Collateral Reallocation in Commercial Real Estate in the Shadow of COVID-19*

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Abstract

We examine collateral reallocation in commercial real estate markets in the shadow of COVID-19. Office, retail and hotel property types located in dense urban centers have been particularly impacted. We show that use-type redeployment—redeveloping assets from one use to another—occurs frequently in property markets, and that debt slows the reallocation process. We argue that things are somewhat different this time, in the sense that forbearance in response to loan default is not necessarily an optimal policy response. Rather, certain use-types in certain locations may merit an activist lender response to facilitate capital reallocation. A model is developed to distinguish between policy-induced delay and delay due to market uncertainty. Several bank regulatory policy implications are highlighted.

1. INTRODUCTION

Resource allocation is the central task of a market economy. The goal is to use resources in ways that are most valuable to participants in the market. The US may have great natural resources but if we try to grow wheat in Hawaii and pineapples in Minnesota we will be less productive than if we grow wheat in Minnesota and pineapples in Hawaii. Of course, for a modern economy, the important allocation tasks do not, generally, involve agricultural products but rather the allocation of labor and capital to different activities. Economists have long studied the labor allocation process and, more recently, have turned to the question of capital allocation.[1]

In a mature dynamic economy, much of our interest focuses on *re*-allocation decisions. Every day, firms are buffeted by idiosyncratic shocks to their own business and also by macroeconomic shocks like technological change. As a result, some firms grow and others shrink. Even to economists the extent of high frequency resource reallocation is surprising. For example, in 2019, U.S. private sector employers increased employment by about 1.8 million jobs. One might think this means that about one percent of workers were allocated to growing firms. In fact, more than 13 million workers were allocated to new or growing

[1] See Eisfeldt and Shi (2018) for an excellent literature review. An important branch of this literature explores the role of finance in capital allocation. See, among others, Peek and Rosengren (2005) and Caballero, Hoshi, and Kashyap (2008).

firms with the overwhelming majority, about 11 million, re-allocated from firms that shrank or closed down entirely.[2] Given numbers like this, it is clear that efficient reallocation is crucial to the success of a modern economy.

In this paper, we focus on reallocation in one particular part of the economy: commercial real estate. While reallocation can occur at many levels of aggregation, we focus on what we call redeployment, which we define to be reallocation of commercial real estate across different use-types. We focus on CRE for several reasons. First, CRE accounts for a large share of the capital stock. Figure 1 shows that non-residential structures have accounted for roughly a third of the value of the capital stock in the post-war era. Second, and equally important, loans secured by CRE account for a disproportionate share of bank assets, especially for small banks. CRE loans account for over 40 percent of loan portfolios for small banks (defined as having less than $10 billion in assets) compared to less than 20 percent for banks with more than $100 billion in assets. Thus, while single-family residential mortgages get the lion's share of public attention, CRE mortgages play a much bigger role in causing bank failures (Balla et al., 2019; Cole and White, 2012; Fenn and Cole, 2008). We focus on redeployment because COVID-19 pandemic has made reallocation across use-types particularly relevant. Indeed, the pandemic has led to massive changes in the way people live, work and shop, has created a correspondingly large potential need for use-type redeployment (for more on the effects of COVID, see, among others, Davis, Ghent, and Gregory (2021)).

We divide our analysis into three parts. We first utilize several data sources, including a novel dataset that measures the extent of reallocation in commercial real estate. We then analyze determinants of redeployment, showing that mortgage indebtedness tends to impede reallocation. Lastly, we provide a model to explain how and why debt can create frictions in the reallocation of commercial real estate.

We find that redeployment plays a central role in the evolution of commercial real estate. Public records data are utilized from three New England states to provide detailed information on the use-type. Use-type includes the usual categories like Retail, Multi-Family and Office, as well as includes a category for Land. In our main analysis, we take the universe of commercial property, including land, in 2011 and then look at the same locations in 2020.

[2]See https://www.bls.gov/web/cewbd/anntab1_1.txt

We call a transition "redeployment" if its use-type changes from 2011 to 2020. We exclude transitions out of or into land in our definition of redeployment.

To understand our basic findings, imagine an office property investor who wants to develop a new office property but cannot find an existing one to redevelop. One option would be to acquire raw land, and another option would be to acquire a site that houses another use-type and redeploy it. We find that many investors are in this situation and, second, they almost always choose the latter option to redeploy an existing use-type. For example, of all retail properties in use as of 2020, 24 percent emerged from a different use-type sometime after 2011. Of those transitions, only 4 percent (or 1.2 percentage points) were land in 2011, with redeployment accounting for 96 percent (or 23 percentage points) of transitions. The results are most striking for the 5 standard categories of commercial real estate (multifamily, industrial, office, retail and lodging) where over 90 percent of transitions are redeployment. For other property uses such as education (86 percent of transitions) and parking (57 percent of transitions), redeployment is less important.

We then consider determinants of redeployment, asking why investors redeploy some buildings and not others. One answer is that, in denser urban areas, where there is little or no empty land nearby, investors have almost no choice but to redeploy an existing property. Indeed we find that in highly dense places, redeployment is much more likely. A key finding is that mortgaged properties are less likely to be redeployed than properties without a mortgage. Although we do not have an instrument for indebtedness, we do control for many factors that might be correlated with whether the property has a mortgage. For example, we control for the fact that mortgaged properties are also highly improved (as measured by value per square foot of land and share of value from structure) and therefore more likely to be mortgaged.

If redeployment plays a role in the efficient allocation of real estate, then anything that inhibits such reallocation could reduce efficiency. To study why debt might hinder the redeployment of property required by a shock such as COVID-19, we develop a formal model of CRE lending that incorporates stylized empirical facts documented in prior sections. These include incorporating the disparate effects of the unanticipated COVID shock, tradeoffs under uncertainty in taking immediate action versus delay, and blanket bank regulatory policy that incentivizes forbearance over foreclosure.

The model incorporates two distinct factors that impact CRE asset productivity over time: i) cash flow productivity shocks associated with good versus bad economic outcomes, and ii) obsolescence that accumulates to decrease asset productivity as capital ages. There are three parts to the formal analysis. The first part considers cash flow evolution and resulting asset value. The asset is initially financed with a 2-period non-recourse mortgage structured to maximize debt proceeds for the cash constrained asset owner-manager. Loan proceeds and coupon payments are determined endogenously as an optimal contract subject to meeting lender underwriting constraints.

The second part introduces the COVID-19 shock as having occurred at some point between the loan origination date and the first coupon payment date. The asset experiences a negative cash flow shock as well as an unanticipated increase in the rate of obsolescence. Analysis occurs at t=1, the time at which the coupon payment is due. The borrower has incentives to default, and the lender has incentives to forbear, in an environment in which bank regulatory policy disincentivizes foreclosure actions.

The third part considers the possibility of bank intervention through foreclosure to facilitate capital reallocation. Here the incumbent borrower prefers the status quo (forbearance in response to default), as she is unwilling and unable to implement a major new redeployed project herself. She is also unwilling or unable to sell in the current environment. To facilitate transition, the lender must assume an active role by engaging in an analysis of possible redevelopment through redeployment. The capital reallocation problem is studied in a real options framework, where redeployment decisions incorporate the effects of uncertainty when assessing forbearance (status quo) versus foreclosure (transfer control) action outcomes.

A crucial feature of the model is that it distinguishes between policy-induced delay associated with loan evergreening and uncertainty-induced delay associated with resolving uncertainty. Interestingly, in sharp contrast to standard option pricing intuition, we find that higher correlations in investment returns between the current and alternative use lead to more immediate redeployment. This happens because, from an opportunity cost perspective, a higher return correlation increases the hedging benefit of redeployment. That is, a bad ex post outcome conditional on redeployment is less costly when the alternative use also experiences a bad ex post outcome. Similarly, contrary to standard relations, a higher standard deviation in investment returns reduces delay, since higher variability in future cash flow outcomes benefits the higher-valued alternative use more than the lower-valued current use.

Policy implications and recommendations that follow from our empirical analysis and theory of collateral reallocation include: 1) Although one-size-fits-all forbearance is an appropriate policy response to large common shocks (such as the GFC) and periods of high uncertainty (like that experienced early on with the COVID pandemic), it is less appropriate as we begin to move on from the pandemic. Rather, policies that force lenders to seriously consider foreclosure as a mechanism to reallocate capital should be examined; 2) Negative neighborhood externalities that accompany the foreclosure of residential property are less prominent with CRE. Indeed, inhibiting the reallocation of CRE capital can lower agglomeration benefits associated with productive complementary uses in the urban core, implying that foreclosure may in the current environment generate more positive than negative spillovers; 3) A stronger role for lenders in facilitating CRE use-type transitions may help counteract local political factors that often favor the status quo over change.

Our analysis proceeds as follows. Section 2 describes our data and in Section 3 we conduct our empirical analysis of the extent and drivers of redeployment. Section 4 and 5 discuss the effects of COVID-19 on the commercial real estate market and the interaction between redeployment and debt, respectively. In Section 6, we build our model and explore its properties. Section 7 briefly reviews policy implications.

2. DATA

We use public records and assessors files collected by The Warren Group for commercial and residential properties from Massachusetts, Connecticut, and Rhode Island. The public records contain information on all property transactions and liens on properties, such as mortgages. The assessors file is created by local property tax collectors and contain information for a comprehensive set of land parcels within each town or city. This information includes assessed values of both property values and land, as well as a description of the specific use of the property. We use a property identifier created by The Warren Group to match the assessors data with the public records, and vice versa.

The data are comprehensive. The deeds records contain all property sale transactions, foreclosure activities and mortgages outstanding between 1987–2020. The assessors data contain all land parcels that local municipalities track for property tax purposes. This includes properties for which zero property tax is due. We have assessors data for the years 2011 to 2020. There are changes in the number of land parcels over time. Parcels can be combined (assembled) or split (disassembled). Having a parcel split to be used for two different purposes, or that is assembled from two parcels from different uses happens infrequently in our data.[3] We therefore combine any parcels in 2011 that are assembled into one larger parcel by 2020, and combine any parcels in 2020 that were created from more than one 2011 parcel using information on the street address associated with the parcels. Our main analysis of land use is therefore based on a balanced panel of land parcels. Table 1 has information on the number of parcels by state along with some descriptive information.

The data contain detailed information on the use-type of the property. For example, this field includes descriptions such as "post office", "sand quarry", "nursing home", and "art gallery." We use this information to create 14 broader property type categories including single family, multifamily, other residential, industrial, office retail, lodging, parking, religious, government, education, mixed, land, and other. Throughout this paper, we consider a property as redeployed if it switches between one and another of these broader use-type categories.

The assessors data also contain assessed values of each parcel. These assessed values are subdivided into the value of the land and the value of any buildings on the property. We use these assessed values to obtain the share of the value of the parcel that is attributable to land.

In our analysis of CRE debt sources, we make use of two loan-level CRE datasets from Trepp. We use loan-level data on CRE mortgages that are bundled into commercial mortgage backed securities (CMBS). These data include monthly information on loan performance, including delinquency status and whether the loan has been modified. Loan-level information on bank loans comes from the Trepp Anonymized Loan-Level Repository (T-ALLR), which

[3]The most common parcel splits we see are single family residences being split in two.

is effectively a replication of the Y-14 H.2 schedule that the Federal Reserve collects for stress testing. These data are quarterly, not monthly, and also include information on delinquency and loan modifications.

3. REDEPLOYMENT IS COMMON AND HAS CLEAR CORRELATES

In this section we establish some facts about land-use transitions. We conduct two exercises using the combination of public records and tax parcels for MA, RI, and CT.

Our first exercise is to assess flows between different use-types. To do this we compare the use-type of each tax parcel in 2011 (the earliest year in our data) to the use-type of the same parcel in 2020 (the last year in our sample).[4] We then break down changes of use into gross outflows and gross inflows, where gross inflows are further broken down into redeployment (inflows from other active uses) and new development (inflows from land parcels).

The results of this exercise are reported in table 2. The first column contains the number of parcels by use-type in 2020. The next two columns are gross outflows and inflows to this property type between 2011 and 2020 expressed as a percentage of 2020 parcels. For example, 16 percent of the 50 thousand multifamily parcels in 2020 were new multifamily parcels. Of those new multifamily parcels, the majority (15 of the 16 percent) were redeployed, while less than 1 percent were new developments on empty land parcels. The net inflow to multifamily, however, was about half gross inflows because 9 percent of parcels flowed out of multifamily and into other uses.

There are three important takeaways from Table 2. First, there is a lot of transition of parcels between use types. Gross flows are high, both in and out of property types, resulting in gross flows that are higher than net flows. For example, about 4,000 office properties (20 percent of 20,000) in 2011 were categorized as another use-type in 2020. In contrast, about 7,600 parcels (38 percent of the 2020 office stock) was classified as a non-office use-type in 2011. The net flow into office from redeployment was 3,600, or 18 percent of the 2020 stock of office properties. Another 1 percent of new office properties came from new development.

[4] We compare the beginning and end of our sample to abstract from the fact that redeployment takes time. If a redeployment involves major construction, those parcels will appear as land between the original and final use-type. Looking over a 9 year period allows us to abstract from that transition period.

The second takeaway is that redeployment is the main source of inflows to all property types. When looking at the 5 major commercial property types, over 90 percent of inflows were redeployments, while new developments accounted for less than 10 percent of gross inflows. Government properties saw the lowest share of inflows coming from redeployment, with 46 percent new government properties coming from undeveloped land.[5]

Lastly, table 2 provides some initial evidence that properties that flow from one use-type to another tend to be lower-valued relative to parcels that remain in the same use. The last two columns of table 2 compare the average value of properties that did not change use between 2011 and 2020 to the average value of those that did change uses. Average values of outflows for four out of the five major commercial real estate property types are lower than the average value of those that remain in the same use. The exception is multifamily. However, this statistic does not control for location of these parcels, so it may simply reflect a location, as opposed to a quality difference in these properties. We will better control for these covariates in our second exercise.

Our second exercise is to run a set of regressions to better understand what features of land parcels are correlated with redeployment. To do this we flag all the parcels in our data that change uses between 2011 and 2020, and run linear probability regressions of that indicator on some explanatory variables measured as of 2011.

Our regression specification is as follows:

$$Y = \alpha + \boldsymbol{\beta} \boldsymbol{X} + \text{State FE} + \text{Property Type FE} \tag{1}$$

where Y is the indicator of whether the parcel was redeployed. It is multiplied by 100 so that coefficients can be interpreted as the effect in percentage points. X is a vector of characteristics that include the age of the building in years, the population density of the census tract (normalized to have zero mean and a standard deviation of 1), an indicator for whether the property is mortgaged in 2011, an indicator for whether the property was sold between 2011 and 2020, the log of the total assessed value of the property per square foot of the lot size, the share of the total assessed value that is attributable to land, and an indicator

[5] Table A.1 in the appendix provides numbers of parcels that transitioned between each type of property.

for whether the parcel was subject to a foreclosure sale between 2011 and 2020. We also include state and property type fixed effects, where the property type indicator refers to the 2011 property type.

We run these regressions on three subsamples of our data, created according to the use of the parcel in 2011: income producing commercial real estate, which we define as all parcels that were classified as office, retail, industrial, or lodging; all residential properties (single family, multifamily, and other residential); and, lastly, land parcels. The mean of the dependent variable is included in the bottom row of the table. Summary statistics for all of the dependent variables are in table 3. The results of the regressions are in table 4.

The regressions show that., on average, assets that transition to a new use are older and are located in more densely populated areas. This makes sense intuitively. In densely populated areas, there is relatively little undeveloped land, so nearly all inflows to a given property type will be redeployed from another use. Older buildings are more likely to be redeployed because newer buildings are more likely to have already been recently developed or redeployed, and are generally more more productive in their current use.

This is true for both commercial and residential properties, although the importance of each parcel characteristic varies between the two. For example, building age matters less for commercial properties than for residential properties. Looking at column (1), for commercial properties, a parcel with a building that is 10 years older is 0.8 percent more likely to have been redeployed as compared to an increase of almost 0.1 percent for residential properties in column (5). However, an increase of 0.8 percent is only 4 percent of the average redeployment rate for commercial properties of 17.5 percent, whereas 0.1 percent is 10 percent of the average redeployment rate for residential properties, which have an average redeployment rate of just over 1 percent.

Importantly to the main thesis of this paper, the regressions show that properties that are mortgaged in 2011 are significantly less likely to be redeployed. Mortgaged commercial and residential property are both about 0.7 percent less likely to be redeployed than properties that are owned free and clear. While this effect is smaller for commercial properties when considered relative to their average redeployment rate, it indicates that debt contracts may limit the transition of land parcels to a better use.

Beyond building age, less valuable parcels and parcels with a higher land share are more likely to be redeployed. This can be seen in columns (2) and (3) for commercial properties and columns (6) and (7) for residential properties. These correlations also make intuitive sense. There are multiple reasons why less valuable parcels are more likely to be redeployed. Parcels that are not currently in their first-best use-type will be valued lower than if they were deployed more efficiently. Lower quality buildings in a given use-type are also more likely to benefit from redeployment. Parcels with more of their value attributable to land are going to be more likely to have alternative options for their use (hence the high value of the land).

Lastly, in column (9) we look solely at land parcels. Unlike income-producing property, land parcels are more likely to transition in less densely populated areas. This is because land is cheaper and more available in less dense, more rural areas than in more densely populated cities. Land parcels in cities are more likely to have a use as land (as a park, for example). Also, in contrast to residential and commercial properties, it is more valuable land parcels that are more likely to transition. This is because land parcels that are developed are almost certainly closer to existing developments and therefore have a relatively high value because of that proximity.

4. COVID AS A SHOCK TO CRE

The COVID-19 pandemic disproportionately affected dense cities with high land values such as San Francisco and New York. It furthermore impacted some property types negatively and others positively. Namely, the lodging, retail, and office sectors experienced large negative effects, while multifamily and industrial property experienced an increased demand for space. Some empirical evidence of these divergent impacts can be seen in correlations in returns of REITS. As can be seen in Figure 2, in 2019, total returns for mall, data center, hotel, and industrial reits were positively correlated. During the pandemic, correlations became negative when comparing hotels and and malls to data centers and industrial REITS.

Below we will describe in more detail how each property type has been affected by the pandemic.

4.1. Lodging

The most acute impact of COVID-19 lock-downs was on the lodging sector. As can be seen in Figure 3, hotels immediately experienced increases in vacancy and declines in revenue per available room (RevPAR). Initially the thought was that this stress would be short-lived, but the sector has not yet fully recovered. While leisure travel has rebounded to some extent,[6] business travel has not as many companies have proposed plans to cut their travel budgets permanently. Thus COVID may have been a permanent shock to hotels that largely depend on income from business travelers and conferences.[7]

4.2. Retail

Stay-at-home orders and the concurrent increase of e-commerce was a negative shock to brick-and-mortar retail investments. E-commerce increased from about 11 percent to almost 16 percent of all retail sales in the early months of the pandemic. Throughout 2020, e-commerce saw an over 30 percent increase in the dollar amount spent relative to 2019.[8]

However, the most acute effect on retail was a trend that was occurring pre-pandemic: the obsolescence of malls. Department stores, which anchor malls, have seen declining sales revenue since 2000 (see the top panel of figure 4). The pandemic was a shock that put some over the edge, with 6 department stores declaring bankruptcy in 2020, up from 1 in 2019.[9] Green Street Advisors predicts that half of department stores within malls could close by the end of 2021. Other brick-and-mortar retail has been less affected (see the bottom panel of figure 4).

The fact that malls were in decline pre-COVID means that they have already been the target of redeployment efforts. According to a 2020 retrospective survey conducted by NAR, of the about 90 vacant malls purchases (which largely occurred in the last 20 years), just

[6] https://www.cbre.com/insights/books/us-real-estate-market-outlook-2021/hotels

[7] As of 2021:Q2, four in five companies are spending less than 25 percent of what they were spending in 2019 on travel (Deloitte report on future of business travel). Half of companies do not expect to return to their 2019 travel habits by the end of 2022. In the long run, companies may never make a full return to their pre-pandemic levels of travel because it saves money as well as helps them meet corporate environmental goals.

[8] See the Census 2021 Q2 Quarterly Retail and E-Commerce Sales Report.

[9] Century 21, Stein Mart, Lord & Taylor, J.C. Penney, Stage Stores, and Neiman Marcus all declared bankruptcy in 2020.

under 30 percent were used for other retail purposes, while 15 percent were transitioned to mixed-use office and multifamily. While the conversion of malls into distribution centers has received a lot of press, only 5 out of the 90 transactions resulted in a transition of a mall to a distribution center.[10] This is partly because malls are not typically designed for the heavy loads required in more industrial settings, implying greater transition costs.

The NAR survey also provides insight into how the redeployment process works in practice. On average, the 90 malls were acquired for 43 percent less than their previous sale price, were vacant for an average of 4 years prior to being purchased, and generally did not require rezoning for redeployment. Six case studies reveal redeployment obstacles that include lease breakage costs, the unwinding of complex ownership structures, and local politics that can significantly delay major redevelopments.

4.3. Office

Early in the pandemic there was less concern for the future of office property because it was assumed that work-at-home would be short-lived. But remote work has lasted much longer than initially expected. While some companies have returned their employees to the office (e.g., Netflix, Bloomberg, Goldman Sachs) others' plans to return to the office have been delayed (e.g., Apple, Google, Microsoft). And more recently, some companies have actively started to downsize their office spaces as they transition to a more permanent model of remote work,[11] or are anticipated to downsize after having announced permanent remote work.[12] Evidence of this trend can be seen in increasing vacancy rates among office properties (see Figure 5).

Green Street Advisors estimates that the US will see a 15 percent permanent reduction in demand for office space. This decline in demand will vary geographically. As of 2021:Q2, office vacancy rates nationally were about 2 percent points above their pre-pandemic levels, but in San Francisco, the office vacancy rate had doubled: rising from just over 6 percent to over 12 percent (see Figure 5). These vacancy rates are for offices that are no longer

[10] NAR Case Studies

[11] Examples include GlaxoSmithKline which is reducing its footprint in Philadelphia, PA and Durham, NC by as much as 80 percent, and Lockheed Martin, which is downsizing its space in Crystal City.

[12] PwC announced that all of its US employees could work remotely from anywhere within the US.

being leased. Physical vacancy rates—offices that are being leased, but are not physically occupied by employees—are even higher. According to keycard data from Kastle,[13] physical occupancy is 35 percent of pre-COVID levels.

4.4. Multifamily

Initially multifamily properties in some dense cities such as San Francisco saw vacancy rates spike. However, nationwide, multifamily was little impacted outside of slight declines in income due to eviction moratoriums. Recently, in parallel with the increase in house prices, vacancy rates in multifamily properties have dropped (left panel of figure 6).

Consistent with an increase in demand for housing, we have already seen some of the impact of COVID on conversions of multifamily property. An analysis of Yardi Matrix data shows that there has been an increase in the number of apartments units coming from conversions. In 2021, for example, over 20,000 apartment conversions are expected to be finalized. Over 40 percent of those conversions are from former office buildings, followed by factories and hotels.[14]

4.5. Industrial

Industrial property has seen a strong increase in demand since the pandemic, due in part to the increase in e-commerce. Vacancy rates have been trending downwards since mid 2020, and rents are increasing (see the right panel of figure 6).

5. REDEPLOYMENT AND COMMERCIAL REAL ESTATE DEBT

As we will describe in our model below, existing debt contracts may limit the efficient redeployment of commercial real estate assets. As of the fourth quarter of 2019, there was \$4.5 trillion dollars of commercial real estate debt outstanding, over 50 percent of which was on bank balance sheets (figure 7). The other major lenders in the market are the GSEs, which provide funds for multifamily properties, life insurance companies and investors in the CMBS market.

[13] https://www.kastle.com/safety-wellness/getting-america-back-to-work/

[14] https://www.rentcafe.com/blog/apartmentliving/adaptive-reuse-apartments-2021/

The effect of the COVID-19 pandemic on commercial real estate market is evident from CRE loan delinquency rates. They are especially high in CMBS lodging loans, which saw a peak of about 15 percent delinquency in early 2020 (left panel of figure 8). Retail has had the next highest delinquency rates.

Delinquency rates on bank CRE loans were much lower than delinquency rates on CMBS loans (right panel of figure 8). This is partly because banks have more flexibility in their ability to modify loans, and may do so before loans officially become delinquent (Glancy, Kurtzman, and Loewenstein, 2022). Figure 9 shows the cumulative share of CMBS and bank loans by property type that were modified during 2020 and 2021, although other differences, like the use of recourse in bank CRE loans (Glancy et al., 2021), may also have affected the difference in delinquency rates.

One way in which debt contracts could limit efficient redeployment of CRE assets is if lenders provide modifications that allow borrowers to retain their properties when it would be better for them to sell the property for redeployment. This is a greater concern for bank loans. Bank loan modification rates were not just higher for property types affected by the pandemic, but were relatively common for all property types. This possibly reflects banks being less discriminating than CMBS servicers in which kinds of loans they modified.

There were changes in rules and regulations early in the pandemic that encouraged lenders to work with borrowers in need of assistance. An inter-agency statement issued by regulatory agencies encouraged lenders to provide prudent modifications to borrowers affected by the pandemic. It further did not require them to automatically classify these modified loans as troubled debt restructurings,[15] which allowed banks to defer realizing losses on these loans. CMBS servicers are much more limited in their ability to modify delinquent loans because of REMIC rules and limits set forth in pooling and servicing agreements (PSAs). In response to the pandemic the IRS did issue a statement[16] that allowed for forbearances of up to 6 months within the REMIC structure, resulting in more forbearances on cmbs loans (Glancy, Kurtzman, and Loewenstein, 2022), but this rule change did not eliminate the restrictions put in place in the PSAs.

[15] https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20200407a1.pdf
[16] https://www.irs.gov/pub/irs-drop/rp-20-26.pdf

Lenders may not only limit the efficient transition of assets by modifying loans, but more generally by delaying foreclosure. We can see some evidence that foreclosure activity in the CMBS market has slowed in figure 10. The top panel shows the share of delinquent loans for which foreclosure is initiated in a given month. In 2019, this ratio fluctuated between 5 and 11 percent. In early 2020, it dropped to under 5 percent. The time between first delinquency and foreclosure initiation has also increased. In the bottom panel, we can see that before the pandemic, loans were delinquent for 10 months on average before foreclosure was initiated. This dropped early in the pandemic, but has since increased to over 14 months.

6. MODEL

We now develop a formal model of CRE lending that incorporates stylized facts documented in prior sections. These include incorporating effects of the unanticipated COVID shock, tradeoffs in taking immediate action versus delay when reallocating capital in response to the shock, and blanket bank regulatory policy that incentivizes forbearance over foreclosure.

The model incorporates two distinct factors that impact CRE asset productivity over time: i) cash flow productivity shocks associated with good versus bad economic outcomes, and ii) obsolescence that accumulates to decrease asset productivity as capital ages. There are three parts to the analysis. The first part considers cash flow evolution and resulting asset value. The asset is initially financed with a 2-period non-recourse mortgage structured to maximize debt proceeds for the cash constrained asset owner-manager. Loan proceeds and coupon payments are determined endogenously subject to meeting lender underwriting constraints.

The second part introduces the COVID shock as having occurred at some point between the loan origination date and the first coupon payment date. The asset experiences a negative cash flow shock as well as an unanticipated increase in the rate of obsolescence. Analysis occurs at t=1, the time at which the coupon payment is due. The borrower has incentives to default on the loan in an environment in which bank regulatory policy favors forbearance over foreclosure.

The third part considers the possibility of bank intervention through foreclosure to facilitate capital reallocation. Here the incumbent borrower prefers the status quo (forbearance in response to default), as she is unwilling and unable to implement a major new project herself. She is also unwilling or unable to sell in the current environment. To facilitate transition, the lender must assume an active role by engaging in an analysis of possible redevelopment or redeployment. The capital reallocation problem is studied in a real options framework, where redevelopment and redeployment decisions incorporate the effects of uncertainty when assessing forbearance (status quo) versus foreclosure (transfer control) action outcomes.

6.1. Fundamental Risks, Cash Flows and Asset Value

Time is discrete, all agents are risk neutral and the riskless rate of interest is zero. Cash flows are subject to two sources of variation occurring over an infinite investment time horizon: near-term technology shocks and long-term obsolescence.

There is an incumbent commercial property owner-manager of an asset characterized by a set of parameter values. The asset generates a periodic cash flow net of operating costs, denoted as CF. The cash flow is received at the end of each period. In periods 1 and 2, cash flows experience shocks that proportionally increase or decrease the prior period CF by a factor σ, $\sigma > 0$. Outcomes are the result of a technology shock that may be positive for certain asset types in certain locations and negative for others. For example, the pandemic has negatively impacted traditional office and retail property types, while "digitally" oriented property types such as logistic warehouse and data centers have benefited from the pandemic.

After the end of period 2, cash flow risk of the type described above is fully resolved. At this point, over time, asset productivity as measured by property cash flow experiences a steady geometric decline. This rate of decline, referred to as the obsolescence rate, is summarized by δ>0. Thus, conditional on the time $t = 2$ cash flow realization, cash flows steadily and predictably decline in proportion to $(1-\delta)^{n-2}$, with $n > 2$ indicating the time period.

Figure 11 visually displays the evolution of cash flows over time. There is no cash flow realized at $t = 0$. At $t = 1$ cash flow equals either $CF(1+\sigma)$ or $CF(1-\sigma)$, and at $t = 2$ cash flow equals either $CF(1+\sigma)^2$, $CF(1+\sigma)(1-\sigma)$ or $CF(1-\sigma)^2$. Cash flow remains at the time 2 value thereafter, subject to obsolescence-based productivity declines described above.

Asset value at various points in time, conditional on particular cash flow realizations, can be calculated as a function of expected future cash flows. Time $t = 0$ asset value is determined by working backwards in time, starting just after the conclusion of period 2 and at the beginning of period 3. Given the periodic obsolescence rate, and recalling that all agents are risk neutral and the risk-free rate is zero, a present value conversion factor of $(1 - \delta)/\delta$ transforms the starting period cash flow into an asset value. This valuation multiple is seen to be decreasing in the rate of obsolescence, going from infinity to zero as δ goes from zero to one.

With this present value conversion factor, the asset's $t = 2$ value, inclusive of cash flow receipt at that time, can be determined. This value is conditional on one of three possible up (U) versus down (D) cash flow realizations: U-U, U-D or D-U, or D-D (see figure 11). Conditional asset values at $t = 2$ are as follows:

$$V_2^{U-U} \qquad = CF(1+\sigma)^2 + \tfrac{CF(1+\sigma)^2(1-\delta)}{\delta} = \tfrac{CF(1+\sigma)^2}{\delta} \tag{2}$$

$$V_2^{U-D} = V_2^{D-U} = CF(1+\sigma)(1-\sigma) + \tfrac{CF(1+\sigma)(1-\sigma)(1-\delta)}{\delta} = \tfrac{CF(1+\sigma)(1-\sigma)}{\delta} \tag{3}$$

$$V_2^{D-D} \qquad = CF(1-\sigma)^2 + \tfrac{CF(1-\sigma)^2(1-\delta)}{\delta} = \tfrac{CF(1-\sigma)^2}{\delta} \tag{4}$$

With these $t = 2$ conditional asset values, we are now in a position to calculate asset values at $t = 1$. Doing so requires probabilities associated with U versus D realizations. Given that the law of one price holds, and again recalling agent risk neutrality, a zero risk-free rate and symmetric value changes, the endogenous probability of a U versus D state outcome is $\frac{1}{2}$. With this, the $t = 1$ conditional asset values inclusive of the end-of-period cash flows are:

$$V_1^U = \quad CF(1+\sigma) + \tfrac{1}{2}\tfrac{CF(1+\sigma)}{\delta}[1+\sigma+1-\sigma] = \tfrac{CF(1+\sigma)(1+\delta)}{\delta} \tag{5}$$

$$V_1^D = \quad CF(1-\sigma) + \tfrac{1}{2}\tfrac{CF(1+\sigma)}{\delta}[1+\sigma+1-\sigma] = \tfrac{CF(1-\sigma)(1+\delta)}{\delta} \tag{6}$$

The time $t = 0$ asset value can now be calculated. Keeping in mind there is no cash flow received at that time, asset value is simply the expected present value of t=1 asset values as of t=0:

$$V_0 = \frac{1}{2}\frac{CF(1+\delta)}{\delta}[1+\sigma+1-\sigma] = \frac{CF(1+\delta)}{\delta} \tag{7}$$

Figure 12 presents a visual depiction of the evolution of asset values. We note that, based on our modeling assumptions, $t = 0$ asset value, V_0, depends only on the asset's productivity (CF) and obsolescence rate (δ). It does not depend on the near-term cash flow shock risk as summarized by σ. If instead a positive risk-free rate were introduced, V_0 would depend on that rate as well as σ. Risk aversion would also cause V_0 to depend on σ. We further note that our assumption of two non-overlapping sources of cash flow variation is made for convenience in order to simplify the modeling.

In reference to equation 7, note the obsolescence rate parameter, δ, acts like a real capitalization rate applied to transform current and expected future cash flow into an asset value. In comparison to the usual nominal capitalization rate expression, $r - g$, the real cap rate is interpreted is as follows. After controlling for the appropriate nominal cash flow discount rate and the anticipated nominal cash flow growth rate due to inflation, the residual cash flow growth rate component is measured by real declines in the growth rate due to physical depreciation and economic obsolescence.

As a specific example, conventional (pre-pandemic) wisdom suggested that an office building in midtown Manhattan would experience lower rates of obsolescence than an otherwise identical office building in suburban St. Louis. This is primarily because land value ("land share") in midtown Manhattan is a higher percentage of total property value than in St. Louis. Post-pandemic the conventional wisdom has changed, however. Again, taking office property as an example, WFH has and will likely continue to impact on office markets that require significant commuting times (such as NYC), and/or whose tenant base is more amenable to working from home (such as San Francisco). This creates an excess office supply problem in those markets, particularly with older, lower-quality office buildings that are not terribly desirable in today's "green, zero net-carbon building" CRE marketplace. A more nuanced analysis of obsolescence rates is therefore implied – one that depends not only on land shares but also building age, tenant characteristics and work-commuting patterns.

Bokhari and Geltner (2018) empirically estimate rates of depreciation on commercial property in the US that generally range between 1.0 percent and 2.0 percent per year, with a mean of approximately 1.5 percent. These depreciation rates decrease with land share, with low-barrier markets exceeding 2.0 percent and high-barrier markets in the 1.0 percent range. They also show that depreciation loads almost exclusively on cash flow, consistent with our model. But these rates are after capital expenditures, which, according to industry analyst Green Street Advisors, run between 0.50 percent and 1.50 percent per year with a mean of about 1.0 percent for the property types we are interested in. Altogether the data suggest obsolescence rates of between 1.50 percent and 3.50 percent per year.

Both sources of cash flow variation in our model—technological cash flow uncertainty and obsolescence—can be used to characterize different types of assets. To extend our previous (pre-pandemic) example, properties located in cities with high land shares may have lower rate of obsolescence, but may also experience higher near-term cash flow variability due to supply constraints that intensify rental demand responses to technology shocks ($\sigma \uparrow$,$\delta \downarrow$). Lower-quality retail properties and faddish retail formats may experience a high rate of obsolescence, whereas near-term cash flow risk may be moderate due to long-term leasing ($\sigma \downarrow$,$\delta \uparrow$). A single-tenant property with a high credit quality tenant and a long-term lease will experience relatively low cash flow risk and rate of obsolescence ($\sigma \downarrow$,$\delta \downarrow$), whereas the opposite may be true with a low credit-quality tenant on a short-term lease ($\sigma \uparrow$,$\delta \uparrow$).[17]

6.2. Debt Financing

We now consider the debt financing of the asset characterized above. Debt is a preferred funding mechanism for the incumbent owner-manager due to contracting costs associated with raising outside equity (high state verification costs), as well as a scarcity of inside equity. The high cost of both outside and inside equity causes the owner-manager to ration its own equity as much as possible across existing and anticipated future investments. In a similar vein, the owner-manager prefers to distribute residual cash flows as dividends rather than hold that cash idle inside the enterprise. As a result, we say the owner-manager is

[17] Other firms such as technology licensing enterprises may own assets with low cash flow shock risk while also being subject to a high obsolescence rate. In contrast, infrastructure companies may be subject to highly variable demand with little obsolescence, thus experiencing the exact reverse set of risks. Firms with other risk combinations are easy to imagine and therefore characterize with the pair (σ, δ).

financially constrained, where, all else equal, the owner-manager prefers to issue as much debt as possible to fund ownership of the asset.

It will be up to competitive lenders to place upper bounds on loan amounts, as well as to determine the price of the debt and associated protective covenants. The resolution of firm-specific cash flow uncertainty at the end of two periods, and the introduction of asset obsolescence after that point makes it natural to focus on debt with a 2-period maturity. Then, conditional on the owner-manager maintaining control (that is, not defaulting on the debt on or prior to debt maturity), at debt maturity the owner-manager can fund debt repayment through either an asset sale or with a new debt refinancing.

Now consider debt financing at time $t = 0$. As noted, the debt will mature in two periods. The debt has recourse only to the property as security, which in practice is referred to as non-recourse mortgage debt. It is fixed payment, with coupon interest due at times $t = 1, 2$. The coupon interest rate is set so that the debt is issued at par. Par valuation at issuance is imposed to simulate industry practice and aid in comparing alternative financing regimes.

High shadow costs of inside and outside equity cause the owner-manager to want to maximize loan issuance proceeds at the expense of possible default and loss of control. This in turn focuses attention on the lender, which imposes limits on credit risk and hence debt proceeds in order to comply with internal and/or regulatory risk-bearing constraints. We will label the underwriting risk limits as lender participation constraints (LPCs). Consistent with industry practice, two loan underwriting constraints are imposed: one that establishes a maximum loan amount, L, and one that establishes a maximum coupon payment, ιL. The LPCs are as follows:[18]

$$LPC1: \quad \iota L + L \leq CF(1+\sigma)(1-\sigma)/\delta \tag{8}$$

$$LPC2: \quad \iota L \leq CF(1+\sigma) \tag{9}$$

[18]Implicit in these constraints is a dividend payout restriction, which requires the owner-manager to fund the contractually stated coupon payment and any loan principal payoff prior to distributing operating cash flows as dividends. This payout restriction is standard, often referred to as a "lockbox" requirement. Recourse and possible clawback of previously paid dividends is also sometimes allowed when certain "bad acts" such as fraud or misrepresentation occur. Clawbacks are not considered here. Finally, lenders sometimes require the funding of certain reserves such as capital expenditures prior to approving dividend payouts. We will also not explicitly consider funding reserves of this type in the formal model, although they could be easily incorporated with only minor changes in model structure.

The first participation constraint stated in 8 requires sufficient cash flow and residual asset value to fund full repayment of debt interest and principal given a U-D or D-U realization at $t = 2$. This implies term default conditional on reaching the D-D node at $t = 2$, which in turn implies that $\iota L > 0$. In other words, the credit spread is positive given the potential for loan default. The second participation constraint requires sufficient cash flow from the asset in place given a U state at $t = 1$ to fund the coupon payment; otherwise, sure cash flow default would be possible at $t = 1$ to undermine the loan structure. This constraint implies the lender is willing to entertain the possibility of liquidity-based cash flow default at the D node at $t = 1$.

Given the owner-manager's high shadow cost of equity, her objective is to maximize debt proceeds subject to satisfying the lender's debt underwriting constraints. Consequently, either equation 8 or 9, or conceivably both, will be binding for any given set of feasible parameter values. As such, and given the restriction that lenders make zero profits in competitive equilibrium, the coupon payment, ιL, and the loan amount, L, are endogenously determined. This in turn generates endogenously determined loan-to-value ($LTV = L/V_0$) and debt service coverage ($DSC = CF/\iota L$) ratios that vary depending on the asset's fundamental productivity and risk characteristics.

6.3. Debt Funding Structure

With the further objective of minimizing post-issuance debt value, the borrower's optimal repayment-default decisions are made conditional on state outcomes at times $t = 1, 2$. The lender rationally anticipates the set of feasible-optimal borrower actions along the path of potential state outcomes in determining a loan quantity (loan proceeds, L) and loan price (credit spread, ι) in Bayesian-Nash equilibrium.

The model generates three distinct lending regimes that depend on the size of δ relative σ. We will refer to the regimes as high, moderate and low obsolescence risk (δ), or "real cap rate" regions, appealing also to Figure 13 as we go along.[19]

Regime 1 follows when cash flows are large relative to the asset value; that is, when the real cap rate is high (see Panel A of Figure 13). The lower relative asset value implies that

[19] Proofs and related technical material are available from the authors by request.

the LTV (equation 8) constraint is binding while the cash flow-based debt service coverage ratio constraint (equation 9) is not. Given the binding LTV underwriting constraint, loan amount increases within the region as the real cap rate declines (see Panel A of Figure 13). The loan amount also increases as cash flow shock uncertainty is reduced, since such a reduction increases $t = 2$ asset value at the LTV underwriting constraint (the U-D or D-U realization). Interestingly, the credit spread (ι) does not depend on the real cap rate in this region. This follows because there is no cash flow default in this region, implying the loan coupon payment expands proportionally with loan amount to leave ι unaffected.

The moderate real cap rate/asset value region is such that cash flows are lower relative to those in the high real cap rate region (see Panel B of Figure 13). In this region there is cash flow default at the D node at $t = 1$, with a binding LTV underwriting constraint. Liquidity default is incentive compatible at the D node at $t = 1$, since there is no residual equity value from continuation. This implies that the strategic default decision comes down to whether current cash flow exceeds the coupon payment or not (which it doesn't). The combination of a binding LTV underwriting constraint and cash flow default at $t = 1$ suggests that both σ and δ should impact the credit spread, which they do. However, somewhat unintuitively, increasing the real cap rate through δ has the effect of decreasing the credit spread. This happens because the increase in real cap rate reduces the loan amount due to the binding LTV underwriting constraint, while at the same time cash flow increases in proportion to asset value. The proportional increase in cash flow reduces credit loss, since it reduces the gap between coupon payment amount and cash flow at the D node at $t = 1$. The resulting reduction in credit losses at $t = 1$ decreases in the credit spread.

Region 3 follows from a low real cap rate, implying that cash flows are small relative to asset value (see Panel C of Figure 13). In this case the cash flow underwriting constraint (equation 9) binds. Within this region, loan amount increases with a lower cap rate, since, holding cash flow constant, the value of the asset increases to increase collateral recovery in default. Here the credit spread also decreases as the cap rate decreases, for basically the same reason. The comparative static relation with respect to δ flips in going from region 2 to 3, however. This happens because the loan goes from a binding LTV underwriting constraint (equation 8) to a binding debt service coverage underwriting constraint (equation 9).

Finally, when the real cap rate is sufficiently small within regime 3, resulting in a very high asset value relative to cash flow, it may no longer be incentive compatible for the borrower to default at the D node at $t = 1$. This follows because sufficient residual equity value now exists at the U-D or D-U node at $t = 2$, implying that continuation is optimal at the D node at $t = 1$. The integrity of the loan structure is maintained if the lender believes the borrower cannot or will not bridge the coupon payment funding gap. However, if the lender believes the borrower is willing and able to fund the coupon payment shortfall when a D realization occurs at $t = 1$—that is, the shadow cost of funding the payment gap is sufficiently low—the loan structure is modified to account for this belief.

The key to understanding this result is to recognize that the property owner can increase equity value by funding the coupon payment to avoid a liquidity default. This happens because a liquidity default increases the loan value relative to a no-default outcome, and even though the asset value is currently underwater relative to the loan's par value. When the lender anticipates an equity infusion to cover the coupon payment gap, the lender modifies the initial loan structure by reducing loan proceeds and increasing the credit spread.

This result provides a novel rationale for the inclusion of a cash flow coverage maintenance provision in the debt contract. This provision limits the discretion of the borrower by giving the lender the right to declare default, accelerate loan repayment, and liquidate the loan when property level cash flow is insufficient to fully fund the coupon payment. This cash flow maintenance provision thus serves as a commitment device that allows the property owner to obtain better loan terms—higher debt issuance proceeds and a lower credit spread—than it might otherwise receive. Given a financially constrained borrower, it very well may be that the provision Pareto dominates the no-provision alternative by eliminating the potential for ex post opportunism. This arrangement is also incentive compatible for the lender.

The presence of such provisions is, according to the model, predicted to be associated with high-value assets with low real cap rates. Low cap rates, and hence low relative cash flows, increase the likelihood of liquidity default when the borrower would otherwise like to continue to fund payment to retain control of its high-value asset. Going forward we will assume the existence of this cash flow coverage provision.

6.4. The COVID-19 Pandemic Shock to Commercial Property Markets

Assume now that the loan was originated prior to the COVID-19 shock. It is now time t=1, with one time period remaining until loan maturity. At t=1 the COVID shock has occurred and its lingering effects have yet to be fully resolved.

As discussed previously, the COVID shock has had a generally positive effect on certain CRE property types (e..g., logistic industrial, data centers) while it has had a generally negative effect on others (e.g., office, retail, hotel). Dense urban locations were particularly hard hit. In this section we are focused on those property types that experienced a negative shock. This places cash flow and property value on the D-node at $t = 1$, as seen in Figures 11 and 12.

The possibility of a negative σ shock was not unanticipated at loan origination. What was unanticipated was the *kind* of shock that occurred. The complete shutdown of out-of-the-home, in-person activities, and the resulting impact on economic activity, was not at all anticipated. This unknown unknown—the COVID pandemic—has sped up the rate of obsolescence of urban office and business-reliant hotel property, as well as malls and certain other types of retail property.

As a consequence of the shock, the rate of obsolescence at $t = 1$ is revised upward to equal $\delta^Z > \delta$. This means the $t = 1$ property value is revised downward from its former market value (and book value) of $BV = (CF(1-\sigma)(1+\delta))/\delta$ to equal $MV^Z = (CF(1-\sigma)(1+\delta^Z))/\delta^Z$ (see Figure 12). Going forward we will sometimes refer to the property as "zombie" real estate.

This modification affects the default incentives of the borrower. When the original rate of obsolescence was high, that is, $\delta \geq \sigma/4$ (regime 1), the optimal debt contract is such that there is no incentive for cash flow default at $t = 1$. This incentive does not change post-COVID, and follows because property cash flow at $t = 1$ equals or exceeds the required coupon payment, $\iota_1 L_1$. There will, however, be sure default at $t = 2$. This follows because equation 8 was binding at loan origination, and now property value only equals $CF(1 + \sigma)(1 - \sigma)/\delta^Z < CF(1 + \sigma)(1 - \sigma)/\delta = \iota_1 L_1 + L_1$ at the D-U node at $t = 2$.

Alternatively, when the original rate of obsolescence was moderate to low, that is, $\delta < \sigma/4$

(regimes 2 and 3), the optimal debt contract is such that cash flow default occurs at $t = 1$. Cash flow default remains incentive compatible for the borrower, as the increase of $\delta \rightarrow \delta^Z$ only intensifies the borrower's default incentive.

The unanticipated increase of $\delta \rightarrow \delta^Z$ has potential regulatory implications for the lender. Due to the unanticipated effects of the COVID shock, financial regulators are concerned about negative spillover effects of loan foreclosures. For example, foreclosure of rental, multi-family property may result in displaced tenants and create a "cloud of foreclosure" that may impact surrounding residential property values. Such effects could cascade to negatively impact other loan outcomes and thus bank balance sheets. During an economic crisis period, these external costs may be avoided given policies that encourage forbearance over foreclosure in response to payment default.

We label the regulatory response as "indiscriminate" when it applies to any type of CRE foreclosure. When the capital charge is indiscriminate, it imposes a cost of κ on the lender conditional on a foreclosure action at t=1. Among other possible factors, the regulatory charge cost will be a function of the size of the decline in loan value due to $\delta \rightarrow \delta^Z$. The charge is considered by the lender to be "transitory," in the sense that is thought to apply only at t=1, during the crisis period. Once the crisis period is over, the charge is expected to disappear. The lender can avoid this charge if, conditional borrower default at t=1, it incurs a loss by writing off any payment shortfall so that the loan remains classified as "current" for regulatory accounting purposes.

Conditional on borrower default at $t = 1$, in the baseline model the lender will compare the cost of funding the payment shortfall (PS) to the internal capital charge cost of κ. When $\sigma(1-\sigma)/(4+2\sigma) \leq \delta < \sigma/4$, the lender's LTV constraint (equation 8) binds and the contractually stipulated coupon payment is $\iota_2 L_2 = (CF(\sigma-\delta)(1-\sigma))/3\delta$. Alternatively, when $\delta < \sigma(1-\sigma)/(4+2\sigma)$, the lender's DCR constraint (equation 9) binds and $\iota_3 L_3 = CF(1+\sigma)$. The payment shortfall is thus,

$$PS = Min\left(\frac{CF(\sigma-\delta)(1-\sigma)}{3\delta}, CF(1+\sigma)\right) - CF(1-\sigma) \tag{10}$$

Given an indiscriminate capital charge cost, such that κ exceeds the payment shortfall, the lender has a clear incentive to fund the payment shortfall in order to avoid the capital charge. We will sometimes refer to this type of forbearance incentive as a form "evergreening"(Peek and Rosengren, 2005), which ties our analysis to the zombie lending and capital reallocation literatures (Caballero, Hoshi, and Kashyap, 2008; Eisfeldt and Shi, 2018).

6.5. Foreclosure and the Redeployment Option

6.5.1. Setting and Stylized Empirical Facts

We have documented several facts that support the viability of targeted redeployment in response to the COVID shock. First, higher land share markets such as NYC and San Francisco, which have been hit hard by COVID, are the easiest to "re-create" through reinvestment. Second, there are a large number of aged buildings located in the relevant markets that are ripe for change. Third, the shock had disparate impacts by property type, which may favor redeployment. Fourth, there are plenty of skilled operators with access to capital waiting in the wings for redeployment opportunities. Incumbent property owners, in contrast, seem ill-suited (as well as unmotivated) to carry off the redeployments, thus creating a role for CRE mortgage lenders to broker the transitions.

With respect to the last point, we emphasize that the incumbent property owner in our setting—a specialist in owning a specific type of older income-producing properties—has neither the financial resources nor the expertise to complete a redeployment on its own. Deep pockets are often necessary, as redeployment is risky with expensive and limited availability of construction debt financing. And, even though the incumbent property owner has found herself on a downward economic path, headed towards zombiness, bank regulation has incentivized the lender to forebear through evergreening the loan, with a property owner willing to play along at no cost.

Given a myopic, disincentivized incumbent property owner, the lender is in the best position to intervene—in a hostile fashion if necessary through foreclosure—by facilitating a transfer of control to an agent capable of executing a profitable redeployment. But, again, regulatory forbearance policy acts as a barrier to change, as it encourages a myopic, business-as-usual mentality that penalizes potentially value-enhancing redevelopment when a foreclosure can act as a mechanism to facilitate transition to a new owner.

6.5.2. Model

In this section we consider the option to redeploy the property that is on a path to zombiness. To execute a redeployment, the lender is required to intervene through a foreclosure conditional on borrower default at t=1. According to the model, properties that experience default are those classified as moderate or low real cap rate assets ($\delta < \sigma/4$) at the time of loan origination. Higher real cap rate properties have cash flow sufficient to fund the t=1 loan payment and thus avoid defaulting on the loan.[20]

In the model, redeployment changes the current land use to an alternative use, i) that experienced a positive response to the COVID-19 shock (that is, it is currently situated at the U-node at t=1), and ii) whose rate of obsolescence remains at δ. In other words, unlike the current land use, the alternative land use is not a path to zombiness. Rather, it is currently on an upward trajectory, making foreclosure and redeployment a potentially attractive option for the lender. Redeployed use-type examples include apartment, logistical warehouse and lab space as potential replacements for office, retail or hotel property.

Conditional on a cash flow default, the lender receives $CF(1-\sigma)$ at $t = 1$ in lieu of the promised payment of $min\left(\frac{(CF(\sigma-\delta)(1-\sigma))}{3\delta}, CF(1+\sigma)\right)$. The lender must similarly fund the payment shortfall, PS, in order to avoid the indiscriminate regulatory capital charge of κ. The alternative to forbearance is exercise of the redeployment option. Redeployment requires lender foreclosure and a transfer of control to a new property owner. In this case the lender incurs the regulatory capital charge cost, κ, while avoiding having to fund the payment shortfall, PS. It also forfeits the value of in-place asset, $(CF(1-\sigma))/\delta^Z$. Upon transfer of ownership and control, there is a cost of redeploying to a new land use of K^{RDP}. The redeployed asset that emerges has a new value of $(\eta^{RDP}CF(1+\sigma))/\delta$, $\eta^{RDP} > 1$. The new owner pays $(\eta^{RDP}CF(1+\sigma))/\delta - K^{RDP}$ to the lender for the right to redeploy the property into its new use.

[20] In the $\delta > \sigma/4$ case, if the lender had included an LTV maintenance provision it could force a foreclosure even though the borrower would be willing to fund the mortgage payment. The analysis differs slightly depending on whether $\delta \geq \sigma/4$ inclusive of an LTV maintenance provision or $\delta < \sigma/4$ that results in default at $t = 1$. Because the analysis is very similar, with very little loss in generality we will work through the latter case and set the former case aside as a homework assignment.

The productivity increase from redeployment is summarized by η^{RDP}. There are two component parts implicit to η^{RDP}. First, there is a property specific, age-related productivity adjustment component. All else equal, older buildings that are redeployed into newer buildings will have a larger increase in productivity, and hence higher rents, with a larger η^{RDP}. Second, there is the potential for off-site effects that can cycle back to further impact rents. We would generally consider these effects to be positive, due to beneficial agglomeration economies.

Pulling all of the terms together, we can express the net $t = 1$ value of redeployment as,

$$NPV_1^{RDP} = PS - \kappa + (\eta^{RDP} CF(1+\sigma))/\delta - K^{RDP} - (CF(1-\sigma))/\delta^Z \tag{11}$$

$NPV_1^{RDP} > 0$ implies that immediate redeployment is beneficial relative to forbearing to maintain the status quo. The breakeven redeployment cash flow multiple, η_{BE1}^{RDP}, such that $NPV_1^{RDP} = 0$, can be expressed as,

$$\eta_{BE1}^{RDP} = \delta(\kappa - PS + K^{RDV})/(CF(1+\sigma)) + (\delta(1-\sigma))/(\delta^Z(1+\sigma)) \tag{12}$$

Conditional on $NPV_1^{RDP} > 0$, we now move on to consider the $t = 1$ value of waiting until $t = 2$ to redeploy. We denote this value as NPV_2^{RDP}. In this case the analysis is complicated by the fact that redeployment into an alternative use means that changes in cash flow realizations in period 2 may not move in lockstep. That is, it could be that the redeployed use experiences a positive shock at $t = 2$, while the current use experiences a negative shock – and vice versa. Indeed, contrasting realizations have already occurred at $t = 1$, with the current use experiencing a negative cash flow shock while the alternative use has experienced a positive shock.

As a result, standing at current time $t = 1$, there are four potential outcomes to account for at $t = 2$ with regards to cash flow and value realizations: U-D, U-U, D-D, D-U. For example, U-D indicates that the alternative use experiences a positive cash flow shock at $t = 2$, whereas the current use experiences a negative shock. Consideration of all four potential outcomes is required to properly account for the opportunity costs and benefits of waiting to redeploy.

The NPV's associated with each possible outcome is as follows:

$$
\begin{aligned}
NPV_2^{U-D} &= \quad \eta^{RDP}\tfrac{CF(1+\sigma)^2(1-\delta)}{\delta} - \tfrac{CF(1-\sigma)^2((1-\delta^Z)}{\delta^Z} - K^{RDP} && (13)\\
NPV_2^{U-U} &= \quad \eta^{RDP}\tfrac{CF(1+\sigma)^2(1-\delta)}{\delta} - \tfrac{CF(1+\sigma)(1-\sigma)(1-\delta^Z)}{\delta^Z} - K^{RDP} && (14)\\
NPV_2^{D-D} &= \quad \eta^{RDP}\tfrac{CF(1+\sigma)(1-\sigma)((1-\delta)}{\delta} - \tfrac{CF(1-\sigma)^2(1-\delta^Z)}{\delta^Z} - K^{RDP} && (15)\\
NPV_2^{D-U} &= \eta^{RDP}\tfrac{CF(1+\sigma)(1-\sigma)((1-\delta)}{\delta} - \tfrac{CF(1+\sigma)(1-\sigma)((1-\delta^Z)}{\delta^Z} - K^{RDP} && (16)
\end{aligned}
$$

It is straightforward to show that $NPV_2^{U-D} > NPV_2^{U-U} > NPV_2^{D-D} > NPV_2^{D-U}$.

Given the regularity conditions noted previously, with redeployment it follows that $NPV_2^{U-U} > 0$, and therefore $NPV_2^{U-D} > 0$, is necessary for $NPV_1^{RDP} > 0$. It can further be shown that there are realistic parameter value combinations such that $NPV_2^{D-D} < 0$ when $NPV_1^{RDP} > 0$. When this happens, an advantage of waiting to redeploy is that the loss associated with D-D and D-U realizations can be avoided at $t = 2$.

We are now in a position to calculate the $t = 1$ expected value of waiting until $t = 2$ to possibly redeploy. In order to calculate this expectation, probabilities associated with each of the four possible net payoffs displayed in equations 13–16 are necessary. This will depend on the correlation structure of time $t = 2$ cash flow payoffs as viewed at $t = 1$. Denote the cash flow correlation coefficient as ρ, $-1 \leq \rho \leq 1$. Given, i) a risk-free of zero, ii) a σ shock parameter that is common to both the current and alternative use, and iii) the law of one price holds, it is straightforward to show that the probability of either a U-U or D-D realization at $t = 2$ is $(1 + \rho)/4$ and that the probability of either a U-D or D-U realization at $t = 2$ is $(1 - \rho)/4$.

With this we can now calculate NPV_2^{RDP}, which is the $t = 1$ value of waiting to redeploy. The desired relation is,

$$
\begin{aligned}
NPV_2^{RDP} = \frac{(1+\rho)}{4}\left[Max\left(0, NPV_2^{D-D}\right) + NPV_2^{U-U}\right] \\
+ \frac{1-\rho}{4}\left[Max\left(0, NPV_2^{D-U}\right) + NPV_2^{U-D}\right] \quad (17)
\end{aligned}
$$

When $NPV_1^{RDP} > 0$, and when $NPV_2^{RDP} > NPV_1^{RDP}$, it is optimal to forbear and wait to redeploy. There are two sources of value contributing to this outcome: 1) Avoiding the capital charge cost to foreclosing, and 2) Resolving uncertainty to avoid making a bad ex post decision. In addition, the lender does not surrender any of collateral value by forbearing, as it retains the right to foreclose in the next period. On the other hand, when $NPV_2^{RDP} < NPV_1^{RDP}$, it is optimal to foreclose and transfer control to a new owner that will immediately redeploy the asset to its higher and better use. As noted earlier, the post-foreclosure sales price in this case is $(\eta^{RDP} CF(1+\sigma))/\delta - K^{RDP}$.

Two of the comparative static results are worth highlighting. The first comparative static result is that the value of waiting to redeploy decreases in payoff correlation, ρ. Conditional on the current use experiencing a D outcome at t=1, whereas the alternative use experiences a U outcome, an increase in correlation provides a hedging benefit to redeployment. That is, conditional on redeployment, the opportunity cost with a D outcome at t=2 decreases when the likelihood of a D outcome for the current use concurrently decreases.

Second, for most (sufficiently large) values of ρ, it will be the case that the value of waiting is decreasing in σ. This happens because, in general, an increase in payoff magnitudes benefits redeployment relative to maintaining the status quo (see equation 12), with the effect on NPV_2^{D-U} being crucial. As seen by comparing NPV_2^{D-U} in Equation 16 to the other payoffs, the asymmetric payoff benefit is least for NPV_1^{D-U} (in fact the effect is negative). For ρ sufficiently small or negative, the probability of a D-U realization increases by enough so that the negative effect associated with a D-U realization offsets other benefits to flip the sign of the comparative static.

7. POLICY DISCUSSION

To conclude, we summarize some of the major policy implications from our analysis.

1) The current environment in CRE is very different from that experienced during and shortly after the GFC. The GFC was a common shock associated with financial system instability, with the negative effects felt more or less uniformly across all property types and locations. In effect, asset correlations across property types and locations converged to one during the crisis. Systematic capital reallocation in CRE across property types or locations was not an economic priority. Forbearance was, in general, an effective way to address financial distress. COVID, on the other hand, has had important differential impacts across

property types and locations. Capital reallocation through redevelopment and redeployment is, as a result, much more relevant today. As pandemic-associated economic uncertainty recedes, bank regulation should examine its "one-size-fits-all" approach to incentivizing forbearance over foreclosure. Indeed, incentivizing foreclosure rather than forbearance may be socially desirable in many cases in order to help facilitate the capital reallocation process in affected markets.

2) The politics and economics surrounding foreclosure are very different in residential versus CRE property markets. For example, redeveloping an aged and functionally obsolete regional mall is often a focal political issue that can be difficult for local communities. Lobbying and political pressure can cause local governments to throw good (taxpayer) money after bad in order to delay change. Such reactions as a consequence will provide mall owners incentives to play along in hopes of receiving perquisites and subsidized capital. Furthermore, residential real estate is often susceptible to negative foreclosure externalities that can create a vicious feedback loop, with local house price declines and increased neighborhood instability. In contrast, negative agglomeration effects associated with evergreening CRE mortgage loans collateralized by zombie CRE can be substantial. Capital reallocation vis-à-vis foreclosure may in fact generate desirable neighborhood spillover effects in CRE property markets.

3) A more discriminating forbearance-foreclosure capital charge policy may be optimal once pandemic-related economic uncertainty recedes. Regulation could require lenders to engage in a more formal, systematic, exhaustive and creative exercise that considers alternative potential uses when making forbearance versus foreclosure decisions. This could be structured as a traditional cost-benefit, NPV-style analysis. A more sophisticated version of the analysis would further consider the value of waiting to invest conditional on the redevelopment/redeployment option being in the money.

4) There are very few constraints and frictions in the model. Cash flow uncertainty and capital depreciation, which are so ubiquitous that they don't really even qualify as frictions, occur over time to impact asset value and loan terms. Mortgage loan amounts and coupon payments are limited by lender underwriting constraints. Default is frictionless, except that the lender incurs an indiscriminate capital charge should foreclosure occur. One

important friction is that the incumbent property owner is unwilling and unable to undertake redevelopment or redeployment, should such an outcome be profitable relative to continuing to own the asset as is. Moreover, in the model the owner is unwilling or unable to sell the asset herself should it be profitable to do so. As a consequence, the lender assumes the role of a transitioning agent, acting with hostility if necessary through the foreclosure process to facilitate transfer of control to a higher and better owner and use. A disincentivized owner is, however, not necessary for the economics of capital reallocation to play out as described in the model, where instead the lender can work with the property owner, sharing gains from trade if necessary, to transition the asset to a new owner that is capable of properly reallocating the capital.

5) By extension, for new loan originations collateralized by assets that are ripe or nearly ripe for redevelopment, policies may want to encourage the use of specialty lenders that are themselves capable of assuming ownership and reallocating capital if necessary.

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	Parcels (#)	Low Pop. Density (%)	Low Income (%)
CT			
Residential	886,157	22	16
Commercial	15,510	12	39
Land	38,341	40	19
Other	66,506	30	27
MA			
Residential	1,352,386	17	17
Commercial	57,017	12	28
Land	43,550	32	18
Other	63,749	22	26
RI			
Residential	236,947	15	31
Commercial	2,863	12	39
Land	12,119	21	47
Other	20,169	11	47

Table 1: Number of Parcels Summary Statistics By State. *Note:* Residential includes both single and multifamily. Commercial includes industrial, office, retail, and lodging properties. Low population density is defined as parcels in census tracts that have fewer than 500 people per square mile. Low income is defined as parcels in census tracts with a median household income less than or equal to the national median household income. Values are rounded, so may not add up exactly. *Source:* The Warren Group and Census/ACS.

	Parcels in 2020 (#,000)	Gross Outflow (%)	Gross Inflow (%)	Sources of Inflows: Rede-ployment (%)	Sources of Inflows: New Deve-lopment (%)	Net Inflow (%)	Avg. Value of Unchanged ($,000)	Avg. Value of Outflows ($,000)
Major Commercial Property Types								
Multifamily	50	9	16	15	0.7	7	1,279	1,470
Industrial	26	15	15	12	2.7	0	1,494	1,086
Office	20	20	38	38	0.8	19	2,268	1,193
Retail	34	17	24	23	1.2	7	1,205	1,037
Lodging	2	19	37	37	0.8	19	4,873	2,536
Overall	132	14	22	20	1.2	8	1,241	1,463
Other Property Types								
Single Family	2,435	1	1	1	0.7	0	380	552
Other Residential	3	39	44	39	4.9	5	1,288	1,309
Parking	7	16	19	11	7.8	3	198	467
Religious	10	21	27	24	3.4	6	1,257	1,272
Government	33	23	16	11	5.1	–7	1,965	2,034
Education	4	28	32	28	4.7	4	6,714	4,067
Mixed	37	31	25	21	3.7	–6	713	974
Land	80	32	14	14	.	–18	99	198
Other	53	39	35	29	6.4	–4	1,121	1,179

Table 2: Gross and Net Flows of Land Parcels Between Uses. *Note:* Parcels and their uses in 2011 are compared to their uses in 2020. This is constructed from a balanced panel of parcels, so that the overall net flow is zero. "Other residential" includes nursing homes, dormitories, and group living quarters. "Other" includes pools, tennis courts and properties that do not have a descriptive usage associated with them. *Source:* The Warren Group.

	Density	Value Per Sq. Ft.($)	Building Age	Land Share of Value	Mortgaged	Sold	Foreclosure
Residential							
Mean	3,396	137	62	0.43	0.73	0.31	0.01
SD	5,006	6,534	39	0.16	0.44	0.46	0.12
Commercial							
Mean	4,646	4,415	57	0.41	0.48	0.27	0.02
SD	6,254	777,495	37	0.21	0.50	0.44	0.15
Land							
Mean	2,933	14					
SD	5,008	660					

Table 3: Summary Statistics for Regression Variables. *Note:* Density is people per square mile for each census tract. *Source:* The Warren Group.

	Income Producing Commercial				Residential				Land
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Age of Building	0.0822***	0.0845***	0.0835***	0.0835***	0.00959***	0.0113***	0.0112***	0.0112***	
	(0.00475)	(0.00478)	(0.00482)	(0.00482)	(0.000254)	(0.000259)	(0.000260)	(0.000260)	
Population Density (Normalized)	1.276***	1.519***	1.512***	1.513***	0.203***	0.542***	0.549***	0.549***	-4.454***
	(0.153)	(0.159)	(0.159)	(0.159)	(0.0140)	(0.0155)	(0.0160)	(0.0160)	(0.162)
Mortgaged Property	-0.731**	-0.718**	-0.687**	-0.686**	-0.762***	-0.756***	-0.752***	-0.749***	
	(0.311)	(0.311)	(0.312)	(0.312)	(0.0175)	(0.0174)	(0.0174)	(0.0174)	
Sale Occurred Between, 2012–2020	6.759***	6.740***	6.745***	6.743***	0.217***	0.246***	0.246***	0.244***	
	(0.374)	(0.374)	(0.374)	(0.374)	(0.0148)	(0.0148)	(0.0148)	(0.0148)	
ln(Value Per Square Foot of Lot Size)		-0.748***	-0.704***	-0.703***		-0.691***	-0.694***	-0.693***	3.542***
		(0.141)	(0.142)	(0.142)		(0.0132)	(0.0136)	(0.0136)	(0.0692)
Land Share of Assessed Value			1.476*	1.477*			0.148**	0.150**	
			(0.833)	(0.833)			(0.0590)	(0.0590)	
Foreclosure Sale				0.144				0.301***	
				(0.961)				(0.0681)	
N	55,850	55,850	55,850	55,850	2,316,962	2,316,962	2,316,962	2,316,962	93,006
R2	0.07	0.07	0.07	0.07	0.03	0.03	0.03	0.03	0.03
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Initial Prop Type FE	Y	Y	Y	Y	Y	Y	Y	Y	-
Mean(Y) (%)	17.46	17.46	17.46	17.46	1.03	1.03	1.03	1.03	26.75

Table 4: DETERMINANTS OF REDEPLOYMENT. NOTE: Columns (1)-(4) are restricted to single family, multifamily and other residential properties. Columns (5)-(8) are restricted to office, industrial, lodging, and retail properties. Column (9) is restricted to land parcels. All these restrictions refer to the parcel's use as of 2011. The dependent variable is an indicator of whether the parcel had transitioned to any other use type by 2020. The dependent variable is multiplied by 100, so that coefficients can be interpreted as the effect in percentage points. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively. *Source:* The Warren Group public records and assessors data.

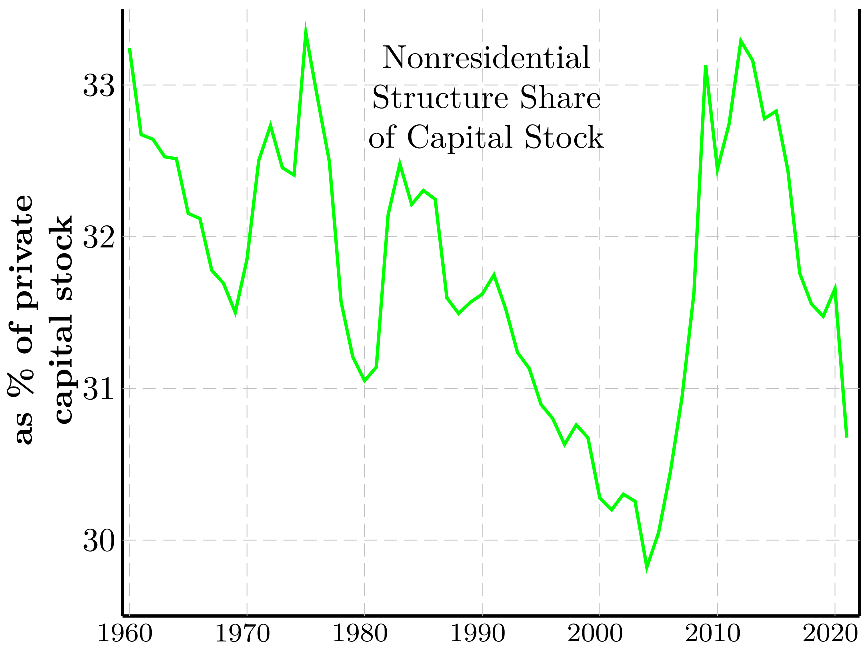

Figure 1: Nonresidential Structure Share of Capital Stock. *Note:* This figure shows the nonresidential structures as a share of the total private capital stock using data produced by the Bureau of Economic Analysis (BEA). Assets are valued at "current cost" which roughly corresponds to market value. Data can be obtained from `Table 1.1` of the `Fixed Assets Accounts Tables` published by the BEA. *Source:* BEA and Haver Analytics.

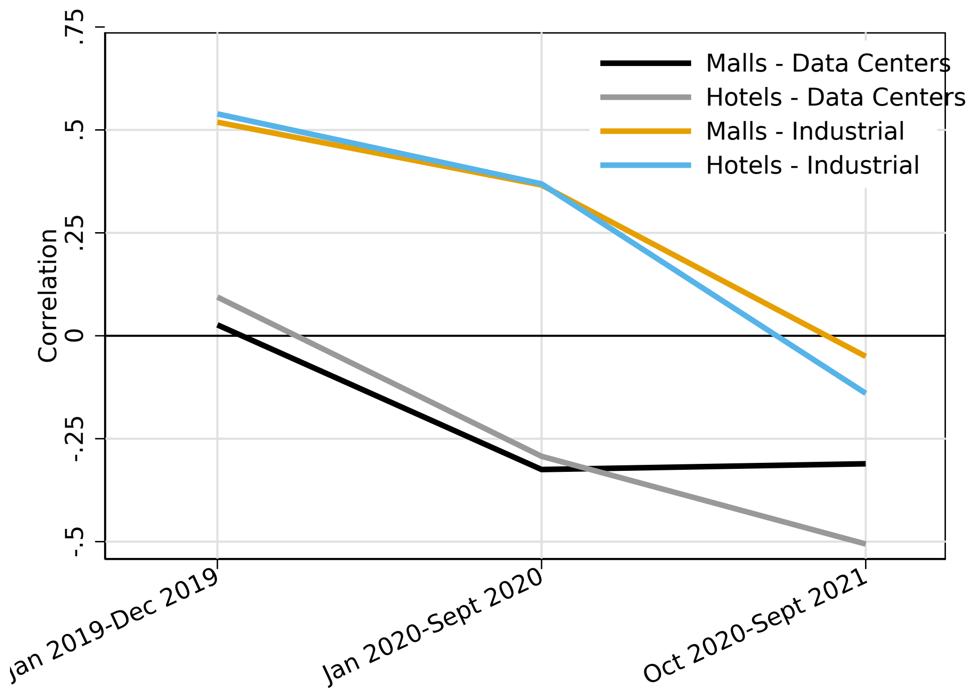

Figure 2: Correlation of REIT Total Returns. *Note:* Values are the correlation of monthly growth in sector-specific total returns indices during the specified time period. *Source:* Nareit.

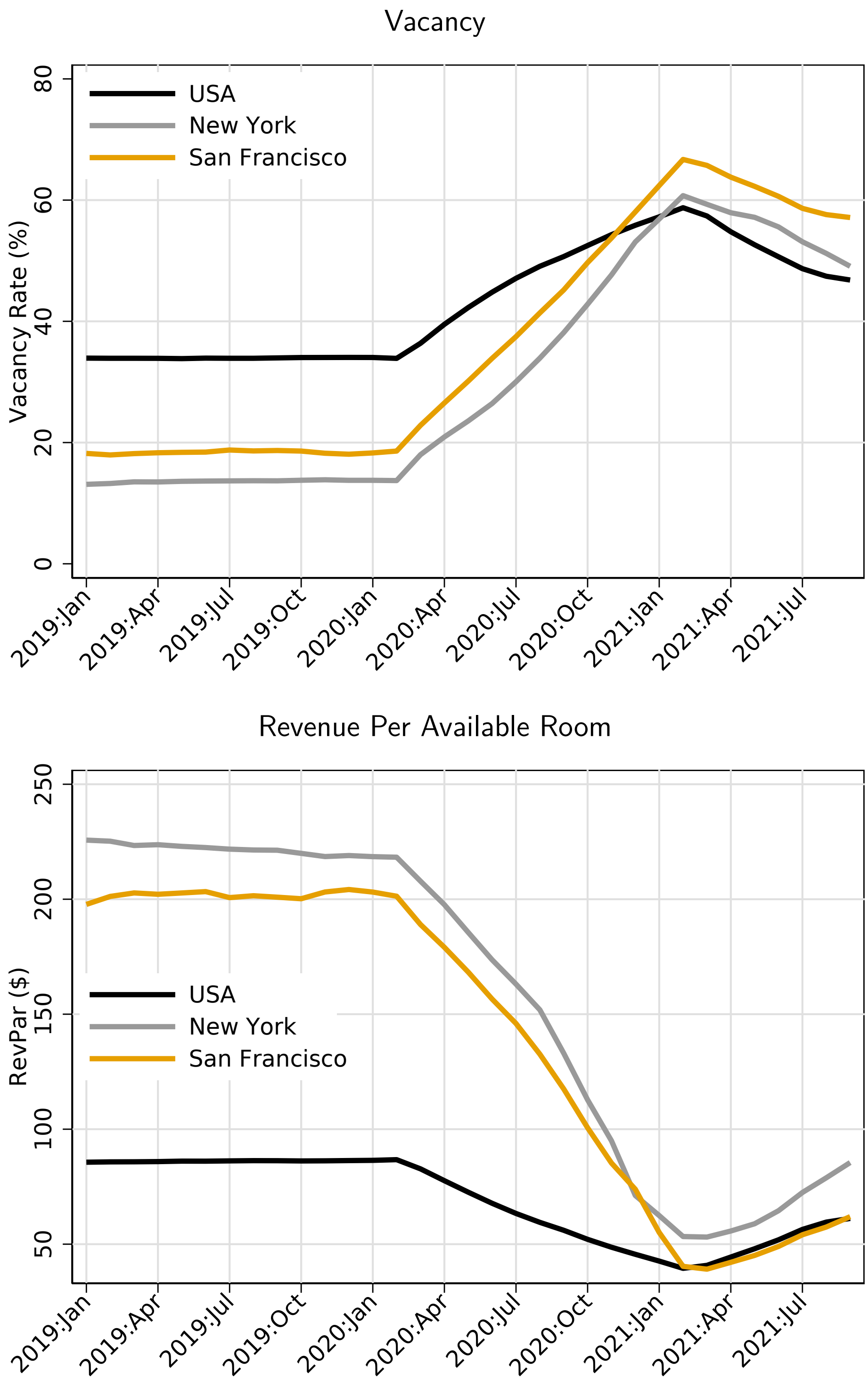

Figure 3: Hotel Vacancy and RevPar. *Source:* CoStar

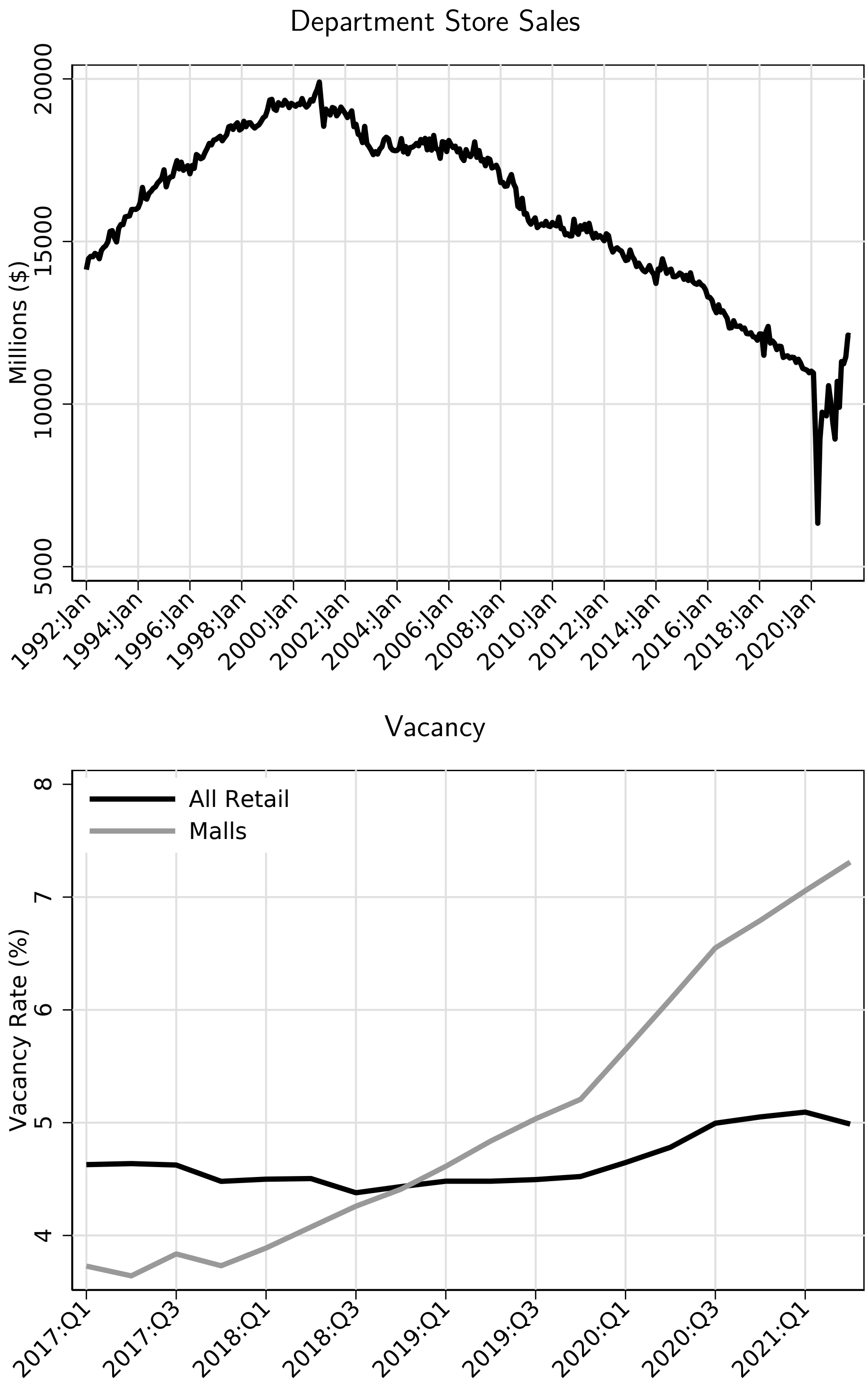

Figure 4: Retail Pre- and Post Pandemic. *Source:* CoStar and Census Department.

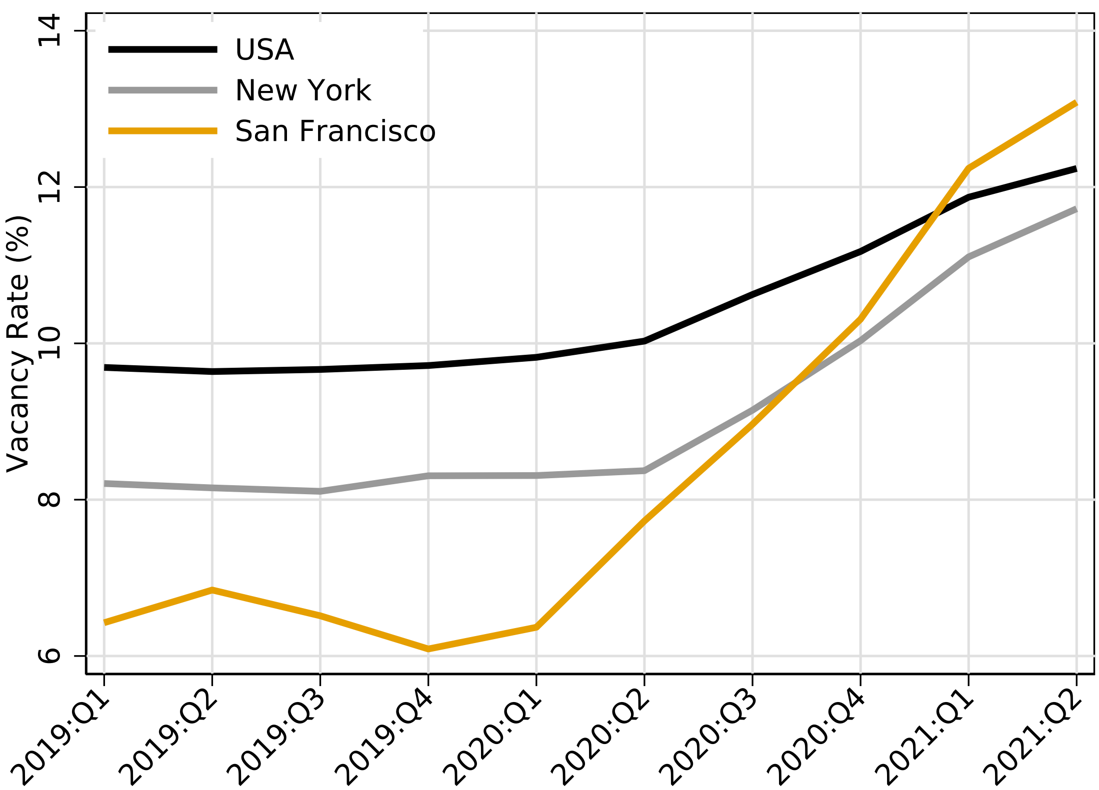

Figure 5: Office Vacancy Rates *Source:* CoStar

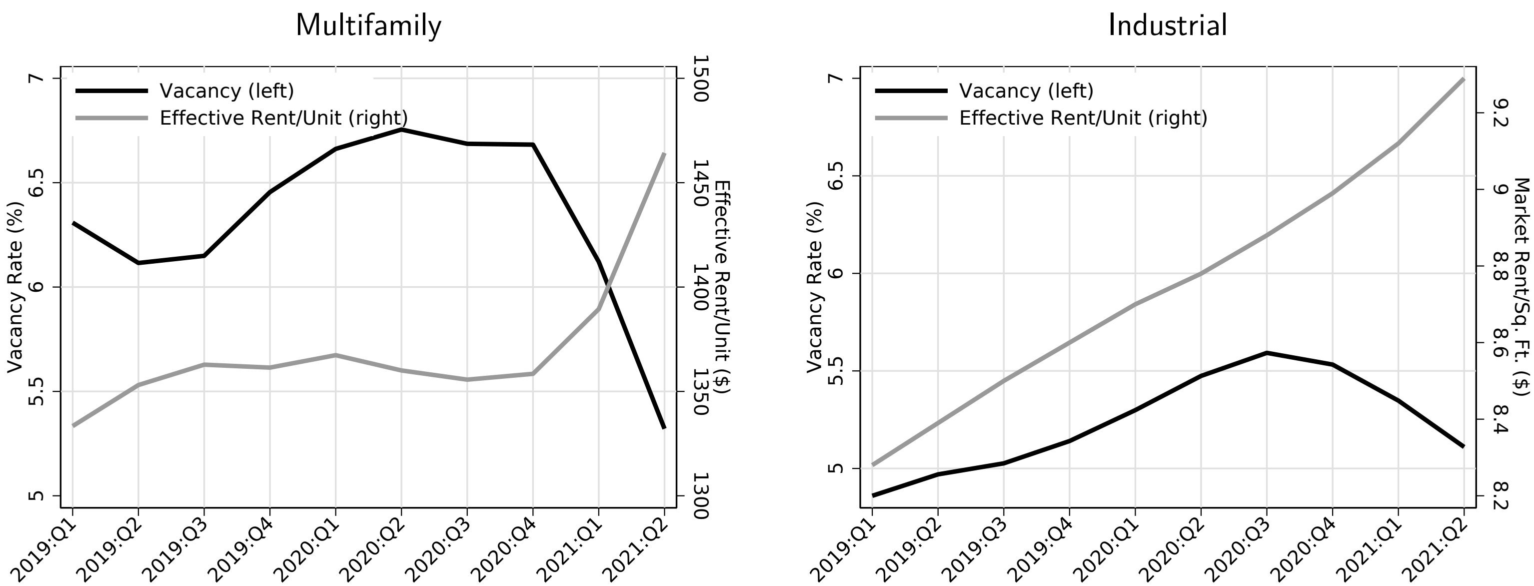

Figure 6: Multifamily and Industrial Properties. *Source:* CoStar.

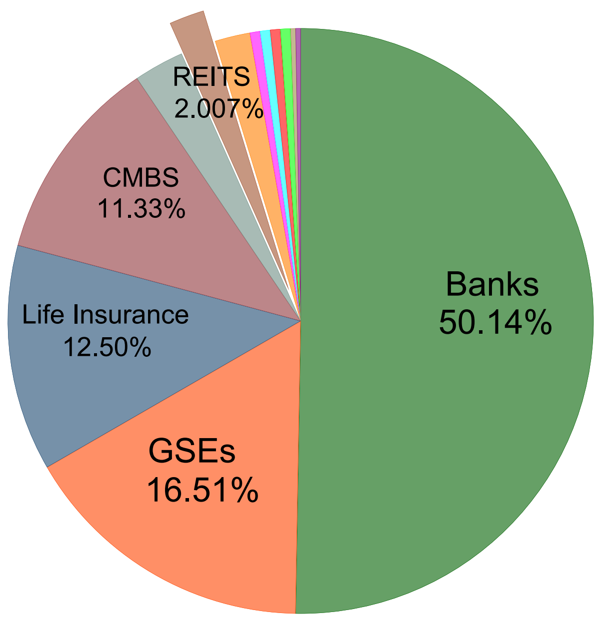

Figure 7: Commercial Mortgage Debt Outstanding in 2019Q4. *Source:* Financial Accounts of the United States.

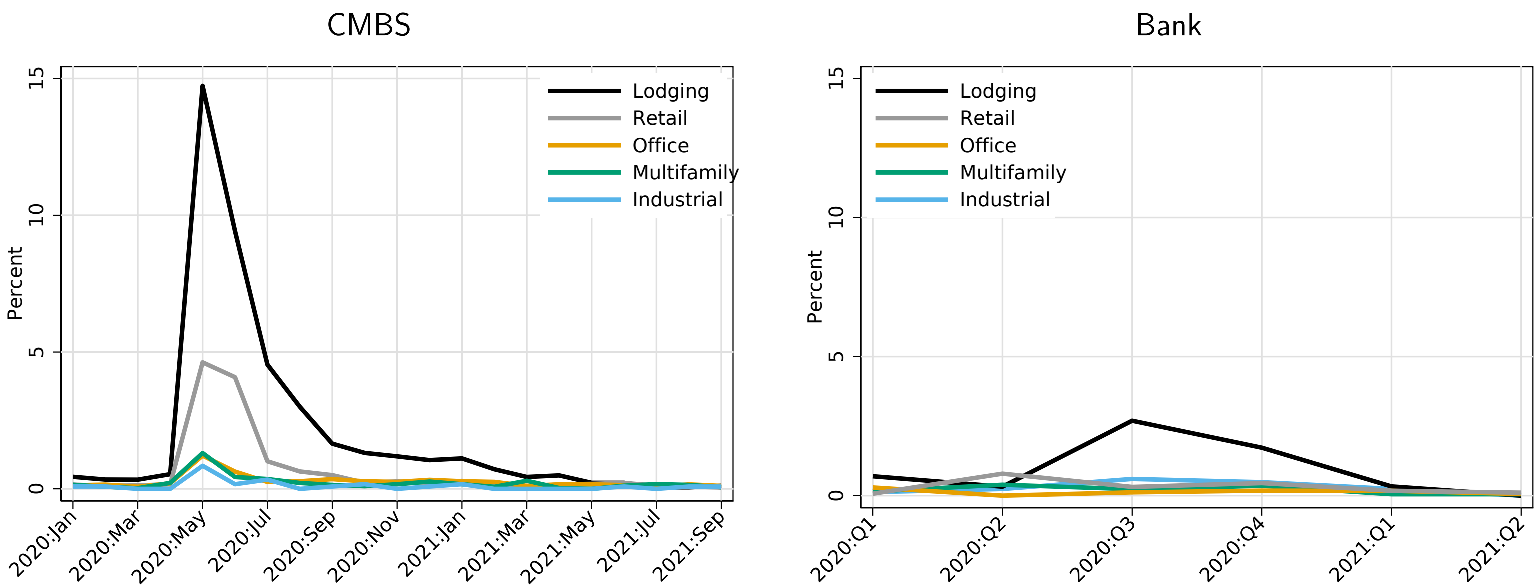

Figure 8: Delinquency Rates. *Note:* Share of loans by number. Rate calculated as first transition to delinquency over all loans at risk of this transition. CMBS limited to non-agency deals. *Source:* Trepp CMBS data and Trepp Anonymized Loan Level Repository.

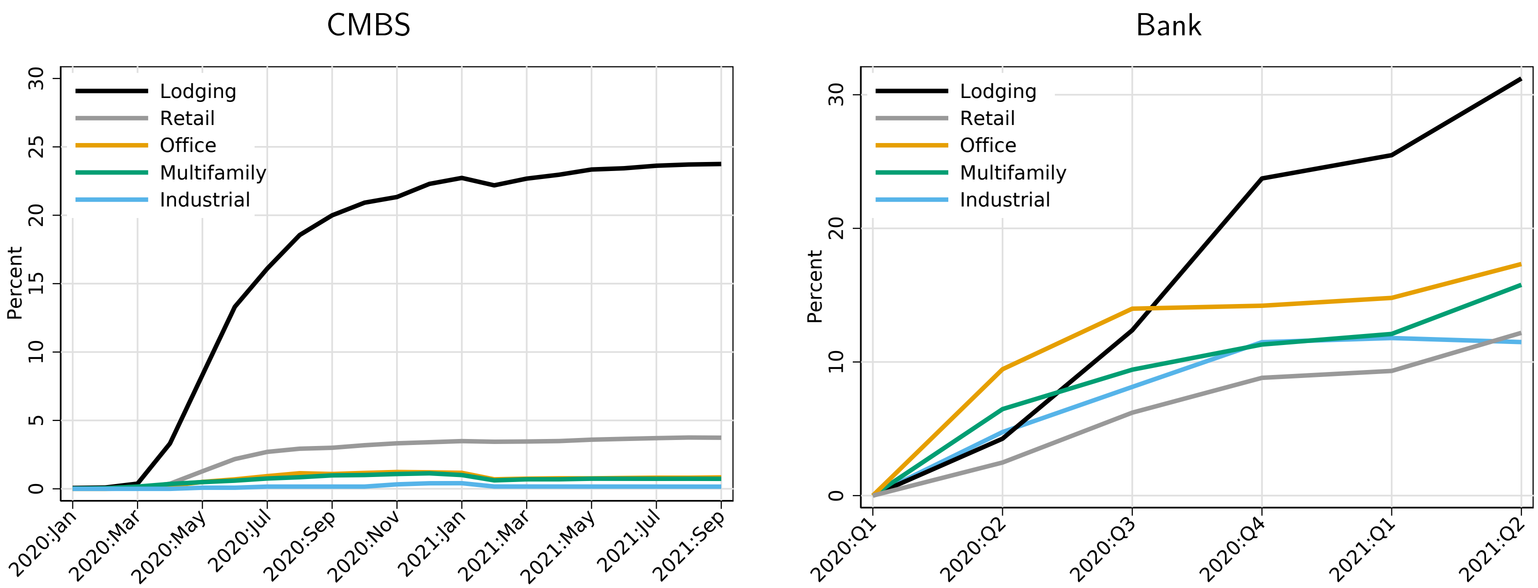

Figure 9: Share of Loans Modified Since January 2020 *Note:* Share of loans by number. CMBS limited to non-agency deals. *Source:* Trepp CMBS data and Trepp Anonymized Loan Level Repository.

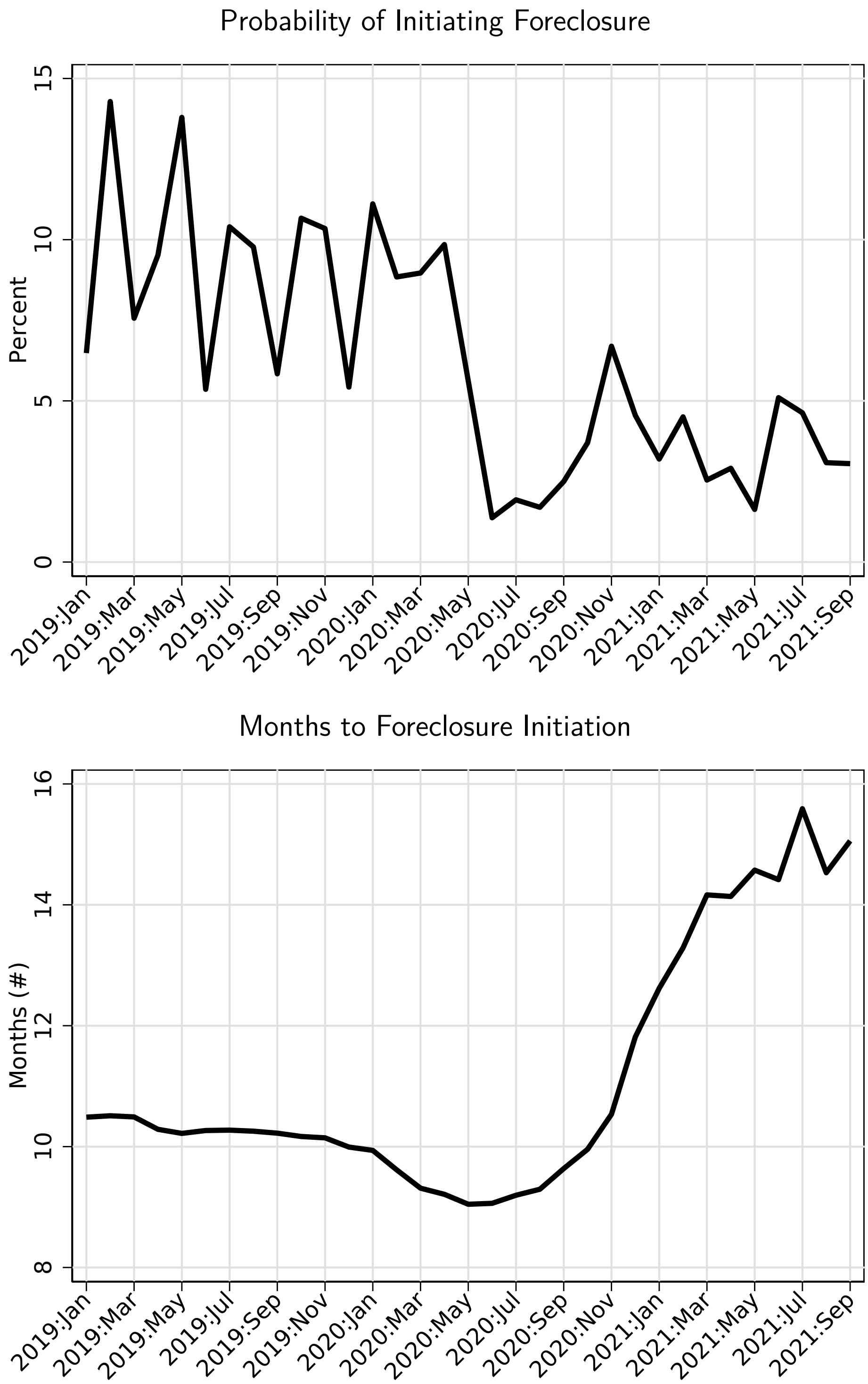

Figure 10: Foreclosure Activity on CMBS Loans. *Note:* The top panel shows the share of currently delinquent loans for which foreclosure is initiated in a given month. The bottom panel is the average number of months between initial delinquency and foreclosure initiation by month of foreclosure initiation. *Source:* Trepp CMBS data.

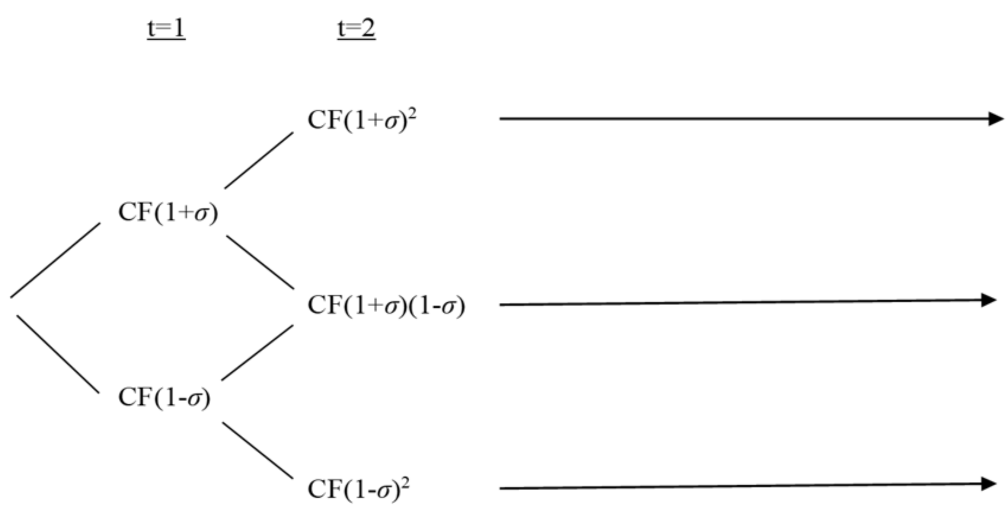

Figure 11: Evolution of Cash Flows Over Time.

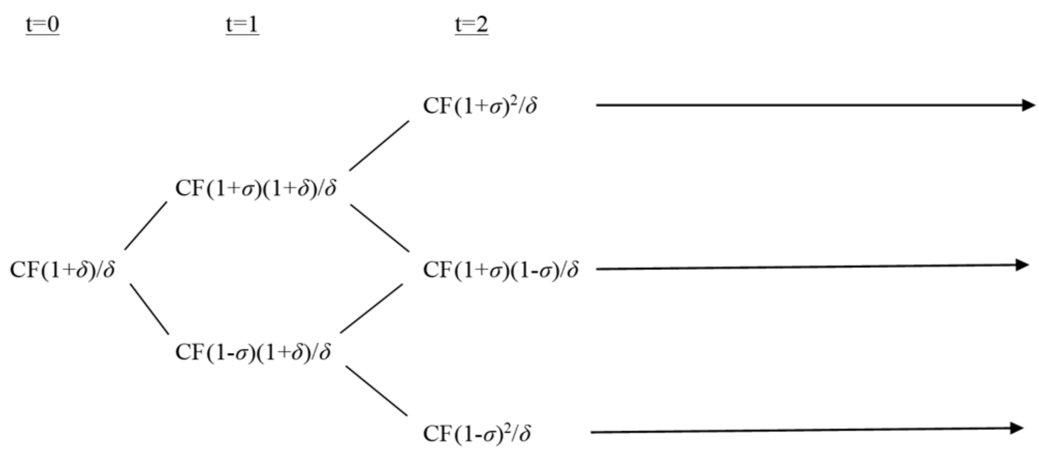

Figure 12: Evolution of Asset Values Over Time.

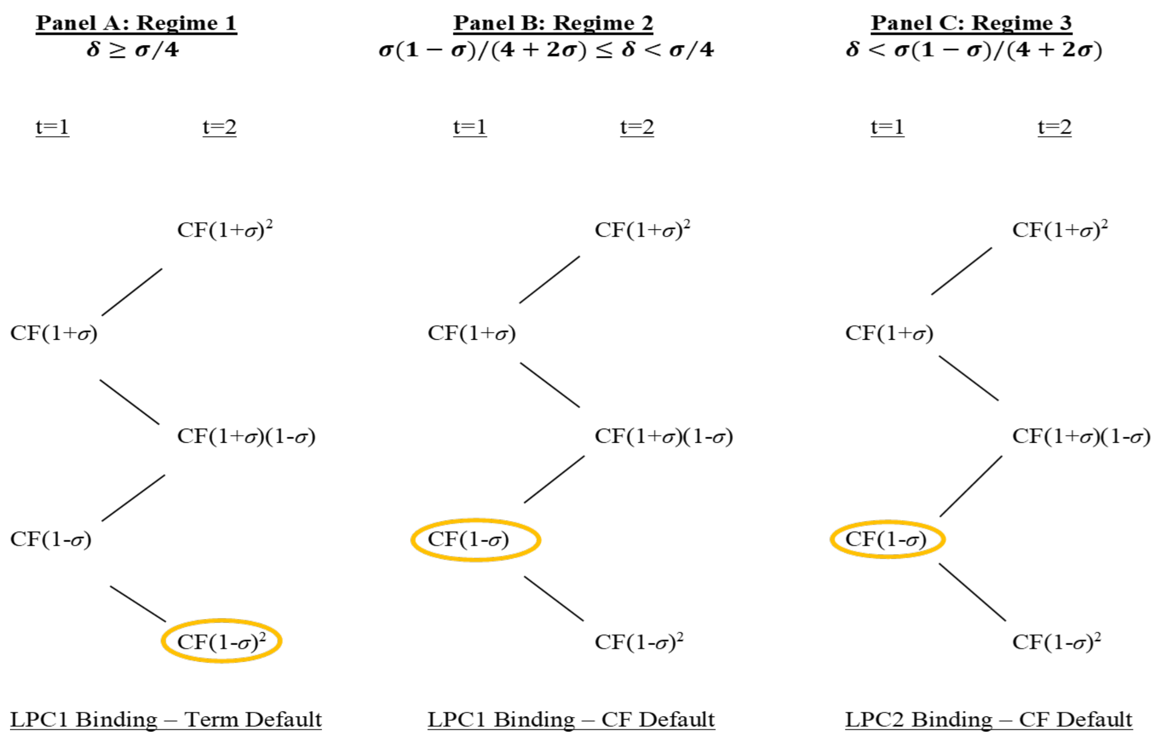

Figure 13: Model Regimes.

A. SUPPLEMENTAL TABLES

This section includes supplemental tables referenced in the text.

Number of Parcels	Single Family	Multifamily	Other Residential	Industrial	Office	Retail	Lodging	Parking	Religious	Government	Education	Mixed	Land	Other	2011 Total
Single Family	2,401,860	5,559	732	131	203	253	214	87	307	1,276	351	4,160	6,832	3,855	2,425,820
Multifamily	2,845	42,080	105	13	17	25	27	13	6	83	21	403	269	590	46,497
Other Residential	825	37	1,868	6	12	24	4	2	17	10	3	170	77	118	3,173
Industrial	199	111	50	21,725	609	579	10	58	44	234	36	395	511	889	25,450
Office	215	62	3	272	12,528	1,094	9	23	39	53	58	322	98	1,754	16,530
Retail	245	56	11	411	1,362	26,072	147	101	76	156	34	535	469	2,337	32,012
Lodging	97	55	5	2	3	17	1,079	4	1	1	5	24	14	91	1,398
Parking	177	12	2	40	14	60	4	5,337	9	31	11	23	100	533	6,353
Religious	748	58	23	23	41	55	4	11	7,107	141	48	51	131	700	9,141
Government	2,340	106	103	169	60	115	18	19	322	28,019	240	100	1,145	2,935	35,691
Education	273	50	6	7	16	22	13	4	147	449	3,006	35	46	191	4,265
Mixed	7,099	618	46	461	280	754	36	46	54	132	30	28,074	780	1,282	39,692
Land	16,130	328	164	687	168	415	13	511	331	1,693	207	1,383	68,584	3,396	94,010
Other	2,218	874	219	1,576	5,006	4,822	146	336	1,279	1,176	395	1,679	912	34,644	55,282
2020 Total	2,435,271	50,006	3,337	25,523	20,319	34,307	1,724	6,552	9,739	33,454	4,445	37,354	79,968	53,315	
Gross Outflow	23,960	4,417	1,305	3,725	4,002	5,940	319	1,016	2,034	7,672	1,259	11,618	25,426	20,638	
Gross Inflow	33,411	7,926	1,469	3,798	7,791	8,235	645	1,215	2,632	5,435	1,439	9,280	11,384	18,671	
Net Inflow	9,451	3,509	164	73	3,789	2,295	326	199	598	–2,237	180	–2,338	–14,042	–1,967	

Table A.1: Property Use Transitions. *Note:* Values are numbers of, or shares of numbers or value of land parcels that transitioned from one use type to another. Rows are use types in 2011. Columns are use types in 2020.