Lease Expirations and CRE Property Performance*

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Abstract

We study how lease expirations affect the performance of commercial real estate properties and how these patterns changed during the COVID-19 pandemic. Even before the pandemic, lease expirations produced notable downside risks to property occupancy and income, particularly in weaker property markets. These risks became more pronounced during the pandemic, driven mostly by office properties; the adverse effect of lease expirations on office occupancy increased more than 50 percent overall, and it doubled for offices in central business districts. This change in office leasing activity is consistent with an eventual 6 percentage point increase in the steady state vacancy rate for suburban offices, and about a 20 percentage point rise for CBD offices. As regional and community banks' office loan exposure is concentrated outside of CBDs, this geographic pattern may mitigate the extent of CRE credit losses for these banks.

Keywords: Commercial real estate, lease expirations, COVID-19, office loans, bank loan exposure
JEL codes: R30, R33, G21, G23.

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1 Introduction

The COVID-19 pandemic has the potential to significantly disrupt the commercial real estate (CRE) market. In particular, the pandemic-induced shift to remote work appears to have led to a large and persistent decline in the demand for office space, especially in central business districts (CBDs). However, CRE loan performance remained relatively resilient during the first few years of the pandemic, as long-term leases temporarily shielded commercial-property owners from the ramifications of the weaker demand for space. How these properties will perform in the longer term as more leases expire remains an open question. To shed light on this topic, we analyze how lease expirations have affected property performance historically and investigate how these patterns have changed so far for leases that have expired since the COVID-19 outbreak.

We find that, before the pandemic, lease expirations tended to be associated with modest deterioration in a property's financial performance. A property with expiring leases accounting for 10 percent of its square footage would be expected to experience a roughly 80 basis point decline in occupancy rate and net operating income (NOI) growth following the expiration. These declines predominantly reflect downside risk; lease expirations have little effect on median or better property outcomes, but they are associated with notable declines in occupancy and income at lower performance quantiles.

These effects of lease expirations are highly dependent on the strength of the local property market. In markets with minimal vacancy, expirations bring about little change in occupancy and even modest increases in income. However, when market vacancy rates are relatively high, expirations are associated with more dramatic declines in income and occupancy. Intuitively, when local demand is weak, expiring leases are less likely to be renewed or replaced at a comparable rent. Even when landlords do manage to lease the space again, costlier concessions are needed to do so, resulting in weaker cash flows after the expiration.

This dynamic implies that the outcome of recent lease expirations can provide a valuable signal about the strength of demand in a local property market. For example, to the extent that demand for office space has fallen structurally due to the pandemic, we would expect the financial performance of office properties to deteriorate more substantially when leases expire. Even when not enough leases have rolled over to cause a significant deterioration in property performance, an environment characterized by difficulty retaining tenants upon expiration can signal that there is stress to come.

To investigate the extent to which the pandemic has stressed CRE markets, we examine how the response of CRE property performance to scheduled lease expirations differs in the pandemic and pre-pandemic periods. We find that, overall, expirations during the pandemic

have so far had only modestly larger effects on occupancy or income compared with the period before the COVID-19 outbreak. However, some segments are clearly experiencing strains. For offices, the predicted effect of lease expirations on occupancy increased by about one-half during the pandemic, and the predicted effect on NOI nearly doubled. These effects vary substantially across localities; the effect of lease expirations on occupancy or income over doubled for office properties in CBDs relative to the effect before the pandemic. Additionally, we find much larger effects of COVID-era lease expirations in counties where there has been a large and persistent decline in time spent at workplaces.

Finally, we provide two exercises to investigate the longer-term implications of the findings in terms of office performance and bank credit risk exposure. First, we relate the regression estimates to a simple model of occupancy dynamics and solve for the new steady state vacancy rates implied by the regressions. If the increase in the rate at which tenants leave upon lease expiration and the decline in the rate at which vacant space is filled persist, we estimate that the steady state vacancy rate would rise by 6 percentage points in suburban office markets, and 20 percentage points in CBD office markets. While the actual rise in vacancy rates is likely to be somewhat smaller (due to an expected contraction in the supply of office space and a shift in the composition tenants as remote-heavy firms exit space), these results suggest the potential for significant further deterioration in office fundamentals, particularly for CBDs.

Second, we examine the extent to which different types of lenders are exposed to vulnerable CRE loan segments. We show that relative to smaller banks, global systemically important banks (G-SIBs) and nonbank CRE lenders have higher concentrations of office lending in the most at-risk areas (that is, CBDs and areas with a greater shift to remote work). Thus, while office loans at small and regional banks still face headwinds from higher interest rates and difficulties refinancing, the properties securing these loans at least appear to be located in markets with more favorable leasing dynamics. This geographic distribution should mitigate the risk of deteriorating office loan performance amplifying regional bank strains.

1.1 Related Literature

Broadly speaking, this paper contributes to three strands of work. First, we contribute to work analyzing frictions in leasing markets. Mooradian and Yang (2000); Yoshida et al. (2016) show that the lessees need to pay significant premiums for short-term leases or cancellation options, consistent with landlords trying to mitigate transaction costs associated with tenant turnover. Moszkowski and Stackman (2022) show that search frictions in leasing

markets combined with substantial heterogeneity in match quality can produce long vacancy spells when tenants exit, as landlords wait to find a suitable tenant. We add to this work by directly testing how property performance changes as leases expire. Consistent with this literature, we show that the effects of lease expirations are significant, and skewed to the downside.

Second, we contribute to work analyzing the disruption to property markets posed by the COVID-19 pandemic. The pandemic caused a significant movement of people and businesses to lower density areas (Ramani and Bloom, 2021; Monte et al., 2023), prompting adverse effects on property prices (Ghosh et al., 2022) and commercial rent (Rosenthal et al., 2022) in urban areas. Gupta et al. (2022) estimate that declines in leasing revenue due to the rise of remote work lowered the value of office buildings in the U.S. substantially. Our estimates provide more information on the dynamics behind the decline in leasing activity. We estimate that there was both a sizable increase in the rate at which tenants exit when leases expire during COVID, and a decline in the rate at which vacant space is filled. Both of these effects were more prominent in CBDs.

Third, we contribute to work analyzing the exposure of the banking sector to such CRE-market strains. Jiang et al. (2023) use information the frequency with which commercial mortgage-backed securities (CMBS) loans have negative equity to quantify the extent to which CRE credit risk compounds bank solvency concerns. Acharya et al. (2023) note that impending commercial real estate losses may add to other stresses being felt by small and regional banks in the aftermath of the run on Silicon Valley Bank. We show that these banks are less exposed than CMBS to the markets where leasing activity is deteriorating the most (i.e., CBDs and areas with a larger shift to remote work). Thus while the performance of bank loans is likely to deteriorate going forward, this geographic pattern suggests that the deterioration might be less severe than would be otherwise expected based on CMBS market signals.

2 Data and Methodology

We panel data from Morningstar on properties securing CMBS loans to investigate the effects of lease expirations on property performance. CMBS are the second-largest category of lenders funding office properties in the United States (behind banks) and tend to specialize in larger loans.[1] This market segment is useful to study because borrowers need to provide regular updates regarding their property's financial performance and lease expiration sched-

[1]See Glancy et al. (2022) for a discussion of how CMBS loan portfolios differ from those of other major CRE lenders.

ule. Our sample contains office, retail, and industrial properties, the three property types for which lease expirations are important. The sample starts in 2009, when reporting of leasing variables began.[2]

While the data are reported monthly, the main variables of interest typically are updated at a lower frequency. At each lease rollover review date, scheduled lease expirations are reported in one year increments up to four years out. We measure pending lease expirations as of the last lease rollover review date that is at least one year before the date financials were updated. Measuring pending lease expirations using scheduled expirations from more than a year away addresses the sample selection concern that very-near-term expirations are observed only for tenants that do not extend their leases by that point.[3] Namely, our measure of lease expirations from year t to $t+1$ comes from the year-ahead pending expirations reported from the lease review in year $t-1$.

Regarding property performance, we consider changes in occupancy and net operating income between the last financial update before the lease expiration window starts to the first update after that window ends.[4] As financials are typically updated annually, the outcome variable is generally the change in occupancy or income in the two year window containing the one year lease expiration window. Details on how we construct our measure of lease expirations, and the timing involved, are provided in Appendix A.

To analyze the effects of lease expirations and how they changed during the pandemic, we estimate equations along the lines of:

$$\begin{aligned} Y_{i,t-.5,t+1.5} = \alpha_{p,t} &+ \text{Expirations}_{i,t,t+1} \times \left(\gamma_0 + \sum_{j \in J} \gamma_j Z_{j,i,t}\right) \\ &+ \text{COVID Expirations}_{i,t,t+1} \times \left(\beta_0 + \sum_{j \in J} \beta_j Z_{j,i,t}\right) \\ &+ \eta' X_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{1}$$

where $Y_{i,t-.5,t+1.5}$ is the change in the occupancy rate or NOI growth for property i over the

[2]Properties securing pari passu loans (loans split across multiple deals) appear multiple times in the data. We only keep one property-month observation in these circumstances.

[3]Appendix Figure A.2 plots the distribution of scheduled lease expirations as of 2019. The density drops off when the expiration is less than a year away, suggesting that some leases that would have had imminent expirations were renewed instead. By comparison, the density is fairly flat for expirations that are more than a year away. Consequently, scheduled lease expirations that are more than a year away should reflect the timing of previous contract arrangements rather than endogenous renewal decisions.

[4]We drop observations where the financial update is more than 1.5 years after the end of the lease expiration window in order to guarantee that we are consistently examining the near-term effects of expirations.

period containing the lease expiration window.[5] $\text{Expirations}_{i,t,t+1}$ is the share of leases (in terms of square footage) set to expire, and COVID $\text{Expirations}_{i,t,t+1}$ is the interaction of that variable with the pandemic indicator (equal to 1 if t is 2020 or later). $\{Z_{j,i,t}\}_{j \in J}$ is a set of variables potentially affecting the sensitivity of property performance to lease expirations, and $X_{i,t}$ is a vector of controls that include the property vacancy rate at the start of the reporting window as well as the non-interacted $Z_{j,i,t}$ variables. $\alpha_{p,t}$ is a property type-year fixed effect.

The key objects of interest are $\hat{\gamma}_0$, which estimates how lease expirations affect property performance in normal times, and $\hat{\beta}_0$, which estimates the degree to which expirations became more impactful during the pandemic. Additionally, the interaction terms $\hat{\gamma}_k$ and $\hat{\beta}_k$ allow us to estimate how certain factors such as market vacancy rates or remote-work patterns amplify the effects of lease expirations before or during the pandemic. In some specifications, we estimate equation (1) by quantile regression, in which case coefficient estimates pertain to how lease expirations affect various quantiles (rather than the expected value) of $Y_{i,t-.5,t+1.5}$.

3 Effects of Lease Expirations on Income and Vacancy

Before analyzing the effects of the COVID-19 pandemic, this section establishes the baseline estimates of how lease expirations affect property performance in normal times. Section 3.1 uses quantile regressions to demonstrate that lease expirations increase the downside risk to property performance. Section 3.2 shows that the effects of expirations are amplified in markets with higher vacancy rates.

3.1 Quantile Regression Estimates

The effects of lease expirations on occupancy and income are likely to be asymmetric. The asymmetry is obvious regarding the occupancy rate, as occupancy would remain the same if the lease is renewed or the tenant replaced, but it would decline if the original tenant downsizes or completely vacates the property. Similarly, the increase in rent that could be achieved if a new lease is signed is likely much less than the loss in rent that would occur if a tenant departs.

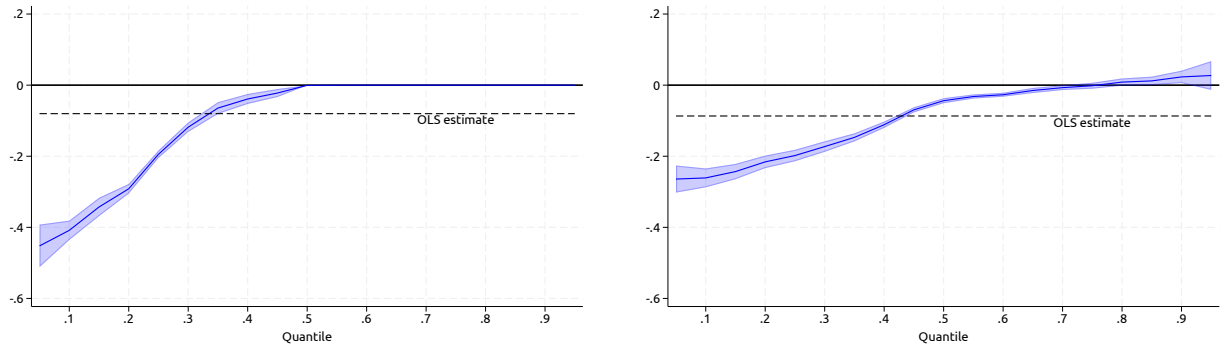
To capture this asymmetry, we start by presenting quantile regression estimates of the relationship between property performance and lease expirations, controlling for the initial

[5] We are loose with the notation for $Y_{i,t-.5,t+1.5}$, as financial updates are not necessarily offset from lease expirations by half-year. We consider the nearest financial updates that are outside the one-year lease expiration window, which could be more or less than a half year.

vacancy rate of the property.[6] The sample covers the years 2009 through 2018 in order to examine the effects of lease expirations that occurred before the pandemic.

Figure 1 plots estimates of how lease expirations affect various quantiles of occupancy changes (the left panel) and NOI growth (the right panel). The dashed line provides the OLS estimate from the same specification. This figure reveals that lease expirations typically do not affect occupancy or NOI notably. At the median and higher quantiles, more expirations are associated with no change in occupancy and only modest differences in NOI growth. This suggests that leases are typically renewed (or replacement tenants found quickly), and at rents comparable to those of existing leases. However, expirations present substantial downside risk. At the fifth percentile, the estimated elasticities are about -0.4 and -0.25 for occupancy and NOI growth, respectively, meaning expirations lead to an increase in vacancy that is almost half the amount of space accounted for by the expiring leases.

Figure 1: Effects of Lease Expirations from Quantile Regressions



(a) ΔOccupancy (b) NOI Growth

Notes: This figure plots quantile regression estimates of the effects of lease expirations on occupancy rate changes (left panel) and NOI growth (right panel) according to equation (1). The x-axis indexes the quantiles of each outcome variable, and the y-axis displays the coefficient estimate for a given quantile. The blue area represents the 95 percent confidence interval. Standard errors are clustered by loan.
Sources: Morningstar, and authors' calculations.

A couple of factors likely contribute to lease expirations affecting performance predominantly at the lower quantiles. First, as already discussed, the effects of expirations are inherently asymmetric; if tenants depart, occupancy and income may fall sharply, whereas if they stay, the property's financials may change little. Thus, even if outcomes of lease expirations are completely determined by idiosyncratic factors related to the tenants, it would

[6] We exclude property type-year dummy variables from the specification because a greater response to lease expirations in times of stress is one factor that could cause effects to be asymmetric, but results are broadly similar when conditioning on these variables.

be mostly the lower quantiles that are affected. Second, lease expirations should have larger effects in weaker markets, as tenants are harder to replace and equilibrium rents may have declined relative to other markets. Again, lease expirations would affect the bottom part of the distribution, but now it would be because the effects of expirations are most pronounced for properties that are otherwise strained. We investigate this second mechanism next, showing that lease expirations have larger effects in markets with higher vacancy rates.

3.2 Role of Local Conditions

The effects of lease expirations should depend on local conditions. In a tighter market, it is harder to find alternative space, so tenants would be less likely to leave their current space and have less bargaining power in extension negotiations. To study such effects, we now estimate equation (1) including the market vacancy rate in the set of interactions. The market vacancy rate refers to the vacancy rate reported by CBRE for the given city, property type, and quarter as of the start of the financial reporting window.[7]

Table 1 presents the coefficient estimates from this analysis. For comparison, the first column reports the baseline OLS estimates without the market vacancy interaction term. The coefficient indicates that a 10 percentage point increase in lease expirations results in a roughly 80 basis point decline in occupancy, on average. Column 2 interacts lease expirations with the market vacancy rate, thus allowing the effects of lease expirations to depend on market conditions. The estimates indicate that in markets with no vacancy lease expirations have only a small effect on occupancy. However, the adverse effects of expirations increase with the market vacancy rate; the estimates imply an elasticity of occupancy with respect to expirations of about -0.07 in markets with a 10 percent vacancy rate, compared with an elasticity of $-.03$ in a market with no vacancy. Column 3 presents quantile regression estimates of the effect of lease expirations on the 25th percentile of occupancy changes. The estimates show that the detrimental effects of lease expirations in weaker property markets are felt predominantly on the lower end of the performance distribution, similar to the pattern shown in Figure 1.

Columns 4 through 6 repeat this analysis for NOI growth. Overall, the effects are qualitatively similar. The effect of lease expirations on income growth is roughly similar to the effect on occupancy. The importance of tightness in the local property markets is even greater for NOI growth. In fact, when market vacancy is low, lease expirations are associated with modest (but statistically insignificant) increases in income. However, when the market vacancy rate is high rises, lease expirations are associated with greater declines in

[7] We use the national index for the property type and quarter for properties not in a CBRE market. Our estimates change little when we restrict the sample to properties in a CBRE market.

Table 1: Heterogeneous Effects by Market Vacancy

	ΔOccupancy		Q_{25}(ΔOccupancy)	NOI Growth		Q_{25}(NOI Growth)
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Expirations}_{i,t,t+1}$	-0.08**	-0.03*	0.02	-0.08**	0.03	0.02
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
$\text{Property Vacancy}_{i,t}$	0.67**	0.67**	0.02**	0.01	0.02	-0.22**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)
$\text{Market Vacancy}_{m(i),t}$		-0.13**	-0.00		-0.31**	-0.22**
		(0.03)	(0.00)		(0.04)	(0.04)
$\times \text{Expirations}_{i,t,t+1}$		-0.42**	-1.54**		-0.92**	-1.61**
		(0.11)	(0.10)		(0.16)	(0.20)
R^2_a	0.308	0.316		0.016	0.019	
Observations	95641	91907	91907	95334	91604	91604
Property Type-Year FEs	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the change in occupancy (columns 1 through 3) or NOI growth (columns 4 through 6). Columns 3 and 6 present estimates from quantile regressions (25th quantile), while the other columns present OLS estimates. $\text{Market Vacancy}_{m(i),t}$ denotes the vacancy rate in property i's market as defined by CBRE. "$\times\text{Expirations}_{i,t,t+1}$" denotes its interaction with $\text{Expirations}_{i,t,t+1}$. Standard errors, in parentheses, are clustered by loan. $^{+}$,*,** indicate significance at 10%, 5%, and 1%, respectively.
Sources: Morningstar, CBRE, and authors' calculations.

NOI than were found for occupancy. The estimates imply that lease expirations are neutral with respect to income growth when the vacancy is about 3 percent, but the elasticity between NOI and the expiring-lease share moves to about -0.06 in a market with a 10 percent vacancy rate. Again, effects are stronger for lower quantiles, indicating that weaker market conditions amplify the downside risks stemming from lease expirations.

4 Effects of Lease Expirations during the Pandemic

The estimates reported in Section 3.2 demonstrate that the effects of lease expirations are influenced by (and thus informative of) the strength of the local property market. Motivated by this finding, we now analyze how the relationship between lease expirations and property performance changed during the COVID-19 pandemic. Section 4.1 reveals that the effects of the pandemic have been modest so far for the CRE sector as a whole, but lease expirations have exerted larger adverse effects on the performance of office properties. Section 4.2 shows that these adverse effects have been concentrated in CBDs and areas where the shift to remote work has been more persistent.

4.1 Effects by Property Type

To investigate how the effect of lease expirations on property performance has changed since the COVID-19 outbreak, we extend the sample to include the pandemic period and add to the specification an extra variable, COVID Expirations$_{i,t,t+1}$, which is the interaction of the share of leases expiring with a pandemic indicator (equal to 1 if t is 2020 or later).[8]

Table 2 presents the estimates from these regressions. Columns 1 through 4 report the effect on occupancy rate changes, while columns 5 through 8 report results for NOI growth. The OLS estimates reported in column 1 consider occupancy changes for the full sample of all property types for which leasing data are available. Overall, while lease expirations are associated with significant increases in vacancies (as is shown in Table 1), the effects of expirations became only slightly stronger during the pandemic, rising from 0.08 before the pandemic to 0.10 during it.

One reason that the adverse effects of lease expirations may not appear to be greatly magnified during the pandemic is that the sample includes many properties with limited susceptibility to the disruptions associated with the crisis. For example, while the office sector has been significantly affected by the shift to remote work, as noted by Gupta et al. (2022), the acceleration in e-commerce sales during the pandemic boosted demand for industrial real estate (such as warehouses). We thus next analyze the effects of pandemic lease expirations separately by property type. Columns 2 through 4 report these estimates, with the sample restricted to office, retail, and industrial properties, respectively.

As would be expected, the pandemic amplified the effects of lease expirations more for offices than for retail or industrial properties. The estimated elasticity between office occupancy growth and lease expirations rose in magnitude from -0.10 before the pandemic to -0.16 during it (column 2). Likewise, the elasticity for NOI growth changed from about -0.14 to -0.27 (column 6). Put differently, damage done by lease expirations rose by over one-half for office properties.

The other two commercial property types have fared better by comparison. For retail, the elasticities of occupancy and income vis-à-vis lease expirations were unchanged during the pandemic relative to the period before the outbreak (columns 3 and 6). Lease expirations actually became less problematic for industrial properties during the pandemic, consistent with the COVID-19-induced shift in spending patterns increasing the demand for these properties (columns 4 and 8).

In addition to tenants being more likely to vacate properties upon expiration, the results

[8]When the lease expiration window starts in 2019 but ends in 2020, we do not count it as a COVID expiration, as tenants could renew before being aware of the pandemic. Results are robust to excluding such observations or coding them as COVID expirations.

Table 2: Effects of Lease Expirations during the Pandemic

	ΔOccupancy				NOI Growth			
	Full Sample	Offices	Retail	Industrial	Full Sample	Offices	Retail	Industrial
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Expirations}_{i,t,t+1}$	-0.08**	-0.10**	-0.07**	-0.06**	-0.08**	-0.14**	-0.06**	-0.08**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\text{COVID Expirations}_{i,t,t+1}$	-0.02*	-0.06**	0.00	0.03*	-0.06**	-0.13**	-0.01	0.03
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.04)	(0.02)	(0.03)
$\text{Property Vacancy}_{i,t}$	0.67**	0.57**	0.75**	0.56**	0.01	-0.01	0.03**	-0.00
	(0.02)	(0.02)	(0.02)	(0.08)	(0.01)	(0.02)	(0.01)	(0.08)
$\times$ COVID_t	-0.31**	-0.31**	-0.34**	0.10	-0.07	-0.16*	-0.05	0.61**
	(0.03)	(0.03)	(0.03)	(0.10)	(0.05)	(0.08)	(0.06)	(0.18)
R_a^2	0.299	0.201	0.364	0.252	0.020	0.022	0.017	0.033
Observations	112964	30751	69428	12785	112588	30623	69301	12664
Property Type-Year FEs	✓				✓			
Year FEs		✓	✓	✓		✓	✓	✓

Notes: This table presents estimates of the effects of lease expirations on occupancy (columns 1 through 4) and NOI growth (columns 5 through 8). $\text{Expirations}_{i,t,t+1}$ is the share of leases (in terms of square footage) set to expire, and $\text{COVID Expirations}_{t,t+1}$ denotes its interaction with an indicator for whether t is 2020 or later. For each outcome variable, the first column presents estimates for the full sample of properties, and the next three restrict the sample to office, retail, and industrial properties, respectively. All specifications control for the property's initial vacancy rate and its interaction with the COVID indicator, and include either property type-year (the first column in each block) or year fixed effects (the other columns). Standard errors, in parentheses, are clustered by loan. $^{+}$,*,** indicate significance at 10%, 5%, and 1%, respectively.
Sources: Morningstar and authors' calculations.

also indicate that vacant space has become more difficult to fill. The coefficient of 0.67 on Property Vacancy$_{i,t}$ indicates that properties are able to fill about a two-thirds of their vacant space during the window under consideration in the pre-pandemic period. However, this rate at which space is filled fell by about half for office and retail properties during the pandemic. This means that when tenants do leave, space is likely to remain vacant longer. We investigate the implications of this result for steady state vacancy rates in Section 5.1.

4.2 Effects of Office Lease Expirations by Geography

Since the effects of the COVID-19 pandemic are most pronounced for offices, the rest of the analysis focuses on the subsample of office properties. In particular, we explore whether offices in markets with a greater shift toward remote work exhibited greater vulnerability to lease expirations during the pandemic. We identify such vulnerable places using two metrics: being a central business district (CBD) or suffering a more persistent decline in time spent at workplaces (or equivalently, more remote work). We estimate equation (1) for office properties only, allowing the effects of lease expirations to depend on these geographic variables. The coefficients on these interaction terms measure cross-location heterogeneity in the adverse effects of lease expirations and how they changed during the pandemic.

Table 3 presents these estimates. For comparison, columns 1 and 4 repeat columns 2 and 5, respectively, of Table 2, estimating the effects of lease expirations on office performance while omitting the geographic variables. Columns 2 and 5 add interactions between the expiration variables and the share of the property's ZIP code identified as being in a CBD using data from Real Capital Analytics (RCA). Columns 3 and 6 add further interactions with the decline in time spent at workplaces relative to before the pandemic to capture the magnitude shift toward remote work.[9] Appendix Table B.1 presents quantile regression estimates of the same specification. As with the earlier results, the effects of lease expirations on the 25th percentile of occupancy or NOI growth are generally larger than the OLS estimates but exhibit similar cross-sectional patterns.

Columns 2 and 5 show that the adverse effects of lease expirations became much more pronounced for CBD properties during the COVID-19 pandemic. The marginal effect of lease expirations on occupancy during the pandemic was -0.27 for CBD properties, compared with about -0.15 for other office properties, and only -0.10 before the pandemic for all offices. That is, the detrimental effect of expirations on occupancy nearly tripled during the

[9]Specifically, Central Business District$_{z(i)}$ is the fraction of properties in i's ZIP code that RCA defines as being in a central business district, while Work From Home$_{c(i)}$ is the decline (relative to the pre-pandemic period) in the average daily time spent at workplaces in the property's county as of September 2022 (the last full month for which data are available) according to Google's Community Mobility Reports (see Chetty et al. (2020)). We use the latest data to best capture the persistent change in remote-work patterns.

pandemic for CBD properties.

Patterns are broadly similar for income growth; the elasticity between NOI growth and lease expirations rose from about -0.14 to -0.24 for non-CBD properties during the pandemic, and from about -0.09 to -0.47 for CBD properties. These geographic differences are consistent with the findings from Ghosh et al. (2022) that during the pandemic, property values for suburban office properties remained more resilient than valuations for urban offices.

Finally, columns 3 and 6 add interactions with the decline in time at workplaces. While larger declines in time at work are correlated with properties being located in a CBD, this variable contains additional information relevant for the effects of lease expirations.[10] Raising Work From Home$_{c(i)}$ by 0.15 (roughly the difference between New York City and the average property in the sample) increases the adverse effect of lease expirations on occupancy during the pandemic by 0.08. This incremental change nearly doubles the predicted effect of lease expirations on occupancy relative to the pre-COVID-19 period. The effects of Work From Home on income are even stronger.[11]

Appendix Figure B.1 shows that occupancy rates overall have declined in markets with a greater shift to remote work. In fact these declines were accelerating rather than moderating as of the end of 2022, indicating conditions are likely to continue to deteriorate, a topic we discuss further in the next section.

[10] The correlation is 0.4 for the sample of office properties.

[11] Geographic differences also exist before the pandemic. Lease expirations had smaller adverse effects on occupancy but larger effects on income growth for properties in counties with a larger increase in remote work during the pandemic. It is possible that those were more liquid office rental markets where owners could more reliably find tenants (with a competitive asking rent).

Table 3: Effects of Office Lease Expirations during the Pandemic, Geographic Differences

	ΔOccupancy			NOI Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Expirations}_{i,t,t+1}$	-0.10**	-0.10**	-0.11**	-0.14**	-0.14**	-0.03
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.05)
$\times$ $\text{Central Business District}_{z(i)}$		0.00	-0.00		0.05^{+}	0.08**
		(0.02)	(0.02)		(0.03)	(0.03)
$\times$ $\text{Work From Home}_{c(i)}$			0.05			-0.44*
			(0.11)			(0.17)
$\text{COVID Expirations}_{i,t,t+1}$	-0.06**	-0.05*	0.09	-0.13**	-0.10*	0.16
	(0.02)	(0.02)	(0.06)	(0.04)	(0.04)	(0.10)
$\times$ $\text{Central Business District}_{z(i)}$		-0.12^{+}	-0.08		-0.28**	-0.19*
		(0.07)	(0.07)		(0.09)	(0.09)
$\times$ $\text{Work From Home}_{c(i)}$			-0.55*			-1.07**
			(0.25)			(0.39)
$\text{Property Vacancy}_{i,t}$	0.57**	0.57**	0.57**	-0.01	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$\times$ COVID_{t}	-0.31**	-0.30**	-0.30**	-0.16*	-0.15^{+}	-0.15^{+}
	(0.03)	(0.03)	(0.03)	(0.08)	(0.08)	(0.08)
R^2_a	0.201	0.202	0.203	0.022	0.023	0.025
Observations	30751	30570	30551	30623	30442	30423
Year FEs	✓	✓	✓	✓	✓	✓

Notes: This table presents estimates of the effects of lease expirations occupancy and income growth for office properties. $\text{Expirations}_{i,t,t+1}$ is the share of leases (in terms of square footage) set to expire in the financial financial reporting window, and $\text{COVID Expirations}_{t,t+1}$ interacts this expiration share with an indicator for whether t is 2020 or later. The dependent variable is the change in occupancy in columns 1 through 3 and the growth in NOI in columns 4 through 6. Columns 1 and 4 repeat results from Table 2, columns 2 and 5 add interactions for whether the property is in a central business district, and columns 3 and 6 add interactions for the percentage decline in time spent at workplaces relative to pre-pandemic levels. All specifications control for the initial vacancy rate, its interaction with the COVID-19 indicator, and year fixed effects. The two location-specific measures and their interactions with the COVID-19 indicator are added to some specifications when relevant (not displayed). Standard errors, in parentheses, are clustered by loan. $^{+}$,*,** indicate significance at 10%, 5%, and 1%, respectively.
Sources: Morningstar, Real Capital Analytics, Opportunity Insights, and authors' calculations.

5 Further Implications for CRE and Banking Sectors

This section investigates the implications of these findings for the longer-run performance of office properties and CRE lenders. First, Section 5.1 presents a simple model of office occupancy dynamics, and uses the regression results to estimate how steady state vacancy rates have changed for urban and suburban markets. Second, motivated by a significant estimated rise in steady state vacancy rates for CBD office markets, Section 5.2 analyzes the exposure of different CRE lenders these at-risk markets. We demonstrate that small and regional banks are generally less exposed to CBD office loans than larger banks and nonbank lenders. This mitigates the potential solvency concern about small and regional banks, whose portfolios are significantly more concentrated in CRE loans.

5.1 Steady State Vacancy Rates

Table 3 showed that, during COVID, lease expirations were associated with larger declines in occupancy and vacant space became slower to fill. These findings indicate that vacancy rates are likely to continue to rise as more leases rollover. The important question is: how much will vacancy rise cumulatively before it reaches a new steady state? To answer this question, we interpret the empirical estimates through the lens of a simple model of occupancy dynamics. Previously estimated regression coefficients map directly into model parameters and help gauge how much the steady state vacancy rate may have changed due to the pandemic.

There are three channels through which a building's occupancy can change: occupied space being vacated because the lease is expiring, occupied space being vacated for other reasons (e.g., from bankruptcies, good guy clauses, or buyouts), and vacant space getting filled. Suppose that a particular building i is able to fill vacant space at rate $f_{i,t}$, experiences tenant exits following lease expiration at rate $\lambda_{i,t}$, and exits outside of expirations at rate $\delta_{i,t}$. Then the change in occupancy can be described by the following law of motion:

$$\Delta Occ_{i,t} = f_{i,t} Vac_{i,t} - \lambda_{i,t} Exp_{i,t} - \delta_{i,t}(1 - Vac_{i,t} - Exp_{i,t}) \tag{2}$$

Where $Occ_{i,t}$ and $Vac_{i,t}$ are the occupancy and vacancy rate, respectively, and $Exp_{i,t}$ is the share of space with expiring leases.

Then we can use the following regression

$$\Delta Occ_{i,t} = \alpha + \beta^{vac} Vac_{i,t} + \beta^{exp} Exp_{i,t} + \varepsilon$$

to back out the average finding rate and the two exit rates:

$$\delta = -\alpha$$
$$f = \beta^{vac} + \alpha$$
$$\lambda = -(\beta^{exp} + \alpha)$$

Likewise, by parameterizing the exit rate as $\lambda_{i,t} = \lambda_0 + \lambda_1 CBD_i + COVID_t(\lambda_2 + \lambda_3 CBD_i)$ (and parameterizing $f_{i,t}$ and $\delta_{i,t}$ analogously), we can use coefficient estimates from fully-interacted regressions along the lines of Equation 1 to back out how these parameters changed during COVID-19 for CBD and non-CBD properties.[12]

The results of this exercise are presented in Table 4. The findings indicate that lease breaks (that is, exits outside of expirations) declined during COVID, perhaps owing to low levels of bankruptcies in 2021 and 2022. However, this effect was more than offset by a decline in the rate at which vacant space was filled (f) from 0.514 before the pandemic to 0.22 during the pandemic, and an increase in the rate at which tenants exit upon lease expiration (λ) from 0.155 to 0.194. These last two effects are more pronounced for offices in CBDs (columns 5 and 6) than for suburban offices (columns 3 and 4).

The primary value of this simple model is to provide a structural framework for assessing how the change in leasing dynamics during COVID-19 will likely affect the steady state vacancy rate for office properties.

Roughly 11% of leases expire per year in the data, namely $\mathbb{E}(Exp_{i,t}) = 0.11$. Treating this rate as exogenous and assuming it will remain roughly the same going forward we can use equation (2) to solve for the vacancy rate in steady state (that is, the vacancy rate such that $\mathbb{E}(\Delta Occ_{i,t}) = 0$) as:

$$Vac_{i,t}^{SS} = \frac{\hat{\delta}_{i,t} + (\hat{\lambda}_{i,t} - \hat{\delta}_{i,t}) \times 0.11}{\hat{f}_{i,t} + \hat{\delta}_{i,t}}$$

These implied steady state vacancy rates are reported in the second-to-last row of Table 4. Before the pandemic, leasing dynamics—exit rates and finding rates—were consistent with a steady state vacancy rate of 11.7%. The CBRE national vacancy rate for offices was also 11.7% as of 2019q4, indicating that the office market entered the pandemic around equilibrium vacancy levels. The COVID-period estimates provide the vacancy rate at which a market would stabilize if the leasing dynamics observed during the first couple of years of the pandemic were to become permanent. These estimates indicate that office vacancy would rise to about 20.8% after the pandemic, an increase of about 9 percentage points.

[12] To focus on the effects of lease expirations, the results in Table 3 did not interact the vacancy rate with geographic risk factors, so the specification in this section differs slightly from those.

Table 4: Estimates of Structural Parameters

Market	Overall		Suburban		CBD	
Period	Pre-COVID	COVID	Pre-COVID	COVID	Pre-COVID	COVID
	(1)	(2)	(3)	(4)	(5)	(6)
δ	0.056	0.036	0.055	0.032	0.066	0.056
	(0.001)	(0.003)	(0.001)	(0.003)	(0.003)	(0.007)
f	0.514	0.220	0.494	0.237	0.617	0.213
	(0.006)	(0.017)	(0.007)	(0.019)	(0.016)	(0.045)
λ	0.155	0.194	0.153	0.181	0.166	0.329
	(0.005)	(0.010)	(0.005)	(0.010)	(0.014)	(0.033)
Steady State Vacancy (%)	11.7	20.8	11.9	17.8	11.3	32.1
SS Vacancy if λ reverts		19.1		16.7		25.4

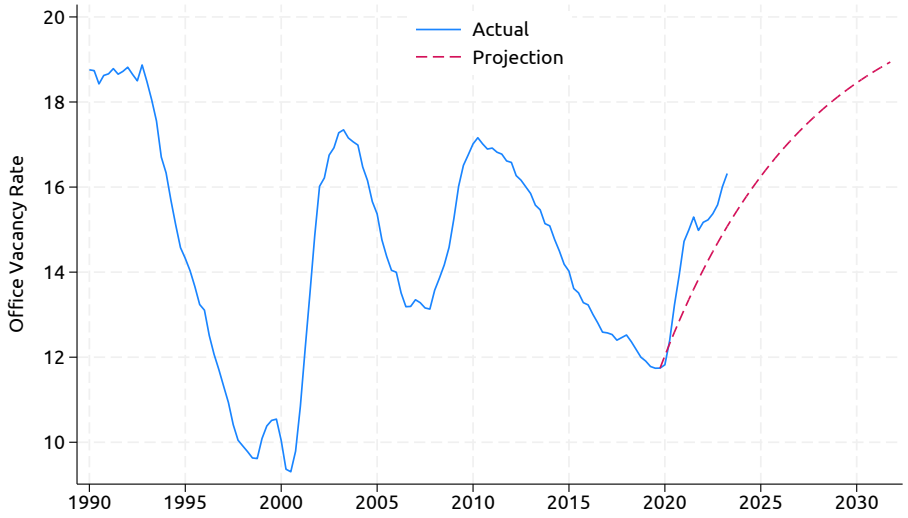
Notes: This table presents estimates of the structural parameters affecting occupancy based on regressions of changes in occupancy on the property-level vacancy rate, the lease expiration share, and the interaction of these two variables with a COVID indicator (columns 1–2) or fully interacted with the COVID indicator, the CBD share, and their interaction (Columns 3–6). Columns (1) and (2) present estimates for dynamics before and during COVID, respectively, pooling across across markets. Columns (3) and (4) present equivalent estimates for suburban office properties, and columns (5) and (6) for CBD office properties. The steady state vacancy rate implied by the estimates is reported in the second-to-last row, and the steady state vacancy rate assuming $\lambda_{i,t}$ returns to pre-pandemic levels is in the last row.

Figure 2 shows that vacancy rates have only risen by about half of this amount (as of 2023q3). The blue line shows the U.S. vacancy rate from CBRE, and the red line shows the vacancy rate predicted based on the estimates from Table 4. This projection extrapolates vacancy rates from 2019q4 levels using Equation (2) and the parameter values column (2). The observed rise in vacancy so far has slightly exceeded projections. The projection has vacancy rates steadily increasing to above 19% by the end of the decade, roughly matching highs observed during the savings and loan crisis, and then slowly asymptoting to the new steady state level thereafter.

This projected increase in equilibrium vacancy is particularly stark for CBD offices, which have a new steady state vacancy of 32.1 percent based on pandemic-era leasing dynamics. Meanwhile, equilibrium vacancy rates for suburban offices appear to have only risen to 16.7 percent.

The actual rise in longer-term vacancy rates may be smaller, as a couple of factors will tend to push f up and λ down over time. First, the tenants with the greatest willingness to switch to a remote-work-heavy model will exit as leases expire, leaving the composition of tenants tilted more towards those who are willing to maintain their office space. Namely, the tenants who choose to sign leases after the pandemic are likely to exit at a slower rate than the overall pool of tenants who entered into leases before the pandemic. This would tend to

Figure 2: Changes in U.S. Office Vacancy



Notes: This figure plots the estimated vacancy rate for U.S. offices from CBRE (blue) and the projected vacancy rate based on COVID-era leasing activity (red). The projected vacancy rate extrapolates changes in vacancy rates from 2019q4 levels, using Equation (2) and the estimates from column (2) of Table 4, assuming that 11% of leased space expires per year.
Sources: CBRE, and authors' calculations.

push λ back to pre-pandemic levels over time. Second, in the longer run, supply should be able to adjust to the lower demand through lower rates of construction and the conversion of offices to other property types. This would reduce the excess supply of office space and make vacant space easier to fill.

To investigate the relative importance of these mitigating factors, the bottom line in Table 4 provides the long-run vacancy rate that would be reached if λ eventually returns to pre-COVID levels. A normalization in the rate at which tenants leave upon expiration attenuates the rise in equilibrium vacancy rates, but not dramatically so; vacancy rates still rise by 4.8 percentage points for suburban offices and 14.1 percentage points for urban ones. This indicates that the replacement of current tenants with less-exit-prone ones would not be sufficient to prevent a notable rise in longer-run vacancies if landlords continue to struggle to fill vacant space. Stemming the rise in vacancies requires raising f, which likely would require a reduction in supply. As such adjustments will only occur slowly over time, these results suggest that substantial additional increases in vacancy in the intermediate term are likely.

5.2 Exposures of Lenders to At-risk Office Markets

The results so far demonstrate that the effects of the COVID-19 pandemic on the office CRE sector are not uniform. In areas outside of CBDs and where the amount of time spent at workplaces has not declined notably since the start of the pandemic, leasing dynamics do not differ substantially relative to before the pandemic. That is, when leases expire, the spaces continue to be filled at rates and rents similar to those observed over the decade before the COVID-19 outbreak. However, in CBDs and markets where time spent at workplaces has declined notably, lease expirations have proven more damaging to occupancy and income. This corroborates the narrative that demand for office space in those markets has fundamentally weakened, causing property performance to deteriorate as leases roll over and property financial data become more reflective of the true underlying current market conditions. Because the various types of CRE lenders differ in their geographic footprint, these cross-market differences have potentially important implications for which lenders are most exposed to losses from office loans in the coming years.

Figure 3 plots the share of outstanding office loans made by G-SIB banks, nonbank CRE lenders (for example, CMBS and life insurers), and smaller banks that are secured by properties in central business districts (red bars), areas where the time at workplaces declined by at least one-third relative to before the COVID-19 outbreak (blue bars), or areas with both risk factors (purple bars). The sample includes office properties in RCA's database, which covers CRE properties valued at more than $2.5 million. Because offices in central business districts are more likely to meet this reporting threshold, the estimated exposure to at-risk markets is likely biased upward, especially for smaller banks, which tend to make smaller loans. Outstanding loans are not directly reported, but are imputed based on the presence of subsequent transaction and on origination and expiration dates.[13]

The figure shows that small and regional banks (that is, banks other than the G-SIBs) tend to finance properties located in markets less exposed to the COVID-19-related disruptions. Roughly 45 percent of G-SIBs' and nonbanks' office portfolios are in CBDs, and slightly more than 40 percent are in counties with a high work-from-home share. In contrast, less than 30 percent of the office loan portfolios of smaller banks are subject to these risk factors. The share of office loan volume secured by properties that are in CBDs and have a persistently high remote-work rate is nearly twice as high for G-SIBs and nonbanks as it is for smaller banks (32 percent versus 17 percent).

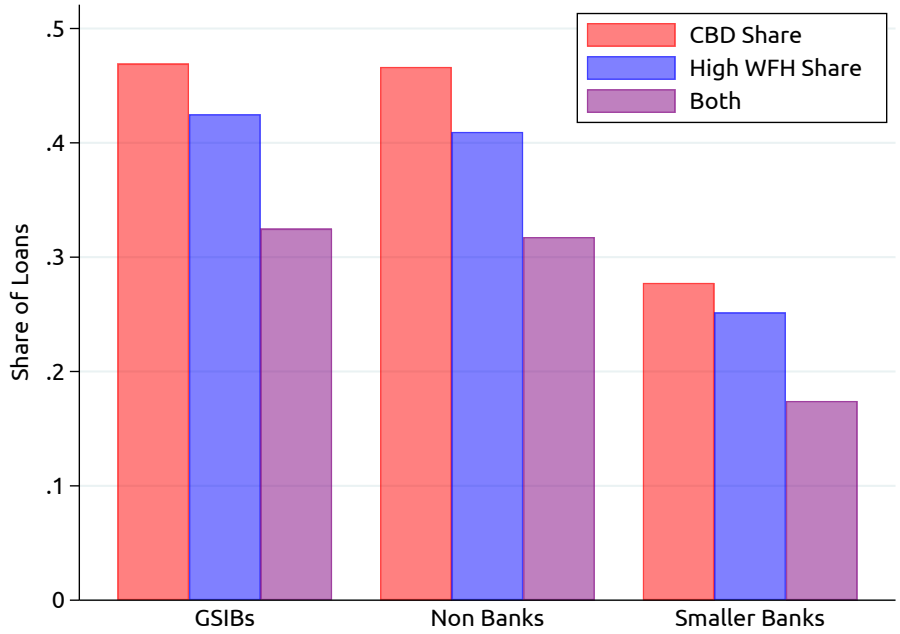
[13]We impute loans to be outstanding if (1) there are no future transactions associated with the property, or, if there are future transactions, but they involve the assumption of existing debt and (2) the loan had not passed the maturity date as of April 2023. If a maturity date is not reported, we assume the loan has a ten year term.

The comparatively lower exposure of smaller banks to the most at-risk loans is primarily driven by these banks making smaller loans, which tend to finance properties located in the parts of a city with less of a decline in office demand. Specifically, Appendix Table C.1 investigates the determinants of non-GSIB-banks' and community banks' market shares for office loans. The results confirm that smaller banks made fewer office loans in CBDs and counties with more work from home. The comparatively lower exposure of smaller banks to at-risk office loans reflects differences in where smaller banks make loans within cities, and can be mostly explained by smaller banks making smaller loans.[14]

In sum, while there remains some concern about small and regional banks facing headwinds from high concentrations of CRE loans in addition to funding pressures in the aftermath of recent bank runs, these banks appear to be at least partially protected from loan losses by having most of their office loans in less-affected CRE markets. Between this more favorable geographic distribution of lending and a superior ability to renegotiate CRE loans to avoid foreclosures (Black et al., 2020; Glancy et al., 2022), small and regional banks may be better positioned than other lenders to weather the strains in the office sector. Consistent with this hypothesis, Appendix Figure C.1 shows that the deterioration in bank CRE loan performance as of 2023q3 has been principally driven by G-SIBs.

[14]Note that this pattern of properties outside of CBDs securing smaller loans is based on the loans recorded in the RCA data, which exclude properties valued at less than $2.5 million. Extending this logic, smaller banks' exposure to CBDs should be even lower than estimated here because more of their loans are secured by properties below this reporting threshold and thus even less likely to be in a CBD.

Figure 3: Exposures to At-risk Office Loans by Lender



Notes: This figure plots the shares of loans in the RCA database that are in central business districts (red bars), in counties where the time at workplaces declined by at least one-third relative to before the pandemic (blue bars), or areas with both risk factors (purple bars). These shares are plotted for three lender groups: G-SIB banks, nonbanks, and smaller banks.
Sources: Real Capital Analytics, Opportunity Insights, and authors' calculations.

6 Conclusion

This paper documents three key facts about the relationship between lease expirations and CRE property performance. First, lease expirations create notable downside risk for the performance of commercial properties. While the intensity of lease expirations has little effect on median or better outcomes, it is an important determinant of performance at the lower end of the distribution. Specifically, lease expirations increase the likelihood that a property experiences a large decline in occupancy or income.

Second, this risk of performance deterioration following lease expirations is highly sensitive to the strength of the local property market. In markets with low vacancy rates, lease expirations have little effect on a property's occupancy and are associated with modest increases in income. Specifically, in tight markets, commercial spaces with expiring leases reliably see their leases renewed or are refilled with new tenants, and often at a higher rent than that on the expiring lease. However, when leases expire in markets with higher vacancy rates, occupancy and income fall notably.

Third, while the CRE market as a whole has remained relatively resilient since the

COVID-19 outbreak, there are segments for which lease expiration outcomes point toward serious stresses that are likely to contribute to loan losses in coming years. The effects of lease expirations on the financial performance of office buildings increased notably during the pandemic, especially for properties in central business districts or counties with a persistently larger shift to remote work. Consequently, while the performance of office CMBS loans remained fairly resilient in the early years of the pandemic, with a delinquency rate of less than 3 percent as of April 2023, greater strains are likely to emerge over time as more leases expire and exert pressure on occupancy and income.

The CRE market also faces headwinds besides those from the acceleration in remote work. Higher interest rates raise debt service costs and reduce property values. Moreover, lenders' concerns about these factors may prompt them to restrict credit availability. In turn, commercial-property owners with maturing loans may struggle to refinance, causing loan performance to deteriorate even before a serious increase in vacancy occurs. To the extent that realized or anticipated loan losses cause banks to tighten credit conditions, these developments may also feed back into the broader economy (see, for example, Peek and Rosengren (2000)). Office CRE loans make up a small share of banks' portfolios, and the properties securing these loans tend to be in less adversely affected office markets, which mitigates the risk of bank CRE losses prompting a broad-based credit crunch. However, some banks' loan holdings are more concentrated in office loans in troubled markets, which may constrain credit availability for some bank borrowers going forward.

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APPENDIX

A Variable Construction

While data on the loans underlying commercial mortgage-backed securities (CMBS) deals are reported monthly, the variables concerning property performance and lease expiration schedules are updated less frequently. This appendix outlines how we address these timing issues. Figure A.1 displays a timeline for key variables pertaining to financial updates and lease expirations.

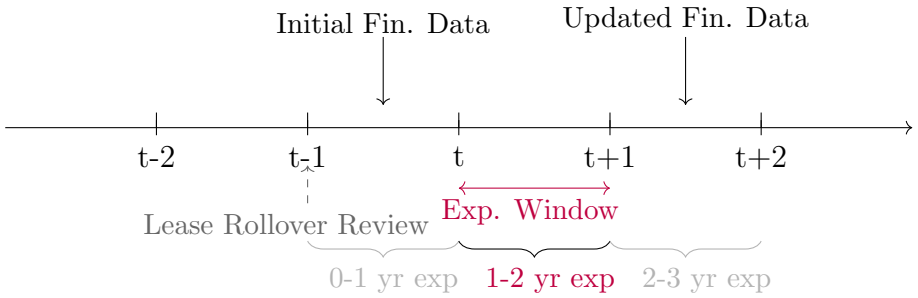
The primary explanatory variable is the share of leases (weighted by a tenant's square footage) expiring in a given year. CMBS data report lease expirations over separate one year intervals: For each lease rollover review, the shares of space with leases expiring within one year, one to two years, two to three years, three to four years, or more than four years are reported (the brackets in Figure A.1).[15] We use scheduled lease expirations as measured one year before to avoid selection bias from early renewals, so our measure of lease expirations between t and $t+1$ pertains to the lease rollover review as of $t-1$.[16]

For the performance variables (occupancy rate and net operating income), we consider changes over the shortest available time horizon that contains the lease expiration window. If a property reports financials annually, and financial reporting occurs halfway between rollover reviews (the circumstance depicted in the figure), then the outcome variables would be the change in the two years starting 6 months before the start of the lease expiration window and ending 6 months after the end of the window. These two dates are shown as "Initial Fin. Data" and "Updated Fin. Data" in Figure A.1. The actual lead and lag may differ depending on the timing of data reporting. We drop observations where the financial update is more than 1.5 years after the end of the lease expiration window in order to guarantee that we are consistently examining the near-term effects of expirations.

[15] We drop observations where the sum of the expiration shares is not between 0.9 and 1.1 to minimize the effects of reporting errors.

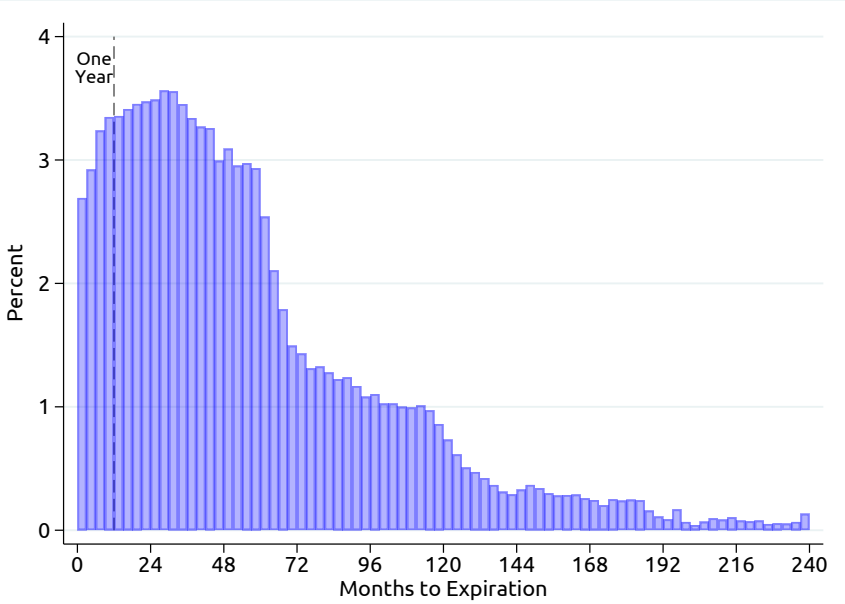
[16] Figure A.2, which plots the distribution of scheduled lease expirations as of 2019, shows that the density of scheduled lease expirations decreases in the three quarters before expiration (consistent with extensions being executed) but levels off at about a year out.

Figure A.1: Timeline of Lease Review and Lease Performance Reporting



Notes: This diagram illustrates the timing with which lease expirations and financial data are reported. "Lease Rollover Review" is the time lease data is reported, "Exp. Window" is the period over which lease expirations are measured, and "Initial Fin. Data" and "Updated Fin. Data" give the time points over which changes in occupancy or NOI growth are calculated. See Appendix A for detailed explanations.

Figure A.2: Distribution of Scheduled Lease Expirations as of 2019



Notes: This figure shows the distribution of the number of months to expiration for leases observed in 2019. It shows the distribution for properties' top five tenants by square footage of occupancy. (The exact expiration dates for these tenants are reported rather than just the aggregate expirations within a given window.)
Sources: Morningstar and authors' calculations.

B Geographic Pandemic Risk Factors:Additional Results

This subsection presents two additional sets of results pertaining to geographic determinants of leasing dynamics, paying special attention to the change since the onset of COVID-19. First, we present quantile regression estimates demonstrating that the adverse effects of lease expirations in at-risk office markets (CBDs and counties with a larger shift to remote work) are particularly pronounced at lower quantiles. Second, we provide additional analysis on the effect the shift to remote work has had on downtown office and retail occupancy.

Table B.1 presents quantile regression estimates of the form presented in Table 3. The results confirm that lease expirations during the pandemic had more severe effects on occupancy and net operating income (NOI) for offices in CBDs or counties with more remote work. Declines in occupancy and income following leases expirations in these more at-risk markets are stronger at the 25th percentile than in the OLS estimates, further demonstrating that lease expirations substantially increase the downside risk to property performance.

Figures B.1 and B.2 document the relationship between the rise of remote work and changes in occupancy for office and retail properties, respectively. The left panel of Figures B.1 shows that markets with a greater rise in remote work also experienced a greater decline in occupancy as of the end of 2022; raising Work From Home$_{c(i)}$ by 0.15 reduces the occupancy rate by about .05 on average. The right panel shows the timing with with these effects occurred. This chart demonstrates that the decline in occupancy in high Work From Home markets has shown little sign of abating in recent quarters.

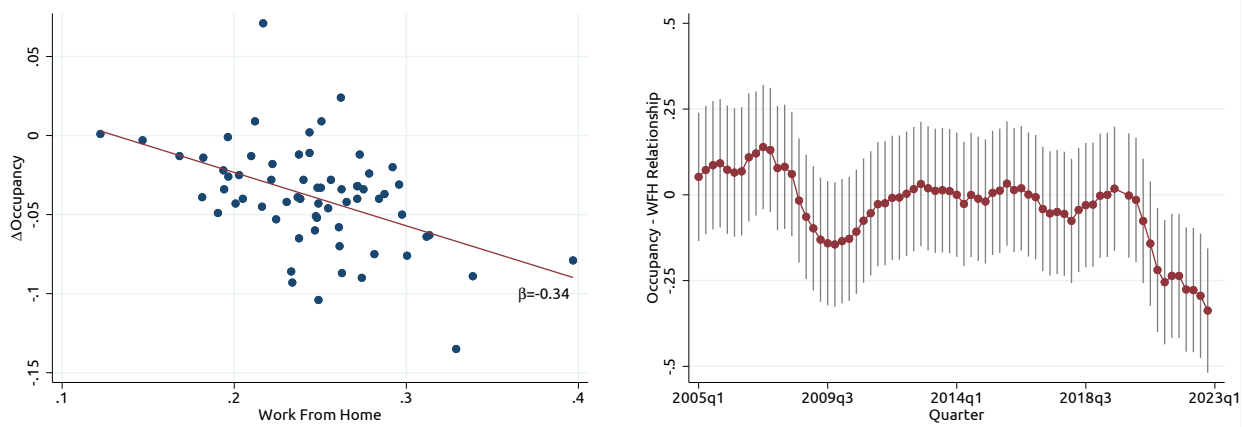
The decline in foot traffic from office workers in counties with more remote work has also reduced demand at retail establishments in those markets. However, the relationship between remote-work intensity and occupancy is only about a third as strong for retail as it is for offices (left panels). The decline in retail occupancy in those remote-work-heavy counties started around 2017, whereas the decline in office occupancy commenced following the onset of the pandemic (right panels). In unreported results, we find that retail lease expirations have not had a disproportionate effect on occupancy or income in these markets, indicating that the occupancy declines are due to other factors such as difficulty filling already vacant space.

Table B.1: Effects of Office Lease Expirations during the Pandemic, Quantile Regressions

	$Q_{25}(\Delta\text{Occupancy})$			$Q_{25}(\text{NOI Growth})$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Expirations}_{i,t,t+1}$	-0.29**	-0.29**	-0.23**	-0.24**	-0.25**	-0.22**
	(0.01)	(0.01)	(0.06)	(0.01)	(0.02)	(0.08)
$\times$ $\text{Central Business District}_{z(i)}$		0.02	0.03		0.05	0.07
		(0.03)	(0.04)		(0.05)	(0.06)
$\times$ $\text{Work From Home}_{c(i)}$			-0.23			-0.12
			(0.24)			(0.29)
$\text{COVID Expirations}_{i,t,t+1}$	-0.14**	-0.09	0.40**	-0.22*	-0.17^{+}	0.57**
	(0.05)	(0.10)	(0.06)	(0.10)	(0.09)	(0.09)
$\times$ $\text{Central Business District}_{z(i)}$		-0.17	-0.02		-0.43**	-0.11
		(0.15)	(0.11)		(0.11)	(0.12)
$\times$ $\text{Work From Home}_{c(i)}$			-1.99**			-2.73**
			(0.28)			(0.44)
$\text{Property Vacancy}_{i,t}$	0.01*	0.01*	0.01*	-0.41**	-0.42**	-0.42**
	(0.00)	(0.00)	(0.00)	(0.04)	(0.04)	(0.04)
$\times$ COVID_{t}	-0.11**	-0.07	-0.06^{+}	-0.38**	-0.34**	-0.37**
	(0.03)	(0.05)	(0.03)	(0.08)	(0.06)	(0.06)
Observations	30751	30570	30551	30623	30442	30423
Year FEs	✓	✓	✓	✓	✓	✓

Notes: This table presents quantile regression estimates of the relationship between lease expirations and the 25th percentile of occupancy changes (columns 1 through 4) and NOI growth (columns 5 through 8) for office properties. $\text{Expirations}_{i,t,t+1}$ is the share of leases (in terms of square footage) set to expire over the following year, and $\text{COVID Expirations}_{t,t+1}$ interacts this expiration share with an indicator for whether t is 2020 or later. Each specification follows that of the same column in Table 3, but with a quantile regression rather than OLS. $^{+}$,*,** indicate significance at 10%, 5%, and 1%, respectively.
Sources: Morningstar, Real Capital Analytics, Opportunity Insights, and authors' calculations.

Figure B.1: Relationship between Work from Home and Office Occupancy Rate



(a) Change in Office Occupancy during COVID

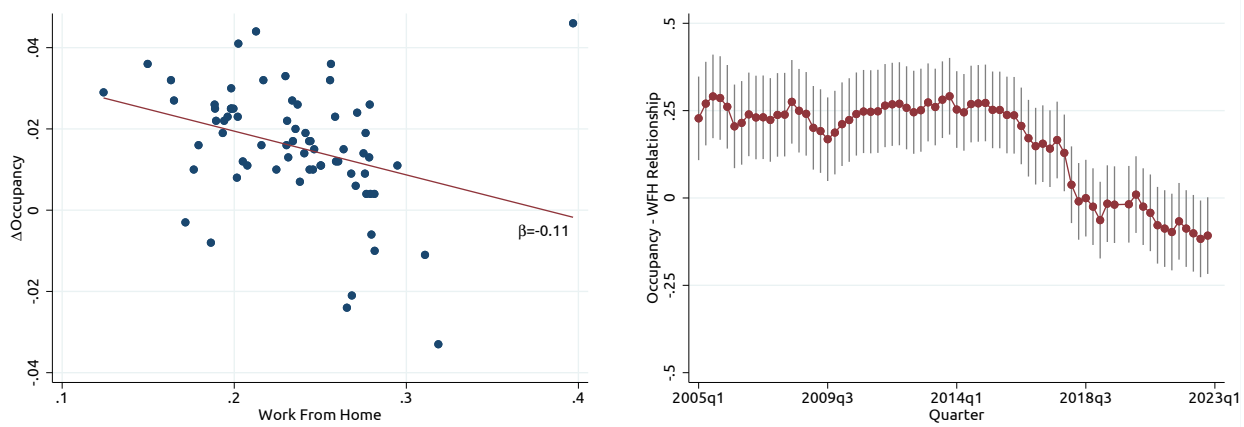
(b) Occupancy over Time

Notes: The left figure presents a scatter plot between the change in office occupancy (from 2019:Q4 to 2022:Q4) and the decline in time spent at workplaces during the pandemic for markets covered in the CBRE database. Work From Home is the population weighted average across the counties in market m. The right chart presents estimates of $\{\beta_t\}$ and 95% confidence intervals from the specification:

$$\text{Occupancy}_{m,\tau} = \alpha_m + \alpha_t + \sum_{t \in T} \beta_t \text{Work From Home}_m \times \mathbb{1}(\tau = t),$$

representing how occupancy changes in markets with a high 2022 work-from-home share over time. *Sources:* CBRE, Opportunity Insights, and authors' calculations.

Figure B.2: Relationship between Work from Home and Retail Occupancy Rate



(a) Change in Retail Occupancy during COVID (b) Occupancy over Time

Notes: The left figure plots a scatter plot between the change in retail occupancy (from 2019:Q4 to 2022:Q4) and the decline in time spent at workplaces during the pandemic for markets covered in the CBRE database. Work From Home is the population weighted average across the counties in market m. The right chart presents estimates of $\{\beta_t\}$ and 95% confidence intervals from the specification:

$$\text{Occupancy}_{m,\tau} = \alpha_m + \alpha_t + \sum_{t \in T} \beta_t \text{Work From Home}_m \times \mathbb{1}(\tau = t),$$

representing how occupancy changes in markets with a high 2022 work-from-home share over time. *Sources:* CBRE, Opportunity Insights, and authors' calculations.

C Bank Exposures to At-risk Office Markets: Additional Results

This section presents evidence that banks, especially smaller banks, are less exposed to CBD office loans than other CRE lenders because they generally make smaller loans, which tend to be located more in suburban markets. Table C.1 analyzes the exposure of non-G-SIB banks (columns 1 through 3) and community banks (columns 4 through 6) to at-risk office loans. It shows that office loans in CBDs, or counties with a higher remote-work intensity, are less likely to be held by non-G-SIB banks (column 1) or community banks (column 4). The coefficient estimates change little with the inclusion of core-based statistical area (CBSA) fixed effects, meaning that the differences are driven by locations *within* cities rather than across cities (columns 2 and 5). Namely, smaller banks do more lending in suburban markets, where demand appears to have fallen less than it has around city centers. Finally, the estimated differences in exposure to high-risk markets fall to almost zero when we control for loan size, indicating that the results are due to smaller banks making smaller loans (columns 3 and 6).

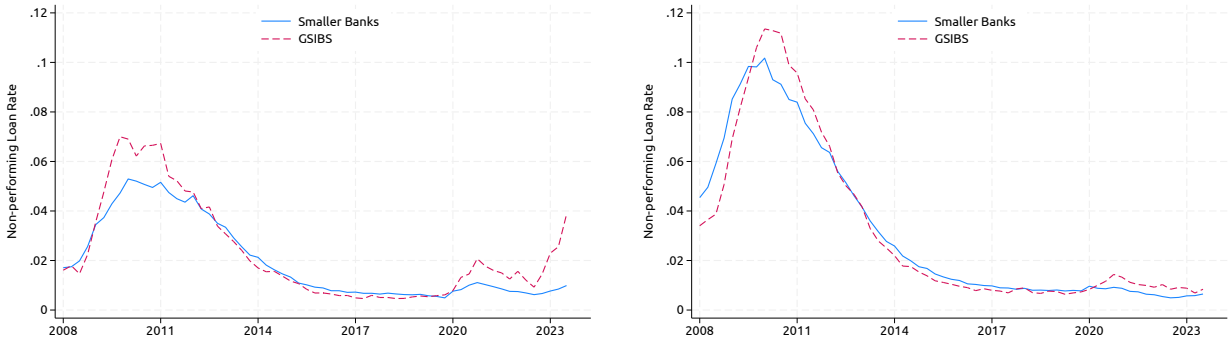
Figure C.1 demonstrates that cross-sectional differences bank CRE loan performance are consistent with these geographic differences in risk exposure. The left chart shows the the rise in nonperforming loan rates (NPLs) for nonowner-occupied, nonfarm, nonresidential, loans—the closest bank analogue to the CMBS sample—during the pandemic is largely concentrated in G-SIB banks. While NPLs for G-SIBs spiked to almost 4 percent as of 2023q3, NPLs for other banks remained slightly below 1%. For other CRE loan categories (combining owner-occupied, multifamily and construction loans), which are less-affected by the dynamics discussed in this paper, delinquency rates remained under 1 percent across bank sizes (right figure).

Table C.1: Determinants of Bank Exposure to At-risk Office Loans

	Non-GSIB Bank Indicator			Community Bank Indicator		
	(1)	(2)	(3)	(4)	(5)	(6)
Work From Home$_{c(i)}$	-0.83**	-0.66**	-0.18^{+}	-0.44**	-0.35**	-0.12
	(0.10)	(0.10)	(0.10)	(0.10)	(0.08)	(0.07)
Central Business District$_i$	-0.07**	-0.08**	-0.02^{+}	-0.03**	-0.04**	-0.00
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln(Loan Amount)			-0.10**			-0.05**
			(0.00)			(0.00)
R^2_a	0.018	0.042	0.090	0.008	0.052	0.072
Observations	40649	40511	40511	40649	40511	40511
CBSA FEs		✓	✓		✓	✓

Notes: This table presents estimates of a linear probability model predicting whether a lender is a non-G-SIB-bank (columns 1 through 3) or a community bank (columns 4 through 6) based on whether the property securing a loan is in a central business district and the decline in the time spent at workplaces. The second and third columns in each set add in CBSA fixed effects and a control for the size of the loan, respectively. The sample is of office loans reported in RCA that we imputed to be outstanding outstanding as of 2023q1, as described in Section 5.2. Community banks are those with under $10 billion in assets. $^{+}$,*,** indicate significance at 10%, 5%, and 1%, respectively.
Sources: Real Capital Analytics, Opportunity Insights, and authors' calculations.

Figure C.1: Nonperforming Loan Rates by Bank Size



(a) Nonowner-occupied CRE Delinquency (b) Other CRE Delinquency

Notes: Each figure plots CRE non-performing loan rates over time for G-SIB (red) and non-G-SIB (blue) banks. Nonperforming loans are loans that are 30 days or more past due or nonaccrual, plotted as a share of aggregate outstanding balances. The left chart plots nonperforming loan rates for nonowner-occupied nonfarm nonresidential loans, while the right plots nonperforming loan rates for other CRE (an aggregation of multifamily, construction and land development, and owner-occupied CRE loans).
Sources: Call Reports, and authors' calculations.