 1st obs. (years)	21,756	10.05	10.00	3.47	0.25	40.08
Term remaining at time of transaction (years)	21,756	4.84	4.25	4.11	0	34.92
Term at origination (years)	21,756	10.28	10.00	3.35	1.29	40.03
LTV at origination	21,756	0.6982	0.7210	0.0942	0.0850	0.8050
DSCR at origination (%)	21,756	1.5038	1.3800	0.4092	1	7.5500
Distressed loan indicator	21,756	0.00	0	0.06	0	1
Property quality score	21,756	0.50	0.50	0.27	0.01	1
Transaction price (millions of dollars)	21,756	25	11	81	0	5400
Loan size at origination (millions of dollars)	21,756	16	8	45	0	3002
CBD indicator	21,756	0.07	0	0.26	0	1
Agency loan indicator	21,756	0.38	0	0.48	0	1
Building age at time of transaction (years)	21,756	32	29	23	0	255
Building size in square feet (1,000s) at time of transaction	21,756	153	100	194	1	10247

Panel C: Statistics for loans on properties that are not sold before or at maturity

Variable	Count	Mean	Median	SD	Min	Max
Interest rate at origination (%)	66,843	0.05	0.05	0.01	0.02	0.09
Term remaining as of 1st obs. (years)	66,843	10.43	10.00	4.27	0.50	40.00
Term remaining at time of transaction (years)	66,843	3.32	0.83	4.88	0	34.75
Term at origination (years)	66,843	10.70	10.01	4.12	1.05	40.03
LTV at origination	66,843	0.6613	0.6870	0.1183	0.0850	0.8050
DSCR at origination (%)	66,843	1.6025	1.4100	0.6198	1	7.5500
Distressed loan indicator	66,843	0.07	0	0.25	0	1
Property quality score	66,843	0.53	0.53	0.27	0.01	1
Transaction price (millions of dollars)	66,843	26	11	80	0	5700
Loan size at origination (millions of dollars)	66,843	15	7	38	0	2901
CBD indicator	66,843	0.10	0	0.31	0	1
Agency loan indicator	66,843	0.43	0	0.49	0	1
Building age at time of transaction (years)	66,843	39	34	27	0	283
Building size in square feet (1,000s) at time of transaction	66,843	130	77	181	0	10247

Table 1: SUMMARY STATISTICS AT LOAN LEVEL. *Note:* DSCR is at time of first transaction, which is typically the loan origination date. We use the label "at origination" in this case to avoid confusing the DSCR timing with the variables that are as of the time of the second transaction like term remaining, age, and building size. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

Variable	Count	Mean	Median	SD	Min	Max
$\Delta_{i,p,t}$	6,645,073	0.0007	0.0016	0.0119	-0.0537	0.0542
Interest rate advantage	6,645,073	0.0043	0	0.0075	0	0.0537
Lt1yr to maturity	6,645,073	0.07	0	0.25	0	1
Lt2yr since origination	6,645,073	0.28	0	0.45	0	1
Indicator for sale	6,645,073	0.0032	0	0.0565	0	1
Indicator for refi	6,645,073	0.0025	0	0.0497	0	1
Indicator for sale or refi	6,645,073	0.0057	0	0.0751	0	1

Table 2: SUMMARY STATISTICS AT LOAN-MONTH LEVEL. *Note:* This table reports summary statistics at the loan-month level for our estimation sample. All variables are defined in Table A.1. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

Property type	Count	Count Shr. (%)	Volume ($ bn.)	Volume Shr. (%)	Sale Count	Sale Shr. (%)
Industrial	5,848	6.6%	$91.1 bn.	4.0%	1,406	24.0%
Multifamily	42,429	47.9%	$991.5 bn.	43.9%	10,207	24.1%
Office	13,868	15.7%	$635.9 bn.	28.1%	3,843	27.7%
Retail	26,454	29.9%	$540.4 bn.	23.9%	6,300	23.8%
Total	88,599	100.0%	$2,258.9 bn.	100.0%	21,756	24.6%

Table 3: PROPERTY TYPE SUMMARY STATISTICS FOR LOANS IN THE SAMPLE. *Notes:* Count Shr. is the count of loans in the property type relative to the count of total loans in the sample (in percentage terms). Sale Shr. is the count of sales in the property type relative to the count of loans in the property type (in percentage terms). Total for Sale Shr. is then the share of total sales out of total loans (in percentage terms). Volumes in billions of dollars reflect nominal transaction value at time of transaction in the sample. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

Buyer Type	Count	Count Shr. (%)	Volume ($ bn.)	Volume Shr. (%)	Sale Count	Sale Shr. (%)
Bank	154	0.2%	$14.0 bn.	0.6%	75	48.7%
Developer/Owner/Operator	59,944	67.7%	$1,325.5 bn.	58.7%	14,867	24.8%
Equity Fund	3,217	3.6%	$182.6 bn.	8.1%	1,201	37.3%
Investment Manager	2,664	3.0%	$145.3 bn.	6.4%	885	33.2%
Other/Unknown	13,422	15.1%	$184.5 bn.	8.2%	2,075	15.5%
Pension Fund	114	0.1%	$34.4 bn.	1.5%	49	43.0%
REIT	4,397	5.0%	$280.4 bn.	12.4%	1,140	25.9%
REOC	305	0.3%	$16.3 bn.	0.7%	123	40.3%
Small	4,382	4.9%	$75.9 bn.	3.4%	1,341	30.6%
Total	88,599	100.0%	$2,258.9 bn.	100.0%	21,756	24.6%

Table 4: OWNER TYPE SUMMARY STATISTICS ACROSS CMBS TRANSACTIONS. *Notes:* Based on Ghent (2021), we define small owners as those "Developer/Owner/Operators" or "Unknown" investors with fewer than 5 transactions. REITs include the owner groups "REIT" or "Non Traded REIT." The other groups are as listed in the data, with "Other/Unknown" including all remaining investors. Count Shr. is the count of loans in the buyer type relative to the count of total loans in the sample (in percentage terms). Sale Shr. is the count of sales in the buyer type relative to the count of loans in the buyer type (in percentage terms). Total for Sale Shr. is then the share of total sales out of total loans (in percentage terms). Volumes in billions of dollars reflect nominal transaction value at time of transaction in the sample. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Salesx100			Ln Price		
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Advantage	-5.41***	-5.93***	-5.40***	7.98***	6.91***	4.28**
	(0.58)	(0.57)	(0.61)	(1.51)	(1.51)	(1.67)
Lt1yr to maturity	0.42***	0.44***	0.44***	-0.00	-0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Lt2yr since origination	-0.37***	-0.38***	-0.39***	0.05***	0.04***	0.02
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Ln. real price	-0.04***	-0.06***	-0.03**			
	(0.01)	(0.01)	(0.01)			
LTV > 0.75	0.09***	0.07***	0.08***	0.01	0.02*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DSCR < 1.25	0.03***	0.03***	0.03***	-0.03**	-0.03**	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Distressed indicator	-0.34***	-0.35***	-0.34***	-1.31***	-1.31***	-1.07***
	(0.02)	(0.02)	(0.02)	(0.39)	(0.39)	(0.40)
Quality score	0.07***	0.07***	0.02	1.18***	1.16***	1.16***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.06)
Term at origination	-0.01***	-0.01***	-0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	-0.01	-0.01	-0.01	0.26***	0.26***	0.27***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.06)
Bldg. age (decades)	0.0156***	0.0129***	0.0096***	-0.0319***	-0.0327***	-0.0322***
	(0.0034)	(0.0033)	(0.0031)	(0.0070)	(0.0070)	(0.0081)
Bldg. age (decades) sqrd.	-0.0011***	-0.0010***	-0.0007***	0.0021***	0.0022***	0.0024***
	(0.0003)	(0.0003)	(0.0002)	(0.0005)	(0.0005)	(0.0006)
Ln bldg. sq. ft.	0.10***	0.09***	0.06***	0.88***	0.86***	0.87***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	-0.03	-0.03**	-0.05***	0.08***	0.08***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Prev. trans. refi indicator	-0.51***	-0.52***	-0.53***			
	(0.02)	(0.02)	(0.02)			
Observations	6,645,073	6,645,073	6,645,047	21,249	21,249	18,416
Adjusted R^2	0.004	0.004	0.004	0.794	0.796	0.820
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Owner Type FE	N	Y	Y	N	Y	Y
Market FE	Y	Y	N	Y	Y	N
Market x Year-Quarter FE	N	N	Y	N	N	Y

Table 5: EFFECT OF INTEREST RATE ADVANTAGE ON SALES AND TRANSACTION PRICES. *Note:* This table shows a linear regression of sales multiplied by 100 (columns 1-3) and log of transaction price (columns 4-6) on *Interest Rate Advantage* and controls. The sample in columns 1 through 3 includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature, while columns 4 through 6 only include sold properties. Building square feet is in millions before taking the natural log. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. All variables defined in Table A.1. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Multifamily (MF)	Commercial (Comm.)	MF & Comm.
CMBS	48.9%	13.8%	26.8%
Banks	34.3%	62.7%	52.2%
Insurers	10.3%	13.8%	12.5%
Other	6.5%	9.7%	8.5%

Table 6: CRE DEBT SHARES IN THE FINANCIAL ACCOUNTS OF THE UNITED STATES IN 2023. *Note:* Data is derived from Tables L.219 (multifamily mortgages) and L.220 (commercial mortgages) from the Financial Accounts of the United States for 2023. CMBS is the sum of Government-sponsored enterprises, Agency- and GSE-backed mortgage pools, ABS issuers, and mREIT holdings of CMBS; Banks is the sum of U.S.-chartered depository institutions, Foreign banking offices in U.S., Credit unions, and Banks in U.S.-affiliated areas; Insurers is the sum of Property-casualty insurance companies and Life insurance companies; Other is all other holders listed on either table of the Financial Accounts. *Source:* Authors' calculations using data from the Financial Accounts of the United States.

	Salesx100					
	High LTV Indicator		Low DSCR Indicator		Distressed Loan Indicator	
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Advantage	-6.22***	-5.67***	-6.45***	-6.45***	-6.36***	-5.84***
	(0.61)	(0.66)	(0.58)	(0.58)	(0.56)	(0.60)
DSCR $<$ 1.25	0.04***	0.05***				
	(0.01)	(0.01)				
Int. Rate Adv. x (DSCR $<$ 1.25)	0.87	0.33				
	(1.16)	(0.81)				
LTV $>$ 0.75			0.08***	0.08***		
			(0.01)	(0.01)		
Int. Rate Adv. x (LTV $>$ 0.75)			0.62	0.62		
			(0.98)	(0.98)		
Distressed indicator					-0.37***	-0.36***
					(0.02)	(0.02)
Int. Rate Adv. x (Distressed Indicator)					2.82**	1.90*
					(1.00)	(0.86)
Lt1yr to maturity	0.46***	0.46***	0.45***	0.45***	0.45***	0.45***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Lt2yr since origination	-0.39***	-0.40***	-0.39***	-0.39***	-0.39***	-0.39***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Ln. real price	-0.06***	-0.03*	-0.06***	-0.06***	-0.05***	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Quality score	0.07***	0.02	0.07***	0.07***	0.05**	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Term at origination	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	-0.0191	-0.0177	-0.0167	-0.0167	-0.0126	-0.0116
	(0.0167)	(0.0165)	(0.0168)	(0.0168)	(0.0166)	(0.0163)
Bldg. age (decades)	0.0126***	0.0089**	0.0125***	0.0125***	0.0116***	0.0084**
	(0.0034)	(0.0031)	(0.0033)	(0.0033)	(0.0033)	(0.0031)
Bldg. age (decades) sqrd.	-0.00***	-0.00**	-0.00***	-0.00***	-0.00***	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln bldg. sq. ft.	0.09***	0.07***	0.09***	0.09***	0.08***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	-0.02	-0.03*	-0.02	-0.02	-0.03*	-0.04**
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Prev. trans. refi indicator	-0.51***	-0.51***	-0.51***	-0.51***	-0.52***	-0.53***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	6,645,073	6,645,047	6,645,073	6,645,073	6,645,073	6,645,047
Adjusted R^2	0.004	0.004	0.004	0.004	0.004	0.004
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Market FE	Y	N	Y	Y	Y	N
Market x Year-Quarter FE	N	Y	N	N	N	Y
Owner Type FE	Y	Y	Y	Y	Y	Y

Table 7: EFFECT OF INTEREST RATE ADVANTAGE ON SALES BY RISK MEASURE. *Note:* This table shows a linear regression of sales multiplied by 100 on *Interest Rate Advantage* and controls. *Interest Rate Advantage* is interacted with three different loan risk measures across the columns. The sample includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Ln Price					
	High LTV Indicator		Low DSCR Indicator		Distressed Loan Indicator	
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Advantage	7.02***	4.35*	7.12***	4.03*	7.43***	4.73**
	(1.54)	(1.75)	(1.70)	(1.88)	(1.59)	(1.81)
DSCR $<$ 1.25	-0.03*	-0.03				
	(0.01)	(0.02)				
Int. Rate Adv. x (DSCR $<$ 1.25)	-2.12	1.58				
	(2.98)	(2.76)				
LTV $>$ 0.75			0.01	0.00		
			(0.01)	(0.01)		
Int. Rate Adv. x (LTV $>$ 0.75)			-0.89	3.38		
			(3.42)	(1.96)		
Distressed indicator					-0.84*	-0.60*
					(0.34)	(0.27)
Int. Rate Adv. x (Distressed Indicator)					-78.27	-101.11
					(47.37)	(61.86)
Lt1yr to maturity	-0.00	0.01	-0.00	0.01	-0.00	0.01
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Lt2yr since origination	0.04***	0.02	0.04***	0.02	0.04***	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln. real price						
Quality score	1.16***	1.16***	1.16***	1.16***	1.16***	1.16***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.06)
Term at origination	-0.00*	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	0.2543***	0.2710***	0.2550***	0.2716***	0.2587***	0.2718***
	(0.0530)	(0.0571)	(0.0531)	(0.0572)	(0.0533)	(0.0580)
Bldg. age (decades)	-0.0328***	-0.0322***	-0.0322***	-0.0320***	-0.0326***	-0.0314***
	(0.0069)	(0.0082)	(0.0069)	(0.0081)	(0.0069)	(0.0081)
Bldg. age (decades) sqrd.	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln bldg. sq. ft.	0.86***	0.87***	0.86***	0.87***	0.86***	0.87***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	0.08***	0.06**	0.08***	0.07**	0.08***	0.07**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	21,249	18,416	21,249	18,416	21,249	18,416
Adjusted R^2	0.791	0.817	0.791	0.817	0.797	0.822
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Market FE	Y	N	Y	N	Y	N
Market x Year-Quarter FE	N	Y	N	Y	N	Y
Owner Type FE	Y	Y	Y	Y	Y	Y

Table 8: EFFECT OF INTEREST RATE ADVANTAGE ON TRANSACTION PRICES BY RISK MEASURE. *Note:* This table shows a linear regression of log of transaction price on *Interest Rate Advantage* and controls. *Interest Rate Advantage* is interacted with three different loan risk measures across the columns. The sample includes columns 4 through 6 only include sold properties. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Salesx100			Ln Price		
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Advantage	-5.42***	-5.92***	-5.26***	8.45***	7.40***	4.99***
	(0.62)	(0.60)	(0.65)	(1.52)	(1.52)	(1.68)
Lt1yr to maturity	0.43***	0.45***	0.45***	0.00	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Lt2yr since origination	-0.37***	-0.39***	-0.39***	0.05***	0.04***	0.02
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Ln real price	-0.04***	-0.06***	-0.03**			
	(0.01)	(0.01)	(0.01)			
LTV > 0.75	0.09***	0.07***	0.08***	0.01	0.02*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DSCR < 1.25	0.03***	0.03***	0.03***	-0.03**	-0.03**	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Distressed indicator	-0.34***	-0.35***	-0.35***	-1.43***	-1.42***	-1.14***
	(0.02)	(0.02)	(0.02)	(0.43)	(0.43)	(0.42)
Quality score	0.07***	0.07***	0.02	1.18***	1.16***	1.17***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.07)
Term at origination	-0.01***	-0.01***	-0.01***	-0.00***	-0.00**	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	-0.01	-0.01	-0.01	0.27***	0.26***	0.28***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.06)
Bldg. age (decades)	0.0165***	0.0138***	0.0103***	-0.0331***	-0.0339***	-0.0332***
	(0.0035)	(0.0034)	(0.0032)	(0.0072)	(0.0072)	(0.0083)
Bldg. age (decades) sqrd.	-0.0012***	-0.0011***	-0.0008***	0.0023***	0.0023***	0.0026***
	(0.0003)	(0.0003)	(0.0003)	(0.0005)	(0.0005)	(0.0006)
Ln. bldg. sq. ft.	0.10***	0.09***	0.07***	0.88***	0.86***	0.87***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	-0.03*	-0.03**	-0.05***	0.08***	0.08***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Prev. trans. refi indicator	-0.51***	-0.53***	-0.54***			
	(0.02)	(0.02)	(0.02)			
Observations	6,393,626	6,393,626	6,393,599	20,795	20,795	18,067
Adjusted R^2	0.004	0.004	0.004	0.794	0.795	0.820
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Owner Type FE	N	Y	Y	N	Y	Y
Market FE	Y	Y	N	Y	Y	N
Market x Year-Quarter FE	N	N	Y	N	N	Y

Table 9: EFFECT OF INTEREST RATE ADVANTAGE ON SALES AND TRANSACTION PRICES: TREPP MEASURE OF MARKET INTEREST RATE. *Note:* This table shows a linear regression of sales multiplied by 100 (columns 1-3) and log of transaction price (columns 4-6) on *Interest Rate Advantage* and controls. *Interest Rate Advantage* is constructed using Trepp CMBS data to define the market interest rate. The sample in columns 1 through 3 includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature, while columns 4 through 6 only include sold properties. Building square feet is in millions before taking the natural log. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from MSCI Real Capital Analytics and Trepp, LLC.

	Salesx100			Ln Price		
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Advantage	-5.45***	-6.01***	-5.40***	14.33***	13.05***	15.75*
	(0.68)	(0.68)	(0.72)	(3.22)	(3.23)	(8.09)
Lt1yr to maturity	0.40***	0.42***	0.41***	0.02	0.02	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
Lt2yr since origination	-0.30***	-0.32***	-0.32***	0.06***	0.05***	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Ln. real price	0.00	-0.01	0.02			
	(0.01)	(0.01)	(0.01)			
LTV $>$ 0.75	0.07***	0.05***	0.06***	-0.00	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
DSCR $<$ 1.25	0.04***	0.04***	0.04***	-0.02*	-0.02	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)
Distressed indicator	-0.34***	-0.35***	-0.35***	-1.58***	-1.58***	-0.74
	(0.01)	(0.01)	(0.01)	(0.46)	(0.46)	(0.49)
Quality score	0.08***	0.08***	0.02	1.46***	1.44***	1.53***
	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.08)
Term at origination	-0.01***	-0.01***	-0.01***	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	0.01	0.00	0.00	0.29***	0.29***	0.30***
	(0.02)	(0.02)	(0.02)	(0.06)	(0.06)	(0.09)
Bldg. age (decades)	-0.0001	-0.0031	-0.0058*	-0.0408***	-0.0419***	-0.0357**
	(0.0031)	(0.0031)	(0.0030)	(0.0099)	(0.0100)	(0.0176)
Bldg. age (decades) sqrd.	-0.0002	-0.0000	0.0002	0.0030***	0.0030***	0.0035***
	(0.0003)	(0.0003)	(0.0003)	(0.0007)	(0.0007)	(0.0010)
Ln. bldg. sq. ft.	0.07***	0.06***	0.03***	0.89***	0.88***	0.88***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Prev. trans. refi indicator	-0.43***	-0.45***	-0.45***			
	(0.01)	(0.01)	(0.01)			
Observations	4,431,633	4,431,633	4,430,895	12,993	12,993	7,234
Adjusted R^2	0.003	0.003	0.003	0.757	0.758	0.801
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Owner Type FE	N	Y	Y	N	Y	Y
Market	Y	Y	N	Y	Y	N
Market x Year-Quarter FE	N	N	Y	N	N	Y

Table 10: EFFECT OF INTEREST RATE ADVANTAGE ON SALES AND TRANSACTION PRICES: EXCLUDING AGENCY LOANS. *Note:* This table shows a linear regression of sales multiplied by 100 (columns 1-3) and log of transaction price (columns 4-6) on *Interest Rate Advantage* and controls. Agency CMBS loans are excluded. The sample in columns 1 through 3 includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature, while columns 4 through 6 only include sold properties. Building square feet is in millions before taking the natural log. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Salesx100			Ln Price		
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Differential, $\Delta_{i,p,t}$	2.61***	3.59***	3.20***	-5.42***	-4.82***	-3.13***
	(0.40)	(0.38)	(0.43)	(0.76)	(0.76)	(0.84)
Lt1yr to maturity	0.42***	0.44***	0.44***	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Lt2yr since origination	-0.36***	-0.37***	-0.37***	0.03**	0.03**	0.01
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Ln. real price	-0.05***	-0.06***	-0.03**			
	(0.01)	(0.01)	(0.01)			
LTV $>$ 0.75	0.09***	0.08***	0.08***	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DSCR $<$ 1.25	0.03***	0.03***	0.03***	-0.02	-0.02	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Distressed indicator	-0.34***	-0.34***	-0.34***	-1.31***	-1.30***	-1.06***
	(0.02)	(0.02)	(0.02)	(0.39)	(0.39)	(0.40)
Quality score	0.07***	0.07***	0.03	1.17***	1.15***	1.16***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.06)
Term at origination	-0.01***	-0.01***	-0.01***	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	-0.01	-0.01	-0.01	0.26***	0.26***	0.27***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.06)
Bldg. age (decades)	0.0157***	0.0131***	0.0098***	-0.0312***	-0.0320***	-0.0318***
	(0.0034)	(0.0033)	(0.0031)	(0.0070)	(0.0070)	(0.0081)
Bldg. age (decades) sqrd.	-0.0011***	-0.0010***	-0.0007***	0.0020***	0.0021***	0.0024***
	(0.0003)	(0.0003)	(0.0003)	(0.0005)	(0.0005)	(0.0006)
Ln bldg. sq. ft.	0.10***	0.09***	0.06***	0.87***	0.86***	0.87***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	-0.02	-0.03*	-0.04***	0.07***	0.06***	0.05**
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Prev. trans. refi indicator	-0.51***	-0.52***	-0.53***			
	(0.02)	(0.02)	(0.02)			
Observations	6,645,073	6,645,073	6,645,047	21,249	21,249	18,416
Adjusted R^2	0.004	0.004	0.004	0.795	0.796	0.820
Prop Type x Year-Quarter FE	Y	Y	Y	Y	Y	Y
Owner Type FE	N	Y	Y	N	Y	Y
Market	Y	Y	N	Y	Y	N
Market x Month FE	N	N	Y	N	N	Y

Table 11: EFFECT OF INTEREST RATE DIFFERENTIAL ON SALES AND TRANSACTION PRICES. *Note:* This table shows a linear regression of sales multiplied by 100 (columns 1-3) and log of transaction price (columns 4-6) on the interest rate differential and controls. The sample in columns 1 through 3 includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature, while columns 4 through 6 only include sold properties. Building square feet is in millions before taking the natural log. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market$\times$property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

	Salesx100		Ln Price	
	(1)	(2)	(3)	(4)
Interest Rate Advantage > 0	-5.79***	-6.16***	7.65***	6.41***
	(0.58)	(0.61)	(1.52)	(1.56)
Lt1yr to maturity	0.44***	0.44***	-0.00	-0.00
	(0.02)	(0.02)	(0.01)	(0.01)
Lt2yr since origination	-0.38***	-0.39***	0.05***	0.04***
	(0.02)	(0.02)	(0.01)	(0.01)
Ln. real price	-0.05***	-0.05***		
	(0.01)	(0.01)		
LTV > 0.75	0.08***	0.08***	0.01	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
DSCR < 1.25	0.03***	0.03***	-0.03**	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
Distressed indicator	-0.35***	-0.35***	-1.32***	-1.31***
	(0.02)	(0.02)	(0.39)	(0.39)
Quality score	0.06***	0.06***	1.19***	1.17***
	(0.02)	(0.02)	(0.05)	(0.05)
Term at origination	-0.01***	-0.01***	-0.01***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
CBD indicator	-0.01	-0.01	0.26***	0.26***
	(0.02)	(0.02)	(0.05)	(0.05)
Bldg. age (decades)	0.0124***	0.0124***	-0.0308***	-0.0317***
	(0.0032)	(0.0032)	(0.0070)	(0.0070)
Bldg. age (decades) sqrd.	-0.0010***	-0.0010***	0.0020***	0.0021***
	(0.0003)	(0.0003)	(0.0005)	(0.0005)
Ln bldg. sq. ft.	0.08***	0.08***	0.88***	0.86***
	(0.01)	(0.01)	(0.01)	(0.01)
Agency loan indicator	-0.03**	-0.03**	0.08***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Prev. trans. refi indicator	-0.52***	-0.52***		
	(0.02)	(0.02)		
High fixed rt. shr. in mkt. ind.	-0.06***	-0.08***	0.11***	0.09***
	(0.02)	(0.02)	(0.03)	(0.03)
High fixed rt. shr. in mkt. ind. x (Interest Rate Advantage > 0)		0.04***		0.02
		(0.01)		(0.02)
Observations	6,645,073	6,645,073	21,249	21,249
Adjusted R^2	0.004	0.004	0.795	0.796
Prop Type x Year-Quarter FE	Y	Y	Y	Y
Owner Type FE	N	Y	N	Y
Market FE	Y	Y	Y	Y

Table 12: EFFECT OF MARKET FIXED RATE SHARES ON SALES AND TRANSACTION PRICES. *Note:* This table shows a linear regression of sales multiplied by 100 (columns 1-2) and log of transaction price (columns 3-4) on *Interest Rate Advantage*, having a high fixed rate share in the market (see Section 6 for details), and the interaction of these measures, along with additional controls. The sample in columns 1 and 2 includes loans that are sold or refinanced, as well as the loans that mature without a sale or refinance or that have yet to mature, while columns 3 and 4 only include sold properties. Building square feet is in millions before taking the natural log. The distressed indicator is 1 for loans where RCA's *DistressedStatus* field is non-missing and not marked as "Resolved." Standard errors, in parentheses, are clustered at the market×property type level. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. All variables defined in Table A.1. *Source:* Authors' calculations using data from MSCI Real Capital Analytics.

A. APPENDIX

A.1. Variable Definitions

Table A.1: Variable definitions

Variable	Definition
$\Delta_{i,p,t}$	The difference between the interest rate on loan i at origination and the current market interest rate, as defined in equation 14
Interest Rate Advantage	Equal to the market interest rate at time t minus the interest rate on loan i when the rate on loan i is smaller than the market rate, and 0 otherwise
Ln real price	Natural log of the previous transaction price in 2017 dollars
LTV>0.75	Indicator equal to 1 when origination loan-to-value ratio is greater than 75%, and 0 otherwise
DSCR<1.25	Indicator equal to 1 when origination debt service coverage ratio is less than 1.25, and 0 otherwise
Distressed indicator	Indicator equal to 1 when the transaction is associated with a distressed property (as defined by RCA), and 0 otherwise
Lt1yr to maturity	Indicator equal to 1 when loan has less than a year remaining to maturity at the time of transaction, and 0 otherwise
Lt2yr since origination	Indicator equal to 1 when transaction occurs less than 2 years after loan origination, and 0 otherwise
Quality score	RCA property quality score
Term at origination	Term to maturity at time of loan origination
CBD indicator	Indicator equal to 1 if property is located in central business district (CBD), and 0 otherwise
Bldg age	Building age in decades
Ln bldg sq ft	Natural log of building square feet
Agency loan indicator	Indicator equal to 1 if loan is an agency CMBS loan, and 0 otherwise
Prev trans refi indicator	Indicator equal to 1 if previous transaction observed in RCA was a refinancing, and 0 otherwise

A.2. *Proof of Proposition 1*

The probability π of the sale is equal to

$$\begin{aligned}\pi &= \Pr(P^B \geq P^S) = \Pr(u \geq S - \Delta M) \\ &= \Pr(x \leq B - S + \Delta M) \\ &= 1 - e^{-\lambda(B-S+\Delta M)}.\end{aligned}$$

Since the exponential function is strictly increasing and $(B - S + \Delta M) > 0$, we have $\pi(\Delta, \lambda)$ is increasing in Δ and λ.

The expected sale price is equal to the expected value of P^*, which is given by (4), conditional on $P^B \geq P^S$, or $u \geq S - \Delta M$. Thus, we can write

$$\begin{aligned}\bar{P}(\Delta,\lambda) &= \frac{1}{2(1+r_0)} E\left[u + S - \Delta M | u \geq S - \Delta M\right] \\ &= \frac{1}{2(1+r_0)} E\left[B - x + S - \Delta M | x \leq B - S + \Delta M\right] \\ &= \frac{1}{2(1+r_0)} \left(2B - (B - S + \Delta M) - E\left[x | x \leq B - S + \Delta M\right]\right) \\ &= \frac{1}{2(1+r_0)} \left(2B - Z - E\left[x | x \leq Z\right]\right), \end{aligned} \quad \text{(A.1)}$$

where Z is defined as follows

$$Z \equiv B - S + \Delta M.$$

Integrating by parts yields

$$\int_0^Z x\lambda e^{-\lambda x} dx = \frac{1}{\lambda} - \left(Z + \frac{1}{\lambda}\right) e^{-\lambda Z}.$$

We use the above integral to calculate

$$
\begin{aligned}
E\left[x|x\leq Z\right] &= \frac{1}{1-e^{-\lambda Z}}\int_{0}^{Z} x\lambda e^{-\lambda x}dx \\
&= \frac{1}{1-e^{-\lambda Z}}\left(\frac{1}{\lambda}-\left(Z+\frac{1}{\lambda}\right)e^{-\lambda Z}\right) \\
&= \frac{1}{\lambda}-\frac{Ze^{-\lambda Z}}{1-e^{-\lambda Z}} \\
&= \frac{1}{\lambda}-\frac{Z}{e^{\lambda Z}-1}.
\end{aligned}
$$

Plugging it into (A.1) yields

$$
\bar{P}(\Delta,\lambda)=\frac{1}{2(1+r_0)}\left(2B-Z-\frac{1}{\lambda}+\frac{Z}{e^{\lambda Z}-1}\right), \tag{A.2}
$$

which is equivalent to (8).

To investigate how $\bar{P}(\Delta,\lambda)$ depends on λ and Δ, we differentiate (A.2) with respect to λ and Z. We note that Z is positive, linear in Δ and independent of λ.

$$
\begin{aligned}
2(1+r_0)\frac{\partial\bar{P}}{\partial\lambda} &= \frac{1}{\lambda^2}-\frac{Z^2e^{\lambda Z}}{\left(e^{\lambda Z}-1\right)^2} \\
&= \frac{1}{\lambda^2}\left(1-\left(\frac{\lambda Ze^{0.5\lambda Z}}{e^{\lambda Z}-1}\right)^2\right).
\end{aligned}
$$

To prove that $\frac{\partial\bar{P}}{\partial\lambda}>0$, we need to show that $\frac{e^{\lambda Z}-1}{\lambda Z}>e^{0.5\lambda Z}$. According to the Taylor series,

$$
e^y=\sum_{n=0}^{\infty}\frac{y^n}{n!}.
$$

Thus,

$$\frac{e^{\lambda Z}-1}{\lambda Z} = \sum_{n=1}^{\infty}\frac{(\lambda Z)^{n-1}}{n!} = 1+\frac{1}{2}\lambda Z+\frac{1}{6}(\lambda Z)^2+..., \tag{A.3}$$

$$e^{0.5\lambda Z} = \sum_{n=0}^{\infty}\frac{(\lambda Z)^{n}}{2^n n!} = 1+\frac{1}{2}\lambda Z+\frac{1}{8}(\lambda Z)^2+... \ . \tag{A.4}$$

One can see that the first sum (A.3) is greater than the second sum (A.4), since the first two terms are identical, but all the other terms are strictly greater in the first sum for $Z>0$. Thus, $\frac{\partial \bar{P}}{\partial \lambda}>0$, and $\bar{P}(\Delta,\lambda)$ is increasing λ.

Finally, differentiating (A.2) with respect to Z yields

$$\begin{aligned} 2(1+r_0)\frac{\partial \bar{P}}{\partial Z} &= -1+\frac{e^{\lambda Z}-1-\lambda Z e^{\lambda Z}}{\left(e^{\lambda Z}-1\right)^2} \\ &= \frac{\phi(Z)}{\left(e^{\lambda Z}-1\right)^2}, \end{aligned}$$

where

$$\phi(Z) = -e^{2\lambda Z}+3e^{\lambda Z}-2-\lambda Z e^{\lambda Z}.$$

To prove that $\frac{\partial \bar{P}}{\partial Z}<0$ for $Z>0$, we need to show that $\phi(Z)<0$ for $Z>0$. We note that $\phi(Z)$ is a continuously differentiable function, $\phi(0)=0$, and

$$\frac{\partial \phi(Z)}{\partial Z} = -2\lambda e^{\lambda Z}\left(e^{\lambda Z}-1\right)-\lambda^2 Z e^{\lambda Z}<0 \text{ for } Z>0.$$

Thus, $\phi(Z)<0$, and $\frac{\partial \bar{P}}{\partial Z}<0$ for $Z>0$. Since Z is strictly increasing in Δ, we have $\bar{P}(\Delta,\lambda)$ is decreasing in Δ. **Q.E.D.**